Appendix ‘F’ – Structural Evaluation Reports

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150 F: 519-824-8089 WWW.GMBLUEPLAN.CA

Prepared By:

City of Brantford

Lorne Bridge (Structures 117, 131, 132)
Structural Evaluation Report

GMBP File: 119104
May 2021

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

APPENDICES

CITY OF BRANTFORD

LORNE BRIDGE (STRUCTURES 117, 131, 132) STRUCTURAL EVALUATION REPORT

GMBP FILE: 119104

MAY 2021

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the City of Brantford (City) to complete an Environmental Assessment (EA) of the Lorne Bridge to evaluate long-term plans for the crossing based on an assessment of the technical, economic, social and natural environments. As part of the assessment of the technical environment, this Structural Evaluation has been completed to assess the structure's ability to carry traffic loading to current standards, as well as to review and update the findings of the "Lorne Bridge Engineering Condition Assessment Report, April 2016" (Parsons 2016). A key consideration for this report is to remove the load posting on Lorne Bridge. Our evaluation has been carried out following Section 14 "Evaluation" of the Canadian Highway Bridge Design Code (S6-19).

2. BACKGROUND INFORMATION

2.1 Existing Structure

The Lorne Bridge is located on Colborne Street West, immediately west of Icomm Drive / Brant Avenue and crosses the Grand River. The structure is comprised of three separate structures, which are distinguished as follows:

- Structure 131: Lorne Arch Bridge
  - The structure spanning the Grand River with clear spans of 39.6 m, 42.7 m, 39.6 m
  - Three-span concrete spandrel arch bridge
  - Originally constructed in 1924 to replace steel truss bridges from 1878 and 1899, and underwent a major rehabilitation in 1981 to raise and widen the deck
  - A load limit of 30 tonnes was imposed on the bridge in 2016 for winter months
- Structure 132: Lorne Girder Bridge
  - The structure spanning the rail corridor east of the Grand River with a span of approximately 19.8 m
  - Immediately east of the Lorne Arch Bridge, a single span prestressed precast concrete box girder bridge
  - Originally constructed in 1924 to replace an overpass of unknown construction date and underwent a superstructure replacement in 1981 to its current condition
  - Includes large retaining walls along the rail corridor, which are assumed to date to construction prior to 1924
- Structure 117: Lorne Bridge Pedestrian Underpass
  - Immediately west of the Lorne Arch Bridge, a single span precast concrete box culvert allowing pedestrian and cyclist traffic to pass beneath Colborne Street West
  - Constructed in 1981

The most recent detailed visual inspection reports for each structure are provided in **Appendix I** to detail the conditions of each structure.

2.2 Review of Background Information

The following background information was provided by the City regarding the Lorne Bridge, and was reviewed as part of our structural evaluation:

- Lorne Bridge Drawings and Contract Specifications, City of Brantford (1923)
- Lorne Bridge Underpass Drawings, City of Brantford (1965)
- Lorne Bridge Report, J.D. Lee Engineering Ltd. (1969)
- L. E. & N. R. Subway at N. End of Lorne Bridge Drawing, Damas and Smith Limited (1971)
- Brant Ave. – Colborne St. Intersection Drawing, Damas and Smith Limited (1972)
- Proposed Lorne Bridge Improvements Widening to Five Lanes Drawing, Damas and Smith Limited (1972)
- Proposed Lorne Bridge Improvements Widening to Six Lanes Drawing, Damas and Smith Limited (1972)
- Subsurface Investigation Proposed Reconstruction of Lorne Bridge Report, Dominion Soil Investigation Inc. (1978)
- Lorne Bridge Reconstruction Approach Pavement Details Drawings, J.D. Lee Engineering Ltd. (1981)
- Additional Subsurface Investigation Proposed Reconstruction of Lorne Bridge Report, Dominion Soil Investigation Inc. (1979)
- Lorne Bridge Reconstruction Drawings, J.D. Lee Engineering Ltd. (1979)
- Geotechnical Investigation - Foundation Subgrade Evaluation - Lorne Bridge Report, Peto MacCallum Ltd. (1986)
- Road and Sewer Reconstruction of Colborne Street from Brant Avenue to Queen Street Drawing, City of Brantford (1990)
- Lorne Bridge Routine Visual Inspection Report, McCormick Rankin (1992)
- Expansion Joint Replacement – Lorne Bridge Drawings, McCormick Rankin (1995)
- Proposed Right Turning Lane on Colborne St. West at Icomm Drive Drawing, City of Brantford (2002)
- Colborne St. W. / Icomm Dr. / Brant Ave. Drawing, City of Brantford (2002)
- Lorne Bridge Condition Survey and Preliminary Engineering Report, McCormick Rankin Corporation (2004)
- Lorne Bridge Rehabilitation Drawings, Philips Engineering (2006)
- Crack Monitoring Reports for the Lorne Bridge, SPL Consultants Limited / WSP (2014-2016)
- Lorne Bridge Engineering Condition Assessment Report, Parsons (2016)
- Lorne Bridge Load Posting Letter, Parsons (2016)
- Site Investigation Report for Lorne Bridge, Ministry of Transportation Ontario (2018)
- OSIM Inspection Report, McIntosh Perry (2019)

3. VISUAL SITE REVIEW

Non-destructive visual site reviews were carried out by Jens Hummel, P.Eng., of GMBP in the following sequence:

- Lorne Arch Bridge
  - June 4, 2020: abutment faces, east arch soffit and vertical faces of arches
  - August 7, 2020: east abutment wall, east arch top of slab, centre arch top of slab and vertical faces, pier chambers, spandrel walls, deck soffit
  - August 13, 2020: west abutment wall, west arch top of slab and vertical faces, west pier at water level, west arch soffit, centre arch soffit, east abutment chamber

- Lorne Girder Bridge
  - August 13, 2020: deck soffit, box beams, east abutment
  - August 21, 2020: retaining walls
- Lorne Bridge Pedestrian Underpass
  - August 22, 2020: barrel

The top of the bridge deck was open to traffic and its general review was completed during the various site visits.

Access to the spandrel walls was provided through openings at the centre of the walls throughout the bridge length. A ladder was used at each of the abutments to access the top side of the arches and the spandrel walls. Chambers are located in the piers and the east abutment. There is no chamber located in the west abutment.

Elements not accessible and not visible were the bearing pads and their supports at the west arch abutment, the east arch abutment, and the west railway overpass abutment. Expansion joints were reviewed from the top and the sides but not from the underside.

4. METHODOLOGY

The structural evaluations were made in accordance with Section 14 of the CSA S6-19 Canadian Highway Bridge Design Code (CHBDC). Provided below is a detailed description of the methodology used for each evaluation. It should be noted that our evaluation refers to the capacity of superstructure elements only. Section 14 of the CHBDC does not refer to the evaluation of the substructure. Based on the defects noted during the site visits completed by GMBP, we do not believe that the substructure elements are a limiting factor in the capacity of any structure that was evaluated.

4.1 Existing Conditions

Where provided, drawings of the existing structure were reviewed to determine the capacity of structural elements. Refer to **Appendix II** for drawings of the evaluated structures. Note that, due to the number of drawings and reports for the Lorne Bridge, only relevant drawings for this evaluation have been included in the appendix. All material strengths were determined in accordance with Section 14 of the CHBDC using the estimated or provided date of construction.

For structural components with visible signs of defects or deterioration, the factored resistance was multiplied by a reduction factor that would be adequate to the level of deterioration.

4.2 Evaluation Procedure

4.2.1 Dead Loads

Dead loads, such as the self-weight of all bridge components, were calculated in accordance with the CHBDC Table 3.4 and Clause 14.8 “Permanent Loads”. The weights of materials used for the evaluation of each structure (where applicable) are summarized in **Table 1**.

Table 1: Summary of Dead Loads for Evaluations

Material	Weight
Steel	77.0 kN/m^3
Concrete (plain)	23.5 kN/m^3
Concrete (reinforced)	24.0 kN/m^3
Asphalt Wearing Surface	23.5 kN/m^3
Aluminum	27.0 kN/m^3

Dead loads are apportioned into three categories: D1 (factory produced products, cast-in-place concrete – excluding decks), D2 (cast-in-place concrete decks, wood, field-measured asphalt, non-structural components), and D3 (asphalt, where the thickness is assumed to be 90 mm). In general, where the geometry could not be verified by field measurement the dead load was considered to be categorized as a D3 dead load.

4.2.2 Live Loads

Three levels of Ontario truck or lane loading were used in the load rating and posting of each structure: CL1-625-ONT, CL2-625-ONT, and CL3-625-ONT (referred to as Evaluation Levels 1, 2 and 3, respectively). The Evaluation Level 1 design truck is applied to the structure. If a load posting is required, the remaining two design truck loads are applied to the bridge to provide appropriate ratings for a triple posting. Following procedures outlined in the CHBDC, single postings may be applicable once the structure has reached a determined level of deterioration. The Live Load Capacity Factor, F, is calculated to determine the residual strength in the structural elements that is available to resist applied live loads once all permanent loads (i.e., dead loads) have been accounted for by the member's strength. This factor is then used to determine the maximum weight that the bridge can support for the given Evaluation Level.

To represent multiple vehicles on the bridge simultaneously, a "lane load" was also considered as a separate live load case. This loading is comprised of the design truck load reduced by a prescribed factor as well as a distributed load across the entire span.

4.2.3 Load Factors

Reliability Indices are used to determine the appropriate load factors for dead and live loads. These indices are dependent upon the element being analyzed, and its system behaviour, element behaviour and inspection level as outlined below:

- System behaviour, classified as one of the following:
  - (S1) Element failure will lead to total collapse
  - (S2) Element failure will likely not lead to total collapse
  - (S3) Element failure will lead to local failure only
- Element behaviour, classified as one of the following:
  - (E1) Element is subject to a sudden loss of capacity with little or no warning
  - (E2) Element is subject to a sudden loss of capacity with little or no warning but will retain post-failure capacity
  - (E3) Element is subject to gradual failure with warning of probable failure
- Inspection level, classified as one of the following:
  - (INSP1) Element is not accessible for inspection
  - (INSP2) Element is accessible for inspection to the satisfaction of the evaluator
  - (INSP3) Element is accessible for inspection and inspection is directed by the evaluator

Once the system behaviour, element behaviour and inspection level have been determined for the failure mode of each element being evaluated, a Reliability Index can be used to determine the appropriate dead and live load factors. It should be noted that a single element may have different load factors depending on the mode of failure being analyzed (i.e., a concrete beam being analyzed for shear may have different load factors for analysis than the same being analyzed for bending).

5. LORNE ARCH BRIDGE EVALUATION

5.1 Background

The Lorne Arch Bridge is a three-span spandrel arch bridge built of reinforced concrete in 1924 with span lengths of 39.6 m, 42.7 m, and 39.6 m. In 1981, the bridge was rehabilitated including the replacement and widening of the deck to accommodate five vehicle lanes and two pedestrian sidewalks. The two bridge abutments and piers use unreinforced mass concrete foundations to transfer loads directly to the bedrock. Chambers are present above the foundations for the east abutment and both piers. These chambers contain minimal reinforcement with the exception of the portions that were reconstructed as part of the 1981 rehabilitation.

The concrete arches built in 1924 are constructed of reinforced concrete. Based on the original drawings, the amount of longitudinal reinforcement would be considered to be compliant with minimum reinforcement requirements of the CHBDC (120% of the cracking moment) for ductility. The amount of transverse reinforcement is minimal and would not comply with current CHBDC minimum reinforcement amounts.

The three arches are solid arch slabs that support transverse concrete spandrel walls (columns) that, in turn, support the bridge deck. The original columns also contained minimal reinforcement. The shorter columns nearer to midspan were completely replaced as part of the 1981 rehabilitation, whereas the taller columns closer to the piers and abutments were only partially reconstructed.

The original bridge deck had expansion joints over the piers and abutments. The 1981 rehabilitation eliminated the expansion joints over the piers but retained the abutment expansion joints.

Overall, the bridge has a very robust appearance. It is noted that the solid arch slab is atypical in spandrel arch bridges, as there are usually two separate “arch girders” that support the spandrel columns and bridge deck. Arch bridges of similar construction style to the Lorne Arch Bridge were quite popular at the time of its construction, as shown by the large collection of concrete arch bridges built in Pennsylvania between 1918 and 1941 [1].

5.2 Arch Bridge Characteristics

Arch bridges are designed to maintain compression along the arch under self weight. The designer needs to balance the compression thrust line within the arch close to the arch centerline. If the thrust line shifts to the faces of the arch, the bridge becomes unstable and may develop concrete “hinges”. This was true of early versions of brick, stone and unreinforced concrete arch bridges as they were constructed of materials that were far weaker in tension than compression; however, several reinforced concrete arch bridges built at the beginning of the 20th century were also designed to be in compression under self-weight. Arch bridges can also be viewed as “prestressed” by the forces generated by the self-weight of the deck, spandrels and arch.

A differentiation may be made between regular arches and flat arches. To decide if a bridge is a regular arch or a flat arch, the rise-to-span ratio can be used. Flat arches have a rise-to-span ratio of 0.1 or less, whereas regular arches have a ratio of greater than 0.1 up to 1.0 or more [2]. The Lorne Arch Bridge has a rise-to-span ratio of 5.3 m / 42.7 m = 0.124 and may be classified as a regular arch shape.

Flat arches are more vulnerable to abutment settlement or horizontal movement as well as seasonal thermal cycling (i.e., horizontal expansion and contraction) [2] [3]; however, thermal sensitivity increases with larger spans. The CHBDC allows the analysis to not consider thermal loading if the bridge is reinforced to be ductile. Some literature sources describe a reduction of thermal restraint forces by concrete cracking, concrete creep and non-linear concrete behaviour ranging between 0.3 and 0.8 [4] [5] [6] [7].

5.3 Structural Evaluation

Based on our observations and review of available information, we do not believe that the deck and spandrel columns are limiting members in evaluation of the Lorne Arch Bridge. Therefore, these elements were not reviewed as part of this evaluation. The arch slabs are the primary element that would lead to the global failure of the bridge. These slabs also have a high degree of redundancy due to the solid transverse width of the slabs and the load spreading properties of concrete. The arch slabs appear to be generally uncracked for longitudinal bending action (i.e., no structurally significant cracks in the transverse direction). Longitudinal cracks are present in all spans, generally at the mid-width of the slab. We believe these cracks may be related to the construction methodology of the bridge (i.e., a cold joint) and/or to shrinkage.

In the Parsons 2016 report it was assumed that the bridge shows brittle behaviour. It is our assessment that this is a valid assumption for elements such as the abutments, piers and the original sections of spandrel columns. However, based on our research, we believe that the failure mode of the arch slabs would be in a ductile manner. As a minimum, the CHBDC requires that bending members are reinforced to resist 1.2 times the cracking moment of the section. This is to ensure that the section remains ductile after the concrete cracks from tensile forces due to bending. The existing drawings note that the longitudinal steel in the arch slabs is “1.25 inch square twisted bars at 12 inch centres”, and we have assumed a yield strength of 230 MPa for the existing reinforcing steel. This reinforcement was found to be sufficient to resist 1.2 times the cracking moment of the arch slab section. Therefore, we believe that the arch slab would show ductile behaviour.

Our analysis concentrated on the 42.7 m long arch slab span, as there were negligible differences between this span and the smaller spans and the only point of continuity for the arch spans is at the foundations. The foundations bear on bedrock and do not show any signs of structural distress related to overloading of the arch slabs.

We modeled a representative 1.0 m width section of the 42.7 m long arch slab span using a 2D finite element model utilizing the S-Frame structural analysis software. Dead loads were generated by the S-Frame model, or superimposed where appropriate. Live loading using the CL-625-ONT design truck for the three evaluation levels was applied following the provisions of the code and prorated to the 1.0 m width model.

In general, the arch slab was found to be in compression under dead loads. When live loads were introduced to the model, the critical load case was determined to be when the design truck was placed over one half of the span, with the tandem axle close to midspan. Refer to **Figure 1** below for a graphical representation of the longitudinal stress distribution due to the live load at the critical location. Note that only one truck is shown graphically; however, multiple trucks were analyzed as travelling in a synchronized manner across the bridge in accordance with the CHBDC. The concrete deck and spandrel columns were assumed to provide uniform lateral distribution of live loads on the bridge deck.

Figure 1: Longitudinal Stress Distribution from Live Load at Critical Location

As this result relates to the overall behaviour of the arch slab, if the tensile force in the slab exceeds the resistance of the reinforced concrete section, hinges will develop in the slab. This scenario is graphically represented in **Figure 2** below for illustration purposes.

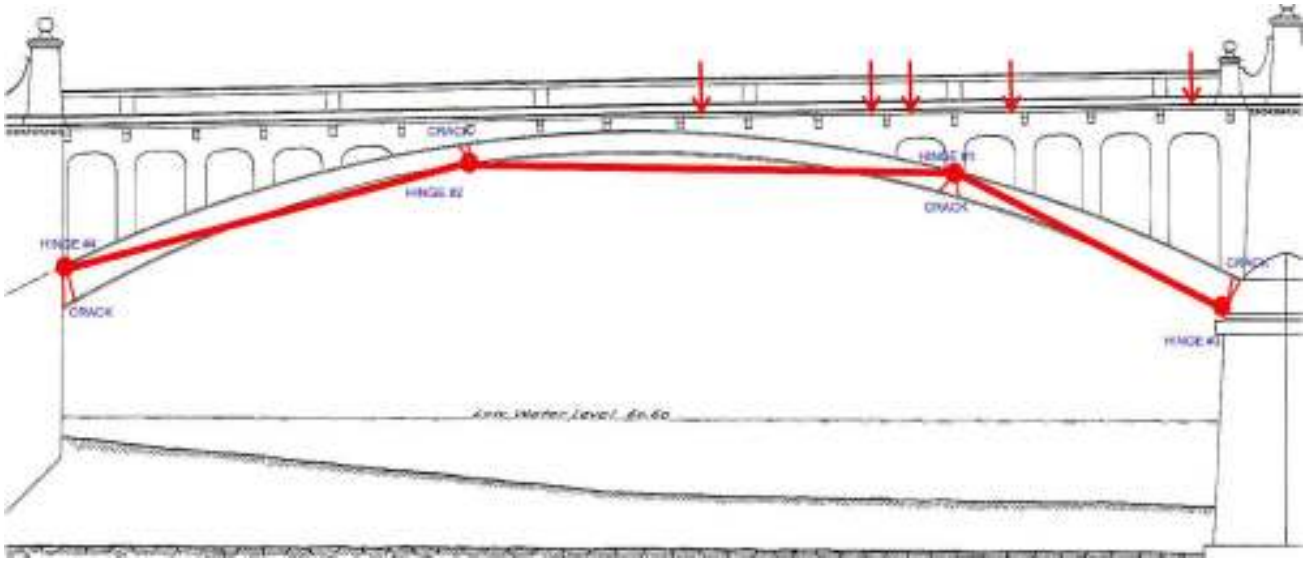


Figure 2: Assumed Hinge Development in Arch Slab when Applied Loading Exceeds Capacity

The effect of seasonal thermal loading was considered in great detail, as it is our understanding that the current load limit on the Lorne Arch Bridge is due to the effects of thermal loading. The CHBDC notes that thermal loading does not need to be considered for ductile structures. The arch slab has been assumed to be ductile in the longitudinal direction, but not in the transverse direction. Based on our research on arch bridge behaviour, a reduction factor of 0.4 was applied to all forces induced from thermal loading [4] [5] [6] [7] [8].

Our design review for the Serviceability Limit State (SLS) conditions shows that the longitudinal tensile stresses at SLS do not exceed the tensile resistance of the concrete section (i.e., does not induce flexural cracking). This is supported by our site observations.

Our design review for the Ultimate Limit State (ULS) conditions shows that the concrete arch slab may crack due to longitudinal tensile forces. The existing reinforced concrete section was found to be sufficient to resist the tensile forces from flexure at ULS conditions.

Further analysis was completed that showed that the concrete arch slab would be capable of resisting the applied loads at ULS for a thermal load reduction factor up to 0.4.

5.4 Discussion

All engineering models used for calculation are a simplification of the actual structural system. The design and evaluation of arch bridges can be delicate since “prestress” by self-weight, concrete quality, loss of stiffness by local cracking, thrust force eccentricity in the arch, material uncertainties, support conditions, thermal creep of concrete, microcracking of concrete, and statically indeterminate structure behaviour under a seasonal thermal cycle are difficult to quantify and evaluate.

Our analysis suggests that the existing structure does not require a load posting, but this is largely based on our estimation of the arch behaviour and applicable reductions in thermal loading to the arch. Prior to recommending that the existing load limit be removed, additional monitoring to calibrate our analytical model against the actual behaviour of the bridge during a range of seasonal temperatures would be necessary. Load testing of the bridge may also be appropriate. Following collection of this data and calibration of the model, the existing load posting can be reviewed and adjusted accordingly. If it is determined that no reduction is appropriate, then the existing load posting should remain.

The concrete arch slabs contain marginal steel reinforcement in the transverse direction. We believe this to be the cause of, or a significant contributing factor to, the longitudinal separation cracks developed in the concrete arch slab. These cracks appear to run completely through the depth of the arch slab, as they are visible both at the top side and the underside of the slab. Comparing the existing transverse steel reinforcement to the current requirements, the reinforcement provided is approximately 7% - 9% of what would be required by the current CHBDC. However, we believe that the marginal transverse reinforcement and the resulting longitudinal cracks do not have a measurable impact on the load carrying capacity of the bridge due to the following:

- There are many similar reinforced and unreinforced concrete structures constructed around the same time period that also have very little transverse reinforcement. Older design methodologies utilized much larger concrete elements with less reinforcement as compared to current practices of more-slender members with increased reinforcement.
- Despite the longitudinal cracks, we do not observe any signs of structural distress (crushing of concrete, tensile cracks). The deterioration noted throughout the bridge could be thought to be caused largely by environmental degradation (numerous freeze/thaw cycles).
- The concrete arch slab has passed the test of time of almost 100 years.
- The new deck built in 1981 and the new tops of the spandrel columns do not show the same longitudinal cracks as the arch slab, suggesting that the spandrel columns and deck are sufficiently strong enough to hold the two to three ribs of the arch slab together.

Our assessment of the existing concrete arch slab has also assumed that the existing reinforcing steel in the arch slab is not undergoing active corrosion. We believe this to be a valid assumption due to the lack of efflorescence staining on the soffit, lack of rust staining on the soffit, and generally small amount of delamination and spalling on the arch slabs. Based on the original specifications, we would expect approximately 60 mm of cover to the main longitudinal reinforcing steel. This is relatively consistent with modern cover requirements, and actually quite substantial for the construction period. As part of the recommended comprehensive monitoring and evaluation program, the alkalinity of the concrete should be assessed to ensure a sufficiently basic environment for the main reinforcing steel that does not induce corrosion. The alkalinity of the concrete can be affected by the natural carbonation of concrete over time or the introduction of chlorides to the concrete from salt-laden waters.

The deck superstructure of this bridge has provided 40 years of service. A major rehabilitation is expected to be required in the next 10 years to maximize the overall service life of the bridge. As the existing foundations and piers are now 100 years old, they should also undergo significant repairs. Based on our observations and review of the Parsons 2016 report, the proposed rehabilitation option would involve asphalt resurfacing, waterproofing, expansion joint replacement, rock protection along piers and isolated concrete repairs to nearly all elements. Strengthening of the arch and piers was also recommended.

6. LORNE GIRDER BRIDGE EVALUATION

6.1 Background

The Lorne Girder Bridge is a concrete slab on prestressed precast concrete box girder bridge. The structure spans across a former railway corridor. The superstructure was constructed as part of the 1981 rehabilitation of the Lorne Arch Bridge, and utilizes the east abutment of the Lorne Arch Bridge as its west abutment (essentially making the east abutment of the Lorne Arch Bridge a pier). The original east abutment of the Lorne Girder Bridge was converted to a retaining wall as part of the 1981 rehabilitation and a new east abutment was constructed behind it. The bridge has a span of approximately 19.8 m.

The existing Lorne Girder Bridge was analyzed in 2016 by Parsons, and found to have sufficient load carrying capacity for the current requirements of the CHBDC.

6.2 Structural Evaluation

The bridge is in overall good condition, and does not show signs of structural distress. In accordance with the CHBDC, we believe this bridge to qualify as a concrete bridge with multiple load paths that does not show signs of excessive material cracking, deformation or degradation. Therefore, we do not recommend a load posting for this structure.

6.3 Discussion

The high concrete retaining wall that runs along the railway corridor in front of the east abutment, which was the east abutment of the previous bridge structure in this location, is in poor condition and requires rehabilitation work. We did not observe any evidence of instability or settlement of the wall, therefore removal of poor concrete and refacing would be an appropriate rehabilitation. This was recommended by Parsons in their 2016 report. The same is true for the smaller concrete retaining wall running in line with the east abutment of the arch bridge.

The superstructure of this bridge has provided 40 years of service. A major rehabilitation is expected to be required in the next 10 years to maximize the overall service life of the bridge. Based on our observations and review of the Parsons 2016 report, the proposed rehabilitation option would involve asphalt resurfacing, waterproofing, expansion joint replacement, retaining wall refacing, barrier installation and isolated concrete repairs to the abutments and soffit.

7. LORNE BRIDGE PEDESTRIAN UNDERPASS EVALUATION

7.1 Background

The Lorne Bridge Pedestrian Underpass is a precast concrete box culvert located west of the Lorne Arch Bridge with a span of 3.0 m. It provides pedestrian and cyclist access beneath Colborne Street West, and was constructed in 1981.

7.2 Structural Evaluation

The culvert is in overall good condition and does not show signs of structural distress. In accordance with the CHBDC, we believe this culvert to qualify as a concrete bridge with multiple load paths that does not show signs of excessive material cracking, deformation or degradation. Therefore, we do not recommend a load posting for this structure.

7.3 Discussion

The existing culvert has been known to have issues with water leaking through the joints between the precast units as noted by McCormick Rankin in their 1992 inspection report. To our knowledge, a repair of this issue has never been completed. A proper repair would involve excavation of the fill overtop of the culvert and installation of a waterproofing membrane. Subdrains that outlet to the ends of the culvert beyond the existing cast-in-place concrete wingwalls may also be appropriate. Replacement of the lighting within the culvert should also be considered at the same time. This work should be completed as part of the next major rehabilitation to the Lorne Bridge.

8. CONCLUSION AND RECOMMENDATIONS

Out of all the structures that make up the Lorne Bridge (arch bridge, railway overpass and retaining walls, pedestrian underpass), the Lorne Arch Bridge is the most significant structure and is in the greatest need of remedial action. The Parsons 2016 report completed a life-cycle cost analysis for various rehabilitation and replacement scenarios, and determined that major rehabilitation and strengthening of the Lorne Arch Bridge, minor rehabilitation of the Lorne Girder Bridge and refacing of the existing retaining walls was the option that provided the greatest net present value to the City.

We have discussed within the body of this report additional testing and monitoring that should be completed in order to accurately scope the level of rehabilitation. Our research into arch bridges has shown that the engineering profession has differing opinions on how thermal loading can influence arch bridge construction. The 2016 analysis by Parsons appears to provide an accurate representation of the behaviour of the bridge when the full thermal loading is applied to the structure. Garrett concludes that the temperature effects on structures are not well understood, and may produce load ratings that are unduly conservative [9]. He notes that the observed performance of the structure should also be a consideration and non-destructive or proof-load testing may be used to further rate or confirm models for arch bridges [9].

We have completed additional research that suggests that it may not be completely necessary to analyze the full thermal loading due to the believed ductile nature of the bridge in longitudinal bending and the ability of arch structures to artificially dampen the effects from thermal loading. It is our belief that the existing concrete arch slab of the Lorne Arch Bridge is a robust load carrying member that is difficult to approximate using modern methods of analysis, as also alluded to by Parsons. This is exemplified by the 1981 rehabilitation which increased the overall dead load to the bridge, increased the number of lanes and added a sidewalk, as well as the increase from the assumed 20 tonne design truck from 1923 to the 36 tonne HS20-44 design truck of the 1981 rehabilitation (per the drawings) to the current 62.5 tonne CL-625-ONT design truck without any additional strengthening to the arch [10].

If the City wishes to remove the existing 30 tonne load limit, without structural strengthening, we recommend that additional monitoring would be advisable to calibrate finite element models of the bridge and accurately inform the scope of rehabilitation. It is estimated that the monitoring program would be 18 months in duration and cost approximately $150,000.

Alternatively, the City could proceed with the models as currently calibrated and design for strengthening to resist the full thermal load as recommended in Parsons 2016 report.

A summary of the recommended rehabilitation work for the Lorne Bridge is provided in Table 2 to Table 5 below.

In accordance with the 2018 Ontario Structure Inspection Manual (OSIM), with structures older than 30 years with critical components in poor condition, it is recommended that an Enhanced OSIM inspection be completed every 6 years in order to monitor member deterioration, until such time that a major rehabilitation is completed to address the poor condition members.

Table 2: Rehabilitation Works Recommended – Lorne Arch Bridge

Item	Rehabilitation Work	Location
1.0	Concrete repair work	• East and West abutments (East shared with Lorne Girder Bridge) • East abutment access chamber • East & West Pier, including underpinning and at top, especially non-vertical areas • Spandrel walls • Deck cantilever soffit, especially north side • Soffit of bridge deck • Concrete barrier and curb
2.0	Replace spalled deck corbels	• East Abutment access chamber. West Abutment
3.0	Crack sealing	• East and West abutments • West Pier • Underside of arches
4.0	FRP mesh reinforcement	• East & West Pier chamber walls • Spandrel walls where horizontal and vertical cracks are present • Bridge longitudinal cracks along top side of arches • Underside of arches at midspan (if strengthening required to remove load rating)
5.0	Replacement of expansion joints	• Both ends of arch bridge
6.0	Deck waterproofing and asphalt replacement	• Entire bridge deck
5.0	Cleaning and maintenance	• Remove pigeon excrement on top of arches top faces near midspans and other locations of concentration • Flush expansion joints after winter season to remove debris

Notes:

1. East end of bridge of the arch span is shared with the west end of the girder pan.
2. Recommend completing a new detailed deck condition survey in advance of detailed design

Table 3: Rehabilitation Works Recommended – Lorne Girder Bridge

Item	Rehabilitation Work	Location
1.0	Concrete repair work	• West abutments • Repair delamination of northern box girder at east abutment • Deck cantilever soffit, especially north side • Concrete barrier and curb
2.0	Crack sealing	• West abutment
3.0	Replacement of expansion joint seals	• Both ends of girder bridge
4.0	Replace bearings	• East and west abutments
5.0	Deck waterproofing and asphalt replacement	• Entire bridge deck
6.0	Cleaning and maintenance	• Flush expansion joints after winter season to remove debris • Clean graffiti from east abutment face

Notes:

1. West abutment of girder span is shared with the east end of the arch span.
2. Recommend completing a new detailed deck condition survey in advance of detailed design

Table 4: Rehabilitation Works Recommended – Lorne Bridge Pedestrian Underpass

Item	Rehabilitation Work	Location
1.0	Concrete repair work	• Barrel/ walls / of culvert
2.0	Repair/waterproof joints between culvert sections	• Throughout length of culvert, primarily three joints at each end
3.0	Repair/replace tunnel light	• Within underpass

Table 5: Rehabilitation Works Recommended – East Bank Retaining Walls

Item	Rehabilitation Work	Location
1.0	Repair or replace	• upper retaining wall (adjacent to girder span east abutment). Repairs include repairing the crown, locations of concrete disintegration, and construction joints.
2.0	Remove	• Concrete retaining wall adjacent to girder span west abutment. Utilize minor slopes in-place of wall

9. LIMITATIONS

The following limitations are applicable to this load limit evaluation report:

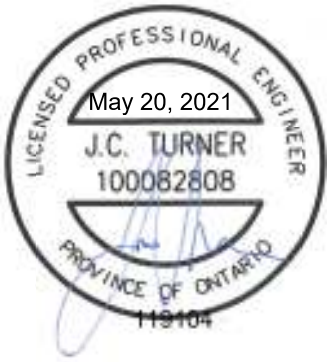
- This report is intended exclusively for the Client(s) named in the report. The material in it reflects our best judgment in light of the information reviewed by GM BluePlan Engineering Limited at the time of preparation. Unless otherwise agreed in writing by GM BluePlan Engineering Limited, this report shall not be used to imply warranty as to the fitness of the property for a particular purpose. This report is not a certification of compliance with past or present regulations. No portion of this report may be used as a separate entity, it is written to be read in its entirety.
- Only the specific information identified has been reviewed. GM BluePlan Engineering Limited is not obligated to identify mistakes or insufficiencies in the information obtained from the various sources or to verify the accuracy of the information. GM BluePlan Engineering Limited may use such specific information obtained in performing its services and is entitled to rely upon the accuracy and completeness thereof.
- This assessment does not wholly eliminate uncertainty regarding the potential for existing or future losses in connection with a property. No physical or destructive testing has been performed unless specifically recorded. Conditions existing, but not recorded, were not apparent given the level of study undertaken. We can perform further investigation on items of concern, if so required.

We thank you for engaging the services of GM BluePlan Engineering Limited, and trust that this report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

Your truly,

GM BLUEPLAN ENGINEERING LIMITED

Per: Per:



Jens Hummel, P.Eng. Jack Turner, P.Eng.

10. WORKS CITED

[1] PennDOT, "Methodology for 2019 Concrete Arch Bridge Evaluation," 2019. [Online]. Available: https://www.penndot.gov/ProjectAndPrograms/Cultural%20Resources/Documents/Historic%20Concrete%20Arch%20Bridge%20Methodology.pdf. [Accessed 29 September 2020].

[2] R. Stroscio, N. Lake, C. Toms and S. Pettifer, "An Integral Flat Arch Bridge," *Bridge Engineering,* vol. 171, no. 3, pp. 210-221, September 2018.

[3] C. Menn, Prestressed Concrete Bridges, Basel: Birkhauser Verlag, 1990, pp. 282-284.

[4] D. Proske and P. van Gelder, Safety of Historical Stone Arch Bridges, Heidelberg: Springer, 2009.

[5] BMVBS, *Guideline for Recalculation of Existing Road Bridges,* Berlin: Federal Highway Research Institute BASt, 2011.

[6] Institut fuer Bautechnik, *Concrete Bridges, Structural Design and Construction,* 1981.

[7] A. Arnold, *Influence of Thermal Restraint Forces on Structures made of Concrete with and without Prestress,* University of Technology of Dortmund, 2008.

[8] C. Larsson and G. Svensson, *Realistic Modeling of Thermal Effects in Concrete Bridges,* Lund: Lunds University, 2013.

[9] G. P. Garrett, "Analytical Load Rating of an Open-Spandrel Arch Bridge: Case Study," *ASCE Journal of Bridge Engineering,* vol. 12, no. 1, pp. 13-20, 2007.

[10] Ministry of Transportation Ontario, *Ontario Structure Inspection Manual (OSIM),* St. Catherines, 2018.

[11] C. Melbourne, "Arch Bridges," in *Proceedings of the 1st International Conference on Arch Bridges*, Bolton, 1995.

[12] J. A. F. O. Correia and A. M. P. De Jesus, "Structural Integrity," in *Proceedings of the 9th International Conference on Arch Bridges*, Porto, 2019.

[13] Canadian Standards Association, *S6:19, Canadian Highway Bridge Design Code,* Toronto: CSA Group, 2019.

[14] L.-Y. Lai, *Thermal Effects on Load Ratings of Reinforced Concrete Arch Bridges,* Pittsburgh: ASCE, 2018.

[15] Ministry of Transportation Ontario, *Structure Rehabilitation Manual,* St. Catherines, 2007.

[16] Canadian Standards Association, *Commentary on CSA S6:19, Canadian Highway Bridge Design Code,* Toronto: CSA Group, 2019.

[17] E. Thuermer, *Widening of a Multi-span Arch bridge on Highway A4 near Hainichen,* Dresden: Technische Universitaet Dresden, 1995.

[18] Victoria State Government, *Bridge Maintenance and Repair Manual,* Victoria, Australia, 2018.

2021 Structural Evaluation Report

Appendix I

2019 Detailed Visual Inspection Reports (by McIntosh Perry)

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

SUMMARY ACTION REPORT

ADDITIONAL INVESTIGATIONS	Priority	Inspection Date
Investigations, Inspections, Surveys Recommended		
Biennial OSIM	Normal	21/Jul/2022

REPAIR AND REHABILITATION REQUIRED	Priority		Comments
Repair and Rehabilitation Required	**6-10 Years**	**1 - 5 Years**	
Abutment		X	Rehabilitate
Wingwalls		X	Rehabilitate
Sidewalk (approaches & deck)		X	Rehabilitate
Wearing Surface (approaches & deck)		X	Rehabilitate
Barrier Walls		X	Rehabilitate
Soffit (exterior, ends & interior)		X	Rehabilitate
Expansion Joints		X	Replace
Piers		X	Rehabilitate
Arch Rib, Bottom Chord		X	Rehabilitate
Spandrel Columns		X	Rehabilitate

MAINTENANCE NEEDS	Priority		
Maintenance Needs	**2 Years**	**1 Year**	**Urgent**
Signs - Replace		X	
Utilities - Repair ducts		X	
Railing Systems - Repair		X	
Expansion Joints - Bridge Cleaning		X	
Embankments - Tree/vegetation maintenance	X		

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

INVENTORY DATA:

Structure Name	Lorne Bridge-Arch		
Main Hwy/Road #		Under Structure:	☑ Navigable Water ☐ Non-Navigable Water ☐ Rail ☐ Road ☐ Pedestrian ☐ Other
		On Structure:	☐ Rail ☑ Road ☐ Pedestrian ☐ Other
Road Name:	Colborne Street West		
Structure Location	0.05 km S of Brant Ave		
Latitude	43.137222	Longitude	-80.27
Owner(s)	City of Brantford	Heritage Designation	☐ Not Cons. ☐ Cons./Not App. ☐ List/Not Desig. ☐ Desig./not List ☐ Desig. & List
MTO Region	Southwestern	Road Class	☐ Freeway ☐ Arterial ☐ Collector ☑ Local
MTO District	-	Posted Speed	50 km/h No. of Lanes 5
Old County	Brant	AADT	27133 % Trucks 10
Geographic Twp.	-	Special Routes	☑ Transit ☑ Truck ☑ School ☐ Bicycle
Structure Type	Spandrel Arch	Detour Length Around Structure	- (km)
Total Deck Length	130.50 (m)	Fill on Structure	- (m)
Overall Str. Width	22.90 (m)	Skew Angle	0 (Degrees)
Total Deck Area	2988.45 (m2)	Direction of Structure	E - W
Roadway Width	17.40 (m)	No. of Spans	3
Span Lengths	41.7; 46.9; 41.7 (m)		

Overall Condition Rating	Fair
Bridge Condition Index (BCI)	64.9

HISTORICAL DATA

Year Built	1924		Last OSIM Inspection	2017
Year of Last Major Rehab.	1980		Last Enhanced OSIM Inspection	7/29/2014
Current Load Limit	-	(tonnes)	Last Bridge Master Inspection	7/29/2014
Load Limit By-Law #	-		Last Evaluation	-
By-Law Expiry Date	-		Last Underwater Inspection	7/29/2014
Min. Vertical Clearance	12.5	(m)	Last Condition Survey	7/29/2014

Rehabilitation History: (Date / Description)

12/31/1980: Deck Replacement

BRIDGE **Structure ID: 131**

Scheduled Improvements:	
Regional Priority Number _____	Programmed Work Year _____
Nature of Program Work:	

Appraisal Indices:		**Comments**
Fatigue		
Seismic		
Scour		
Flood		
Geometrics		
Barrier		
Curb		
Load Capacity		

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

FIELD INSPECTION INFORMATION			
Date of Inspection:	20-Jul-2020	Type of Inspection:	☐ OSIM ☑ Enhanced OSIM
Inspector:	Sabrina Dexter, Transportation Structures Engineer		
Others in Party:	Ted Walls, Survey Party Chief & Ali Babaei, Field Survey Technician		
Access Equipment Used:	Binoculars, sounding hammer, measuring tape, digital camera, drone		
Weather:	Sunny		
Temperature:	28°C		

ADDITIONAL INVESTIGATION REQUIRED	Priority			Estimated Cost
	None	Normal	Urgent	
Rehabilitation/Replacement Study:				$ -
Material Condition Survey				$ -
Detailed Deck Condition Survey:				$ -
Non-destructive Delamination Survey of Asphalt- Covered Deck:				$ -
Concrete Substructure Condition Survey:				$ -
Detailed Coating Condition Survey:				$ -
Detailed Timber Investigation:				$ -
Underwater Investigation:				$ -
Fatigue Investigation:				$ -
Seismic Investigation:				$ -
Structure Evaluation:				$ -
Monitoring				$ -
Monitoring of Deformations, Settlement and Movements:				$ -
Monitoring Crack Widths:		X		By Client
Load Posting – Estimated Load Limit			**Total Cost**	$ -

Investigation Notes:

Continue ongoing annual monitoring of crack widths in piers and arches.

OVERALL STRUCTURAL NOTES:	
Recommended Work on Structure:	☐ None ☐ Minor Rehab. ☑ Major Rehab. ☐ Replace
Timing of Recommended Work:	☑ 1 to 5 Years ☐ 6 to 10 Years
Overall Comments:	
Overall, structure is in fair condition. Spalls, delamination and wide cracks on abutments, wingwalls, piers, parapet walls, sidewalk, arch rib and spandrels. Potholes and wide unsealed cracks in wearing surface. The structure is recommended to undergo a rehabilitation in 1-5 years. Maintenance work required.	
Date of Next Inspection:	21-Jul-2022

Suspected Performance Deficiencies

00 None
01 Load carrying capacity
02 Excessive deformations (deflections & rotation)
03 Continuing settlement
04 Continuing movements
05 Seized bearings
06 Bearing not uniformly loaded/unstable
07 Jammed expansion joint
08 Pedestrian/vehicular hazard
09 Rough riding surface
10 Surface ponding
11 Deck drainage
12 Slippery surfaces
13 Flooding/channel blockage
14 Undermining of foundation
15 Unstable embankments
16 Other

Maintenance Needs

01 Lift and swing bridge maintenance
02 Bridge cleaning
03 Bridge handrail maintenance
04 Painting steel bridge structures
05 Bridge deck joint repair
06 Bridge bearing maintenance
07 Repair of structural steel
08 Repair of bridge concrete
09 Repair of bridge timber
10 Bailey bridges maintenance
11 Animal/pest control
12 Bridge surface repair
13 Erosion control at bridges
14 Concrete sealing
15 Rout and seal
16 Bridge deck drainage
17 Scaling (loose Concrete or ACR Steel)
18 Other

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Abutment	**Length:**	
Element Name:	Abutment Walls	**Width:**	19.51
Location:	East and West	**Height:**	10.00
Material:	Cast-in-place concrete	**Count:**	2
Element Type:	Conventional Closed	**Total Quantity:**	390.20
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	264.20	77.00	49.00

Comments:

Partially covered with graffiti. Light to severe scaling throughout. Rust staining. Narrow to wide vertical cracks; full length longitudinal crack observed on the arch rib extends down both abutments, full height. Delamination of concrete patches. Severe delamination and spalling on E abutment.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years
Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Abutment	**Length:**	9.35
Element Name:	Wingwalls	**Width:**	
Location:	NE, NW, SE, SW	**Height:**	7.00
Material:	Cast-in-place concrete	**Count:**	4
Element Type:	Reinforced Concrete	**Total Quantity:**	261.80
Environment:	Moderate	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	193.80	40.00	28.00

Comments:

Spalls with exposed rebar and delamination at corners of walls. Light to medium scaling.Narrow pattern cracks. Narrow to wide cracks with wet staining and efflorescence. Wide cracks, delamination, and spalls with exposed rebar on patches and at base of NW wingwall.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years
Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Accessories	**Length:**	
Element Name:	Signs	**Width:**	
Location:	North and South side of bridge	**Height:**	
Material:		**Count:**	9
Element Type:		**Total Quantity:**	9.00
Environment:	Severe	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	5.00	2.00	2.00

Comments:

Bridge Ices - 2 (Good); No Diving, Jumping or Swimming Sign - 1 (Good); Regulatory, information and direction signs - 4 (Trucks & Turning Lane in Fair; Parking & Arrow in Good).
On NE wingwall - Caution Bikes (Poor); Slow (Poor)

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☑ 1 Year ☐ 2 Years
18 Other
Replace signs on NE WW

Element Group:	Accessories	**Length:**	
Element Name:	Utilities	**Width:**	
Location:	Bell ducts/Hydro lines below deck	**Height:**	
Material:	Plastic	**Count:**	8
Element Type:		**Total Quantity:**	8.00
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	0.00	8.00	0.00

Comments:

Some ducts are disconnected and/or broken.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☑ 1 Year ☐ 2 Years
18 Other
Repair ducts

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Accessories	**Length:**	
Element Name:	Utilities	**Width:**	
Location:	Light poles on deck level, N/S deck fascia	**Height:**	
Material:	Steel	**Count:**	6
Element Type:		**Total Quantity:**	6.00
Environment:	Moderate	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	6.00	0.00	0.00

Comments:

Electrical boxes in good condition, one box with narrow ck. Pothole in asphalt filled old box in N sidewalk.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Approaches	**Length:**	6.00
Element Name:	Approach Slabs	**Width:**	17.37
Location:	East and West	**Height:**	
Material:	Cast-in-place concrete	**Count:**	2
Element Type:		**Total Quantity:**	208.40
Environment:	Moderate	**Limited Inspection:**	☑
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	193.40	15.00	0.00

Comments:

Not visible; assumed to be generally in good condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Approaches		**Length:**		
Element Name:	Drainage		**Width:**		
Location:	North and South sides of approaches		**Height:**		
Material:	Steel Post and Panel		**Count:**		4
Element Type:	Drain Pipes and Basins		**Total Quantity:**		4.00
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	4.00	0.00	0.00

Comments:

Minor surface corrosion.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Approaches		**Length:**		6.00
Element Name:	Wearing Surface		**Width:**		17.37
Location:	North and South		**Height:**		
Material:	Asphalt		**Count:**		2
Element Type:			**Total Quantity:**		208.40
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	133.40	45.00	30.00

Comments:

Longitudinal and transver medium to wide sealed and unsealed cracks. Light wheel track rutting. Potholes at joints. W approach wearing surface has 6 full length sealed cracks.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years
Mill and resurface

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Approaches	**Length:**		6.00
Element Name:	Sidewalks and Medians	**Width:**		2.49
Location:	North and South	**Height:**		0.20
Material:	Cast-in-place concrete	**Count:**		4
Element Type:		**Total Quantity:**		59.80
Environment:	Severe	**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	45.80	10.00	4.00

Comments:

Rust staining. Light scaling. Narrow to wide longitudinal and transverse cracks. Spalls and delamination at NW and SW approach.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

Element Group:	Barrier	**Length:**		142.50
Element Name:	Barrier/Parapet Walls	**Width:**		0.20
Location:	North and South, Interior (Road) & Top Face	**Height:**		0.75
Material:	Cast-in-place concrete	**Count:**		2
Element Type:	Parapet wall w/single railing	**Total Quantity:**		270.80
Environment:	Severe	**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	195.80	50.00	25.00

Comments:

Length includes approaches. Narrow to wide vertical stained cracks. Severe abrasions on road face of S parapet. Delamination at multiple post locations on S parapet. Light scaling and rust staining throughout. Stained pattern cracks throughout. Longitudinal cracks/delamination at top face. Large spall at SW parapet. Large delamination on S wall @ midspan.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair spalled and delminated concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Barrier	**Length:**	142.50
Element Name:	Barrier/Parapet Walls	**Width:**	
Location:	North and South, Exterior (Sidewalk)	**Height:**	0.50
Material:	Cast-in-place concrete	**Count:**	2
Element Type:	Parapet wall w/single railing	**Total Quantity:**	142.50
Environment:	Severe	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	69.50	50.00	23.00

Comments:

Length includes approaches. Narrow to wide vertical stained cracks. Delamination at multiple post locations on S parapet. Light scaling and rust staining throughout. Stained pattern cracks throughout. Large spall with exposed rebar @ SW.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair spalled and delminated concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

Element Group:	Barrier	**Length:**	142.50
Element Name:	Railing Systems	**Width:**	
Location:	North and South Sidewalk Exterior Railing	**Height:**	1.07
Material:	Aluminum	**Count:**	2
Element Type:	Aluminum Post and Panels	**Total Quantity:**	285.00
Environment:	Severe	**Limited Inspection:**	☐
Protection System	Hot dip galvanizing		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	273.00	7.00	5.00

Comments:

Length includes approaches. Isolated permanent deformations of spindles. Grout disintegrated at several railing post base plates. Severe deformation and missing spindle at SE.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☑ 1 Year ☐ 2 Years

03 Bridge handrail maintenance

Repair railing

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Barrier	**Length:**	142.50
Element Name:	Railing Systems	**Width:**	
Location:	North and South Railing on top of Parapet	**Height:**	
Material:	Aluminum	**Count:**	2
Element Type:	Aluminum Post and Panels	**Total Quantity:**	285.00
Environment:	Severe	**Limited Inspection:**	☐
Protection System	Hot dip galvanizing		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	0.00	0.00	244.00	35.00	6.00

Comments:

Length includes approaches. Abrasions from vehicle impact. Damaged railing splice and weld crack between post and base plate on N parapet railing at NE joint. Loose top rail connection at NE. Missing cap on SE.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☑ 1 Year ☐ 2 Years

03 Bridge handrail maintenance

Repair railing

Element Group:	Coatings	**Length:**	142.50
Element Name:	Railing Systems/Hand Railings	**Width:**	
Location:	North and South Sidewalk Exterior Railings	**Height:**	1.07
Material:	Other	**Count:**	2
Element Type:	Hot Dip Galvanizing	**Total Quantity:**	305.00
Environment:	Severe	**Limited Inspection:**	☐
Protection System	Hot Dip Galvanizing		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	265.00	30.00	10.00

Comments:

Light abrasions, Light flaking and discolouration of grey to grey-black throughout.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Coatings	**Length:**		142.50
Element Name:	Railing Systems/Hand Railings	**Width:**		
Location:	North/South Railings on top of Parapet Walls	**Height:**		0.60
Material:	Other	**Count:**		2
Element Type:	Hot Dip Galvanizing	**Total Quantity:**		171.00
Environment:	Severe	**Limited Inspection:**		☐
Protection System	Hot Dip Galvanizing			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	146.00	20.00	5.00

Comments:

Light abrasions from vehicle impact and light coating discolouration.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Deck	**Length:**		130.50
Element Name:	Deck Top	**Width:**		19.50
Location:	Top of deck	**Height:**		
Material:	Cast-in-place Concrete	**Count:**		1
Element Type:	Cast-in-place Concrete on Supports	**Total Quantity:**		2544.80
Environment:	Severe	**Limited Inspection:**		☑
Protection System	Waterproofing and Asphalt			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	2294.80	250.00	0.00

Comments:

Not visible. Bottom-up defects such as map cracks and pot holes observed on wearing surface. Assumed to be generally in good condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Deck	**Length:**		
Element Name:	Drainage System	**Width:**		
Location:	North and South	**Height:**		
Material:	Steel	**Count:**		4
Element Type:	Metal Drain Pipes	**Total Quantity:**		4.00
Environment:	Severe	**Limited Inspection:**		☐
Protection System	Hot dip galvanizing			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	4.00	0.00	0.00

Comments:

Light corrosion and loss of protective coating.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Deck	**Length:**		126.50
Element Name:	Soffit - Thin Slab	**Width:**		2.74
Location:	Exterior (Overhangs)	**Height:**		0.31
Material:	Cast-in-place Concrete	**Count:**		2
Element Type:		**Total Quantity:**		770.40
Environment:	Moderate	**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	645.40	75.00	50.00

Comments:

Stained and unstained medium to wide cracks, some with efflorescence. Delamination and spalls with exposed rebar. Honeycombing. Wet areas.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years
Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Deck		**Length:**		2.00
Element Name:	Soffit - Thin Slab		**Width:**		22.86
Location:	Ends		**Height:**		
Material:	Cast-in-place Concrete		**Count:**		2
Element Type:			**Total Quantity:**		91.40
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	56.40	20.00	15.00

Comments:

Spalls with exposed corroded rebar. Wet and stained due to joints leaking at NE & NW corners of deck. Rust staining on thickened ends of deck soffit.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

Element Group:	Deck		**Length:**		126.50
Element Name:	Soffit - Thin Slab		**Width:**		17.37
Location:	Interior		**Height:**		
Material:	Cast-in-place Concrete		**Count:**		1
Element Type:			**Total Quantity:**		2197.30
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	2119.30	60.00	18.00

Comments:

Stained hairline cracks. Spalls and delamination.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Deck	**Length:**		130.50
Element Name:	Wearing Surface	**Width:**		17.37
Location:	Top of deck	**Height:**		0.00
Material:	Asphalt	**Count:**		1
Element Type:		**Total Quantity:**		2266.80
Environment:	Severe	**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	1186.80	600.00	480.00

Comments:

Medium to wide longitudinal and transverse unsealed cracks throughout. Light raveling. Light wheel track rutting. Light to medium map cracks and potholes at joints.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Patch, waterproof, pave

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

Element Group:	Joints	**Length:**		20.11
Element Name:	Armouring/Retaining Devices	**Width:**		
Location:	Each End of the Bridge	**Height:**		
Material:	Steel	**Count:**		8
Element Type:		**Total Quantity:**		160.90
Environment:	Severe	**Limited Inspection:**		☐
Protection System	Hot dip galvanizing			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	6.90	84.00	70.00

Comments:

Permanent deformations at eastbound lanes. Light corrosion.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☑ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Joints		**Length:**		17.37
Element Name:	Concrete End Dams		**Width:**		0.30
Location:	Each End of the Bridge		**Height:**		
Material:	Concrete		**Count:**		4
Element Type:			**Total Quantity:**		20.80
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	6.80	7.00	7.00

Comments:

Light to severe scaling thoughout. Shallow spalls throughout.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☑ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Joints		**Length:**		20.11
Element Name:	Seals/Sealants		**Width:**		
Location:	Each End of Bridge		**Height:**		
Material:	Other		**Count:**		2
Element Type:	Compressed Seal		**Total Quantity:**		2.00
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	0.00	2.00	0.00

Comments:

Unable to inspect seals for rips and tears due to accumulation of debris. Signs of leakage on substructure indicate that seals are torn in some places and could be in fair to poor condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☑ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☑ 1 Year ☐ 2 Years
02 Bridge cleaning
Clean joint seals annually

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Embankments and Streams	**Length:**		
Element Name:	Embankments	**Width:**		
Location:	NE, NW, SE, SW	**Height:**		
Material:		**Count:**		4
Element Type:		**Total Quantity:**		4.00
Environment:	Benign	**Limited Inspection:**		☐
Protection System	Other			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	2.00	2.00	0.00

Comments:

The west embankment slopes are steep, but are generally well protected.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☑ 2 Years

18 Other

Tree/vegetation maintenance

Element Group:	Embankments and Streams	**Length:**		
Element Name:	Slope Protection	**Width:**		
Location:	All quadrants E/W Abutments	**Height:**		
Material:		**Count:**		4
Element Type:		**Total Quantity:**		4.00
Environment:	Benign	**Limited Inspection:**		☐
Protection System	Other			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	0.00	4.00	0.00

Comments:

Trees have displaced rocks on W embankments.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Embankments and Streams	**Length:**		
Element Name:	Streams and Waterways	**Width:**		
Location:	All	**Height:**		
Material:		**Count:**		1
Element Type:		**Total Quantity:**		1.00
Environment:		**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	All	0.00	1.00	0.00	0.00

Comments:

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Foundations	**Length:**		
Element Name:	Foundation (Below ground level)	**Width:**		
Location:	Below Abutments and Piers	**Height:**		
Material:	Cast-in-place Concrete	**Count:**		4
Element Type:	Spread	**Total Quantity:**		4.00
Environment:	Benign	**Limited Inspection:**		☑
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	N/A	0.00	0.00	4.00	0.00

Comments:

Assumed in fair condition based on age of original substructure.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Piers	**Length:**		3.65
Element Name:	Shafts/Columns/Pile Bents	**Width:**		16.60
Location:	East and West Pier, Inside Walls	**Height:**		6.70
Material:	Cast-in-place Concrete	**Count:**		4
Element Type:	Concrete Shafts, Pier Walls	**Total Quantity:**		542.70
Environment:	Benign	**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	417.70	70.00	55.00

Comments:

Staining and wet areas. Honeycombing. Severe scaling, delamination and spalling. Medium to wide cracks.
Parsons 2014: Engaged columns (or pilaster as referred on the dwg.) were observed to have severe spalls, exposed reinforcement, and medium to wide cracks.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years
Repair poor concrete; seal cracks

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Piers	**Length:**		8.44
Element Name:	Shafts/Columns/Pile Bents	**Width:**		19.48
Location:	East and West Pier, Outside Walls	**Height:**		12.46
Material:	Cast-in-place Concrete	**Count:**		4
Element Type:	Concrete Shafts, Pier Walls	**Total Quantity:**		1391.50
Environment:	Benign	**Limited Inspection:**		☐
Protection System				

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	966.50	225.00	200.00

Comments:

Stained and unstained medium to wide cracks. Medium pattern cracks. Severe delamination and spalls. Disintigration. Patches from previous rehab noted. Light to severe scaling. Honeycombing and wet areas. Longitudinal cracks observed on the arch ribs continue full height on the vertical walls.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years
Repair poor concrete; seal cracks

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Sidewalks /Curbs		**Length:**		130.50
Element Name:	Sidewalks and Medians		**Width:**		2.49
Location:	North and South		**Height:**		0.20
Material:	Cast-in-place concrete		**Count:**		2
Element Type:			**Total Quantity:**		649.90
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	519.90	110.00	20.00

Comments:

Rust staining. Light scaling. Isolated delamination. Narrow to wide longitudinal and transverse cracks. Trip hazard at NW patched location. Severe delmaination on N and S side approx. over centre span and west span.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

Element Group:	Trusses/Arches		**Length:**		128.16
Element Name:	Bottom Chords		**Width:**		17.38
Location:	Arch Rib, Bottom and Exterior Face		**Height:**		1.08
Material:	Cast-in-place concrete		**Count:**		1
Element Type:			**Total Quantity:**		2504.20
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	2154.20	190.00	160.00

Comments:

Stained and unstained medium to wide cracks, some with efflorescence. Full length longitudinal crack extending down supports. Severe delamination and spalls. Previous patches noted. Light to severe scaling. Honeycombing and wet areas. Crack gauges on all three spans.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete; seal cracks

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 131**

ELEMENT DATA

Element Group:	Trusses/Arches		**Length:**		129.36
Element Name:	Bottom Chords		**Width:**		17.38
Location:	Arch Rib, Top Face		**Height:**		
Material:	Cast-in-place concrete		**Count:**		1
Element Type:			**Total Quantity:**		2248.30
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	1638.30	315.00	295.00

Comments:

Localized poor areas, specifically at the cells near the abutments and piers. Severe scaling, medium to wide cracks, spalls and delamination. Localized exposed rebar. Medium to wide longitudinal crack running almost through entire length of bridge. Narrow to medium pattern, transverse and longitudinal cracks.Spalls and delamination on patches.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete; seal cracks

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

Element Group:	Trusses/Arches		**Length:**		0.35
Element Name:	Verticals/Diagonals		**Width:**		17.38
Location:	Spandrel Columns		**Height:**		2.62
Material:	Cast-in-Place Concrete		**Count:**		48
Element Type:	Rectangular Solid		**Total Quantity:**		4459.50
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	4216.50	128.00	115.00

Comments:

Covered with graffiti. Spalls and delamination at the bottom of many spandrel column connections with arch rib. Spalls and delamination of patches. Light to severe scaling. Efflorescence staining. Hairline to wide horizontal and vertical cracks. Cracks on arch rib continue vertically on spandrels. Wide cracks/delamination/spall on N & S faces of 3 spandrels in W span.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Repair poor concrete; seal cracks

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years

00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE

Structure ID: 131

Structure Name: Lorne Bridge-Arch

Structure Number: 131

Element Group	Element Name	Sub-Element	Unit (Qty.)	Total Element Qty.	Element Qty. in Excellent Condition (1.00)	Element Qty. in Good Condition (0.75)	Element Qty. in Fair Condition (0.4)	Element Qty. in Poor Condition (0)	Element Condition Index	Estimated Life Span	Estimated Remaining Service Life (ERSL)*	Performance Deficiency**	Maintenance Need**
Abutment	Abutment Walls		Sq.m	390.20	0.00	264.20	77.00	49.00	59	40	23	00	00
	Wingwalls		Sq.m	261.80	0.00	193.80	40.00	28.00	62	40	25	00	00
Accessories	Signs		Each	9.00	0.00	5.00	2.00	2.00	N/A	N/A	N/A	00	18
	Utilities		Each	8.00	0.00	0.00	8.00	0.00	N/A	N/A	N/A	00	18
	Utilities		Each	6.00	0.00	6.00	0.00	0.00	N/A	N/A	N/A	00	00
Approaches	Approach Slabs		Sq.m	208.40	0.00	193.40	15.00	0.00	72	25	18	00	00
	Drainage		Each	4.00	0.00	4.00	0.00	0.00	N/A	15	N/A	00	00
	Wearing Surface		Sq.m	208.40	0.00	133.40	45.00	30.00	57	15	8	00	00
	Sidewalks and Medians		Sq.m	59.80	0.00	45.80	10.00	4.00	64	35	22	00	00
Barrier	Barrier/Parapet Walls		Sq.m	270.80	0.00	195.80	50.00	25.00	62	35	22	00	00
	Barrier/Parapet Walls		Sq.m	142.50	0.00	69.50	50.00	23.00	51	35	18	00	00
	Railing Systems		m	285.00	0.00	273.00	7.00	5.00	73	35	25	00	03
	Railing Systems		m	285.00	0.00	244.00	35.00	6.00	69	35	24	00	03
Coatings	Railing Systems/Hand Railings		Sq.m	305.00	0.00	265.00	30.00	10.00	69	20	14	00	00
	Railing Systems/Hand Railings		Sq.m	171.00	0.00	146.00	20.00	5.00	69	20	14	00	00
Deck	Deck Top		Sq.m	2544.80	0.00	2294.80	250.00	0.00	72	25	18	00	00
	Drainage System		Each	4.00	0.00	4.00	0.00	0.00	N/A	15	N/A	00	00
	Soffit - Thin Slab		Sq.m	770.40	0.00	645.40	75.00	50.00	67	50	33	00	00
	Soffit - Thin Slab		Sq.m	91.40	0.00	56.40	20.00	15.00	55	50	28	00	00
	Soffit - Thin Slab		Sq.m	2197.30	0.00	2119.30	60.00	18.00	73	50	37	00	00
	Wearing Surface		Sq.m	2266.80	0.00	1186.80	600.00	480.00	50	15	7	00	00
Joints	Armouring/Retaining Devices		m	160.90	0.00	6.90	84.00	70.00	24	25	6	00	00
	Concrete End Dams		Sq.m	20.80	0.00	6.80	7.00	7.00	38	25	9	00	00
	Seals/Sealants		Each	2.00	0.00	0.00	2.00	0.00	N/A	25	N/A	00	02
Embankments and Streams	Embankments		Each	4.00	0.00	2.00	2.00	0.00	N/A	N/A	N/A	00	18
	Slope Protection		Each	4.00	0.00	0.00	4.00	0.00	N/A	N/A	N/A	00	00
	Streams and Waterways		All	1.00	0.00	1.00	0.00	0.00	N/A	N/A	N/A	00	00
Foundations	Foundation (Below ground level)		N/A	4.00	0.00	0.00	4.00	0.00	N/A	N/A	N/A	00	00
Piers	Shafts/Columns/Pile Bents		Sq.m	542.70	0.00	417.70	70.00	55.00	63	50	31	00	00
	Shafts/Columns/Pile Bents		Sq.m	1391.50	0.00	966.50	225.00	200.00	59	50	29	00	00
Sidewalks /Curbs	Sidewalks and Medians	Sidewalks	Sq.m	649.90	0.00	519.90	110.00	20.00	67	35	23	00	00
Trusses/Arches	Bottom Chords		Sq.m	2504.20	0.00	2154.20	190.00	160.00	68	35	24	00	00
	Bottom Chords		Sq.m	2248.30	0.00	1638.30	315.00	295.00	60	35	21	00	00
	Verticals/Diagonals		Sq.m	4459.50	0.00	4216.50	128.00	115.00	72	35	25	00	00

Conditon Index 64.9

** OSIM codes

Photo 1 – North Elevation

Photo 2 – South Elevation

Photo 3 – Wearing surface, looking West

Photo 4 – West Expansion Joint

Photo 5 – South Sidewalk, Looking West

Photo 6 – East Abutment

Photo 7 – NE Wingwall

Photo 8 – West Pier, North and East Face

Photo 9 – Upstream (North)

Photo 10 – Downstream (South)

Photo 11 – Exterior Barrier Wall, Spall on Pedestal (Typ)

Photo 12 – South Exterior Railing, Impact Damage and Missing Spindle

Photo 13 – North Exterior Railing, Typical Spindle Repair

Photo 14 – North Sidewalk, Ponding

Photo 15 – North Sidewalk, Wide Transverse Cracks(Typ)

Photo 16 – Light Rusting of Bolts

Photo 17 – Interior Barrier Wall Railing, SW Approach, Impact Damage

Photo 18 – South Interior Barrier, SE Approach Expansion Joint, Spall & Delamination

Photo 19 – South Interior Barrier Wall, Wide Horizontal & Vertical Stained Cracks, Delaminations and Spalls

Photo 20 – South Interior Barrier Wall, Inter Face, Wide Horizontal & Vertical Stained Cracks, Delaminations and Spalls

Photo 21 - Regulatory, Info & Direction Signs

Photo 22 – East Abutment, NE Corner, Spalls & Delamination

Photo 23 - East Abutment, Wide Vertical Crack, Full Height

Photo 24 - East Pier, Severe Scaling & Erosion, Cracks with Efflorescence

Photo 25 - West Pier, Severe Scaling & Erosion, Cracks with Efflorescence

Photo 26 - NW Wingwall, Delamination & Spall

Photo 27 - 27. SW Wingwall, Spall with Exposed Rebar

Photo 28 - North Overhang, Delaminations & Spalls with Exposed Rebar

Photo 29 - Arch Rib, Bottom Face, & East Abutment, SE Corner, Spalls

Photo 30 - Arch Rib, Bottom Face, Middle Span, Delaminations

Photo 31 - Arch Rib, Bottom Face, East Span, Wide Longitudinal Crack

Photo 32 - Utilities @ Southeast, Ducts Disconnected & Broken

Photo 33 - Spandrel Column, 2nd from East, SE Corner, Delamination

Photo 34 - Centre Span, South Face of Bottom Chord, Spalls & Delaminations

Photo 35 - Centre Span, Wide Cracks & Suspected Delamination of Bottom Chord, Top & North Face

Photo 36 - East Span, Delamination on West Face of 1st Spandrel, Spalls on West Face of 2nd Spandrel

Photo 37 - West Span, Cracks & Suspected Delamination of Bottom Chord, North Face

Photo 38 - West Span, Delamination on North Face of Bottom Chord & North Face of Centre Spandrel

Photo 39 - West Span, Spalls with Exposed Rebar & Delamination of Bottom Chord, S Face, & Centre 3 Spandrels

Photo 40 - Bird Nest, East Pier, South Face

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 132**

SUMMARY ACTION REPORT

ADDITIONAL INVESTIGATIONS	Priority	Inspection Date
Investigations, Inspections, Surveys Recommended		
Biennial OSIM	Normal	17-Dec-2021

REPAIR AND REHABILITATION REQUIRED	Priority		Comments
Repair and Rehabilitation Required	**6-10 Years**	**1 - 5 Years**	
East Abutment		X	Rehabilitate
West Abutment		X	Rehabilitate
Approach Wearing Surface		X	Rehabilitate
Deck top		X	Rehabilitate
Deck Soffit Interior		X	Rehabilitate
Deck Soffit Exterior		X	Rehabilitate
Deck Soffit Ends		X	Rehabilitate
Deck Wearing Surface		X	Rehabilitate
Concrete End Dams		X	Rehabilitate
Armoring/Retaining Device		X	Rehabilitate
Seals/Sealants		X	Replace
Retaining Walls		X	Replace

MAINTENANCE NEEDS	Priority		
Maintenance Needs	**2 Years**	**1 Year**	**Urgent**
Utilities - Other - Replace missing bolts	X		

BRIDGE **Structure ID: 132**

INVENTORY DATA:

Structure Name	Lorne Bridge-Girder		
Main Hwy/Road #		Under Structure:	☐ Navigable Water ☐ Non-Navigable Water ☐ Rail ☐ Road ☑ Pedestrian ☐ Other
		On Structure:	☐ Rail ☑ Road ☐ Pedestrian ☐ Other
Road Name:	Colborne Street West		
Structure Location	10m S of Brant Ave		
Latitude	43.137847	Longitude	-80.269361
Owner(s)	City of Brantford	Heritage Designation	☐ Not Cons. ☐ Cons./Not App. ☐ List/Not Desig. ☐ Desig./not List ☑ Desig. & List
MTO Region	Southwestern	Road Class	☐ Freeway ☑ Arterial ☐ Collector ☐ Local
MTO District	-	Posted Speed	50 km/h — No. of Lanes: 5
Old County	Brant	AADT	27133 — % Trucks: 10
Geographic Twp.	-	Special Routes	☑ Transit ☑ Truck ☑ School ☐ Bicycle
Structure Type	Box Beams or Girders	Detour Length Around Structure	5.00 (km)
Total Deck Length	19.81 (m)	Fill on Structure	0.10 (m)
Overall Str. Width	24.17 (m)	Skew Angle	0 (Degrees)
Total Deck Area	478.81 (m2)	Direction of Structure	E - W
Roadway Width	18.66 (m)	No. of Spans	1
Span Lengths	19.80 (m)		

Overall Condition Rating	Fair
Bridge Condition Index (BCI)	63.7

HISTORICAL DATA

Year Built	1924	Last OSIM Inspection	2017
Year of Last Major Rehab.	1980	Last Enhanced OSIM Inspection	2014
Current Load Limit	- (tonnes)	Last Bridge Master Inspection	-
Load Limit By-Law #	-	Last Evaluation	-
By-Law Expiry Date	-	Last Underwater Inspection	-
Min. Vertical Clearance	- (m)	Last Condition Survey	-

Rehabilitation History: (Date / Description)

12/31/1980 - Deck Replacement

BRIDGE **Structure ID: 132**

Scheduled Improvements:	
Regional Priority Number _____	Programmed Work Year _____
Nature of Program Work:	

Appraisal Indices:		**Comments**
Fatigue		
Seismic		
Scour		
Flood		
Geometrics		
Barrier		
Curb		
Load Capacity		

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 132**

FIELD INSPECTION INFORMATION			
Date of Inspection:	17-Dec-2019	Type of Inspection:	☑ OSIM ☐ Enhanced OSIM
Inspector:	Sabrina Dexter, Transportation Structures Engineer		
Others in Party:	Akhilesh Prabhu, Transportation Structures Intern		
Access Equipment Used:	Binoculars, sounding hammer, measuring tape, digital camera		
Weather:	Overcast		
Temperature:	-3°C		

ADDITIONAL INVESTIGATION REQUIRED	Priority			Estimated Cost
	None	Normal	Urgent	
Rehabilitation/Replacement Study:				$ -
Material Condition Survey				$ -
Detailed Deck Condition Survey:				$ -
Non-destructive Delamination Survey of Asphalt- Covered Deck:				$ -
Concrete Substructure Condition Survey:				$ -
Detailed Coating Condition Survey:				$ -
Detailed Timber Investigation:				$ -
Underwater Investigation:				$ -
Fatigue Investigation:				$ -
Seismic Investigation:				$ -
Structure Evaluation:				$ -
Monitoring				$ -
Monitoring of Deformations, Settlement and Movements:				$ -
Monitoring Crack Widths:				$ -
Load Posting – Estimated Load Limit			**Total Cost**	$ -

Investigation Notes:

OVERALL STRUCTURAL NOTES:	
Recommended Work on Structure:	☐ None ☐ Minor Rehab. ☑ Major Rehab. ☐ Replace
Timing of Recommended Work:	☑ 1 to 5 Years ☐ 6 to 10 Years
Overall Comments:	
Structure is generally in fair condition, with cracks, delaminations and spalls on the abutment walls, ballast walls, barier walls, deck soffit and and girder ends. Wide sealed and unsealed cracks on the wearing surface and deteriorations on the concrete end dams. The bridge is recommended to undergo rehabilitation in 1-5 years. Concrete patch repair techniques are recommended and the retaining walls that are extensively deteriorated should be replaced.	
Date of Next Inspection:	17-Dec-2021

Suspected Performance Deficiencies

00 None
01 Load carrying capacity
02 Excessive deformations (deflections & rotation)
03 Continuing settlement
04 Continuing movements
05 Seized bearings
06 Bearing not uniformly loaded/unstable
07 Jammed expansion joint
08 Pedestrian/vehicular hazard
09 Rough riding surface
10 Surface ponding
11 Deck drainage
12 Slippery surfaces
13 Flooding/channel blockage
14 Undermining of foundation
15 Unstable embankments
16 Other

Maintenance Needs

01 Lift and swing bridge maintenance
02 Bridge cleaning
03 Bridge handrail maintenance
04 Painting steel bridge structures
05 Bridge deck joint repair
06 Bridge bearing maintenance
07 Repair of structural steel
08 Repair of bridge concrete
09 Repair of bridge timber
10 Bailey bridges maintenance
11 Animal/pest control
12 Bridge surface repair
13 Erosion control at bridges
14 Concrete sealing
15 Rout and seal
16 Bridge deck drainage
17 Scaling (loose Concrete or ACR Steel)
18 Other

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Abutment	**Length:**	20.59
Element Name:	Abutment Walls	**Width:**	0.99
Location:	East Abutment	**Height:**	1.38
Material:	Cast-in-place concrete	**Count:**	1
Element Type:	Abutment Stem	**Total Quantity:**	31.00
Environment:	Benign	**Limited Inspection:**	☑
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	21.40	8.10	1.50

Comments:

Includes area of abutment and bearing pedestal. Inaccessible due to presence of chain link fence. Comments are carried forward from previous inpsection. Medium cracks and delamination noted. Medium scaling, honeycombing and wet areas noted. Localized cracks and light scaling of east abutment bearing pedestal. Repair deteriorated concrete and seal cracks.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Abutment	**Length:**	19.51
Element Name:	Abutment Walls	**Width:**	0.99
Location:	West Abutment	**Height:**	7.11
Material:	Cast-in-place concrete	**Count:**	1
Element Type:	Abutment Stem	**Total Quantity:**	141.30
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	117.10	18.10	6.10

Comments:

Includes area of abutment and bearing pedestal. Medium to wide cracks and delmaination with spalls. Light to medium scaling and wet areas. Wide horzintal crack at south west bearing pedestal. Repair deteriorated concrete and seal cracks.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Abutment	**Length:**	20.59
Element Name:	Ballast Walls	**Width:**	0.46
Location:	East and West	**Height:**	1.34
Material:	Cast-in-place concrete	**Count:**	2
Element Type:		**Total Quantity:**	53.90
Environment:	Benign	**Limited Inspection:**	☑
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	47.40	5.50	1.00

Comments:

West Ballast wall was not visible during time of inspection so comment has been carried forward. No visible defects observed. East ballast wall; some unstained and stained medium cracks and wet areas and shallow spall with exposed rebar at north east end.

Performance Deficiencies: 00 None

Recommended Work:	☐ Rehab	☐ Replace	**Maintenance Needs:**	☐ Urgent	☐ 1 Year ☐ 2 Years
	☐ 1 - 5 Years	☐ 6 - 10 Years		00 None	

Element Group:	Abutment	**Length:**	0.00
Element Name:	Bearings	**Width:**	0.00
Location:	East and West	**Height:**	0.00
Material:	Elastomeric Pad	**Count:**	14
Element Type:		**Total Quantity:**	14.00
Environment:	Benign	**Limited Inspection:**	☑
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	14.00	0.00	0.00

Comments:

Not visible. Comments carried forward from previous inspection. Light bulging of bearings of east bearings. Narrow cracks and light bulding of west bearings.

Performance Deficiencies: 00 None

Recommended Work:	☐ Rehab	☐ Replace	**Maintenance Needs:**	☐ Urgent	☐ 1 Year ☐ 2 Years
	☐ 1 - 5 Years	☐ 6 - 10 Years		00 None	

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Abutment	**Length:**	5.72
Element Name:	Wingwalls	**Width:**	0.76
Location:	NE, SE	**Height:**	0.00
Material:	Cast-in-place concrete	**Count:**	2
Element Type:	Reinforced Concrete	**Total Quantity:**	18.80
Environment:	Moderate	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	16.70	2.10	0.00

Comments:
Medium width cracks and wet areas.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Accessories	**Length:**	0.00
Element Name:	Utilities	**Width:**	0.00
Location:	Bell Ducts/Hydro lines, below deck	**Height:**	0.00
Material:	Plastic	**Count:**	2
Element Type:		**Total Quantity:**	2.00
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	0.00	2.00	0.00

Comments:
Some ducts are disconnected and/or broken.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Accessories	**Length:**	0.00
Element Name:	Utilities	**Width:**	0.00
Location:	Light poles on deck level, SE and NW	**Height:**	0.00
Material:	Steel	**Count:**	2
Element Type:		**Total Quantity:**	2.00
Environment:	Moderate	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	2.00	0.00	0.00

Comments:

Comments carried forward from previous inspection as element covered in snow in 2019. Missing bolts on electrical box covers on the north sidewalk. Plywood cover in poor condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☑ 2 Years 18 Other

Element Group:	Approaches	**Length:**	6.00
Element Name:	Approach Slabs	**Width:**	18.60
Location:	East Approach	**Height:**	0.00
Material:	Cast-in-place concrete	**Count:**	1
Element Type:		**Total Quantity:**	223.20
Environment:	Moderate	**Limited Inspection:**	☑
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	208.20	15.00	0.00

Comments:

Not visible. Condition based on previous inpsection and condition of wearing surface.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Approaches		**Length:**		6.10
Element Name:	Wearing Surface		**Width:**		18.60
Location:	East		**Height:**		0.00
Material:	Asphalt		**Count:**		1
Element Type:			**Total Quantity:**		113.46
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	68.46	30.00	15.00

Comments:

Wide unsealed transverse and longitudinal cracks on wearing surface. Potholes noted at ends, with some patched.

Performance Deficiencies: 00 None

Recommended Work:			**Maintenance Needs:**			
	☑ Rehab	☐ Replace		☐ Urgent	☐ 1 Year	☐ 2 Years
	☑ 1 - 5 Years	☐ 6 - 10 Years		00 None		

Element Group:	Approaches		**Length:**		6.00
Element Name:	Sidewalks and Medians		**Width:**		2.54
Location:	North and South		**Height:**		0.28
Material:	Cast-in-place concrete		**Count:**		4
Element Type:			**Total Quantity:**		67.70
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	62.70	4.00	1.00

Comments:

Light scaling noted. Narrow to medium longitudinal and travsverse cracks noted throughout. Shallow spalls noted.

Performance Deficiencies: 00 None

Recommended Work:			**Maintenance Needs:**			
	☐ Rehab	☐ Replace		☐ Urgent	☐ 1 Year	☐ 2 Years
	☐ 1 - 5 Years	☐ 6 - 10 Years		00 None		

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Barrier	**Length:**	20.55
Element Name:	Barrier/Parapet Walls	**Width:**	0.20
Location:	North and South, Exterior	**Height:**	0.50
Material:	Cast-in-Place Concrete	**Count:**	2
Element Type:		**Total Quantity:**	20.60
Environment:	Severe	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	14.10	6.00	0.50

Comments:

Narrow to wide vertical cracks with staining and mositure. Light scaling throughout. Narrow to medium wet map cracks. Shallow spall noted at south west.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Barrier	**Length:**	20.55
Element Name:	Barrier/Parapet Walls	**Width:**	0.20
Location:	North and South, Interior	**Height:**	0.50
Material:	Cast-in-Place Concrete	**Count:**	2
Element Type:		**Total Quantity:**	28.80
Environment:	Severe	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	22.70	5.70	0.40

Comments:

Narrow to wide vertical crcks with staining and moisture. Light scaling and rust staining throughout. Wet narrow to medium map cracks. Several spalls with exposed corrosded rebar at north east end.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Barrier	**Length:**	20.55
Element Name:	Hand Railings	**Width:**	0.00
Location:	North and South	**Height:**	0.00
Material:	Aluminium	**Count:**	2
Element Type:	Aluminium Post and Aluminium Panels	**Total Quantity:**	41.10
Environment:	Severe	**Limited Inspection:**	☐
Protection System	None		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	35.10	5.00	1.00

Comments:
Abrasions from vehicle impact and localized deformations.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Barrier	**Length:**	27.13
Element Name:	Railing Systems	**Width:**	0.00
Location:	North and South	**Height:**	1.07
Material:	Aluminium	**Count:**	2
Element Type:	Aluminium Post and Aluminium Panels	**Total Quantity:**	54.30
Environment:	Severe	**Limited Inspection:**	☐
Protection System	None		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	54.30	0.00	44.30	5.00

Comments:
In good condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Beams/ MLEs	**Length:**	16.20
Element Name:	Girders	**Width:**	1.22
Location:	Middle	**Height:**	0.99
Material:	Precase Concrete	**Count:**	7
Element Type:	Box/Trapezoidal	**Total Quantity:**	363.00
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	360.50	1.50	1.00

Comments:

Moisture stains noted. Delmination on exterior face of north girder.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Beams/ MLEs		**Length:**		2.00
Element Name:	Girders		**Width:**		1.22
Location:	Ends		**Height:**		0.99
Material:	Precast Concrete		**Count:**		14
Element Type:	Box/Trapezoidal		**Total Quantity:**		89.70
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	86.70	2.00	1.00

Comments:

Shallow spalls and wet areas noted. Wide vertical cracks and suspected delamination.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Beams/ MLEs		**Length:**		2.00
Element Name:	Diaphragms		**Width:**		0.31
Location:	Between Girders		**Height:**		0.76
Material:	Cast-in-place-Concrete		**Count:**		12
Element Type:	Rectangular-solid		**Total Quantity:**		18.70
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	18.70	0.00	0.00

Comments:
In good condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Coatings		**Length:**		20.55
Element Name:	Railing Systems/Hand Railings		**Width:**		0.00
Location:	North south railings on parapet walls		**Height:**		0.60
Material:	Other		**Count:**		2
Element Type:			**Total Quantity:**		24.70
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	20.70	3.00	1.00

Comments:
Abrasion from vehicle impact and light coating discoloration.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Coatings		**Length:**		27.13
Element Name:	Railing Systems/Hand Railings		**Width:**		0.00
Location:	North and South sidewalk exterior railings		**Height:**		1.07
Material:	Other		**Count:**		2
Element Type:			**Total Quantity:**		0.00
Environment:	Severe		**Limited Inspection:**		☐
Protection System					
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	50.10	6.00	2.00

Comments:

Light abrasions at some locations. Light flaking and soicoloration of grey to grey-black throughout.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Deck		**Length:**		19.81
Element Name:	Deck Top		**Width:**		18.66
Location:	Top of Deck		**Height:**		0.00
Material:	Cast-in-place Concrete		**Count:**		1
Element Type:			**Total Quantity:**		369.70
Environment:	Moderate		**Limited Inspection:**		☑
Protection System	Waterproofing and Asphalt				
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	324.20	43.00	2.50

Comments:

Rating based on previous report and age of structure. 2014 Condition survey comments: No defects were revealed from the concrete cores and sawn samples, however bottom-up asphalt defects indicate poor condition due to potholes in asphalt, and fair condition due to wide longitudinal and transverse cracks.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Deck		**Length:**		2.00
Element Name:	Soffit - Thin Slab		**Width:**		15.63
Location:	East and West ends of Structure		**Height:**		0.00
Material:	Cast-in-place Concrete		**Count:**		2
Element Type:			**Total Quantity:**		62.60
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	51.60	8.00	3.00

Comments:

Spalls, delaminations and wet areas noted on ends.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Deck		**Length:**		16.50
Element Name:	Soffit - Thin Slab		**Width:**		1.13
Location:	North and South exterior overhand soffit		**Height:**		0.00
Material:	Cast-in-place Concrete		**Count:**		2
Element Type:			**Total Quantity:**		45.80
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	32.80	10.00	3.00

Comments:

Narrow to medium cracks with efflorescence, spalls, delaminations and wet areas noted. Narrow to medium vertical cracks noted on fascia.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Deck		**Length:**		16.50
Element Name:	Soffit - Thin Slab		**Width:**		12.28
Location:	Underside of deck, Interior		**Height:**		0.00
Material:	Cast-in-place Concrete		**Count:**		1
Element Type:			**Total Quantity:**		202.70
Environment:	Benign		**Limited Inspection:**		☐
Protection System					
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	197.10	3.80	1.80

Comments:

Spall/delamination at north west covere by plywood.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Deck		**Length:**		19.81
Element Name:	Wearing Surface		**Width:**		18.66
Location:	Top of deck		**Height:**		0.00
Material:	Asphalt		**Count:**		1
Element Type:			**Total Quantity:**		369.70
Environment:	Severe		**Limited Inspection:**		☐
Protection System					
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	304.70	45.00	20.00

Comments:

Unsealed medium to wide transverse, longitudinal, and random cracks noted. Light to medium potholes/patches noted.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Joints		**Length:**		18.66
Element Name:	Armouring/Retaining Devices		**Width:**		0.00
Location:	East and West		**Height:**		0.00
Material:	Steel		**Count:**		4
Element Type:			**Total Quantity:**		74.60
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.00	57.60	10.00	7.00

Comments:

Permanent deformations of east armoring angles. Light corrosion noted. No armoring on outside edges of end dams.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Joints		**Length:**		18.66
Element Name:	Concrete End Dams		**Width:**		0.30
Location:	East and West		**Height:**		0.00
Material:	Concrete		**Count:**		4
Element Type:			**Total Quantity:**		22.40
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	12.40	5.00	5.00

Comments:

Narrow to medium cracks and spalls at the edges without armoring. Light to medium scaling throughout. Light to medium spalls.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Joints		**Length:**		24.20
Element Name:	Seals/Sealants		**Width:**		0.00
Location:	East and West		**Height:**		0.00
Material:			**Count:**		2
Element Type:	Compression seal		**Total Quantity:**		2.00
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	0.00	1.00	1.00

Comments:
Covered with debris. Leakage observed from soffit. Rip/tears visible.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab ☐ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Embankments and Streams		**Length:**		-
Element Name:	Embankments		**Width:**		-
Location:	NE, NW, SE, SW		**Height:**		-
Material:	Vegetation / Rip-rap / Gabion		**Count:**		2
Element Type:			**Total Quantity:**		2.00
Environment:	Benign		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.00	2.00	0.00	0.00

Comments:
In good condition.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Foundations		**Length:**		-
Element Name:	Foundation (Below ground level)		**Width:**		-
Location:			**Height:**		-
Material:			**Count:**		2
Element Type:			**Total Quantity:**		0.00
Environment:			**Limited Inspection:**		☑
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	N/A	0.00	0.00	0.00	0.00

Comments:

Not Inspected. No visible deficiencies noted.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Sidewalks / Curbs		**Length:**		20.55
Element Name:	Sidewalks and Medians		**Width:**		2.49
Location:	North and South		**Height:**		0.20
Material:	Cast-in-place concrete		**Count:**		2
Element Type:			**Total Quantity:**		110.60
Environment:	Severe		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	97.60	13.00	0.00

Comments:

Medium cracks and light scaling noted.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 132**

ELEMENT DATA

Element Group:	Retaining Walls		**Length:**		334.90
Element Name:	Walls		**Width:**		0.00
Location:			**Height:**		2.57
Material:	Cast-in-Place Concrete		**Count:**		1
Element Type:	Reinforced Concrete		**Total Quantity:**		860.70
Environment:	Moderate		**Limited Inspection:**		☐
Protection System					

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.00	528.90	220.00	111.80

Comments:

Horizontal and vertical medium to wide cracks. Extensive severe delamination and spalls with exposed corroded rebar. Light to severe scaling, honeycombing and wet areas throughout. Large holes in north west wall. Heavy vergetation growth on south west.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab ☑ Replace ☑ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE

Structure ID: 132

Structure Name: Lorne Bridge-Girder
Structure Number: 132

Element Group	Element Name	Sub-Element	Unit (Qty.)	Total Element Qty.	Element Qty. in Excellent Condition (1.00)	Element Qty. in Good Condition (0.75)	Element Qty. in Fair Condition (0.4)	Element Qty. in Poor Condition (0)	Element Condition Index	Estimated Life Span	Estimated Remaining Service Life (ERSL)*	Performance Deficiency**	Maintenance Need**
Abutment	Abutment Walls	East Abutment	Sq.m	31.00	0.00	21.40	8.10	1.50	62	40	25	00	00
	Abutment Walls	West Abutment	Sq.m	141.30	0.00	117.10	18.10	6.10	67	40	27	00	00
	Ballast Walls		Sq.m	53.90	0.00	47.40	5.50	1.00	70	40	28	00	00
	Bearings		Each	14.00	0.00	14.00	0.00	0.00	75	35	26	00	00
	Wingwalls		Sq.m	18.80	0.00	16.70	2.10	0.00	71	40	28	00	00
Accessories	Utilities		Each	2.00	0.00	0.00	2.00	0.00	N/A	N/A	N/A	00	00
	Utilities		Each	2.00	0.00	2.00	0.00	0.00	N/A	N/A	N/A	00	18
Approaches	Approach Slabs		Sq.m	223.20	0.00	208.20	15.00	0.00	73	25	18	00	00
	Wearing Surface		Sq.m	113.46	0.00	68.46	30.00	15.00	56	15	8	00	00
	Sidewalks and Medians		Sq.m	67.70	0.00	62.70	4.00	1.00	72	35	25	00	00
Barrier	Barrier/Parapet Walls	Exterior	Sq.m	20.60	0.00	14.10	6.00	0.50	63	35	22	00	00
	Barrier/Parapet Walls	Interior	Sq.m	28.80	0.00	22.70	5.70	0.40	67	35	23	00	00
	Hand Railings		m	41.10	0.00	35.10	5.00	1.00	69	35	24	00	00
	Railing Systems		m	54.30	0.00	44.30	5.00	5.00	65	35	23	00	00
Beams/ MLEs	Girders	Ends	Sq.m	89.70	0.00	86.70	2.00	1.00	73	50	37	00	00
	Girders	Middle	Sq.m	363.00	0.00	360.50	1.50	1.00	75	50	37	00	00
	Diaphragms		Sq.m	18.70	0.00	18.70	0.00	0.00	N/A	50	N/A	00	00
Coatings	Railing Systems/Hand Railings		Sq.m	24.70	0.00	20.70	3.00	1.00	68	35	24	00	00
	Railing Systems/Hand Railings		Sq.m	58.10	0.00	50.10	6.00	2.00	69	35	24	00	00
Deck	Deck Top		Sq.m	369.70	0.00	324.20	43.00	2.50	70	25	18	00	00
	Soffit - Thin Slab		Sq.m	62.60	0.00	51.60	8.00	3.00	67	50	33	00	00
	Soffit - Thin Slab		Sq.m	45.80	0.00	32.80	10.00	3.00	62	50	31	00	00
	Soffit - Thin Slab		Sq.m	202.70	0.00	197.10	3.80	1.80	74	50	37	00	00
	Wearing Surface		Sq.m	369.70	0.00	304.70	45.00	20.00	67	15	10	00	00
Joints	Armouring/Retaining Devices		m	74.60	0.00	57.60	10.00	7.00	63	25	16	00	00
	Concrete End Dams		Sq.m	22.40	0.00	12.40	5.00	5.00	50	25	13	00	00
	Seals/Sealants		Each	2.00	0.00	0.00	1.00	1.00	N/A	25	N/A	00	00
Embankments and Streams	Embankments		Each	2.00	0.00	2.00	0.00	0.00	N/A	N/A	N/A	00	00
Foundations	Foundation (Below ground level)		N/A	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	00	00
Sidewalks / Curbs	Sidewalks and Medians	Sidewalks	Sq.m	110.60	0.00	97.60	13.00	0.00	71	35	25	00	00
Retaining Walls	Walls		Sq.m	860.70	0.00	528.90	220.00	111.80	56	40	23	00	00

Conditon Index 63.7

** OSIM codes

01 North elevation

02 South elevation

03 Deck, looking east

04 Deck, looking west

05 Numerous longitudinal and transverse cracks on deck wearing surface

06 Potholes on wearing surface near east expansion joint

07 East expansion joint

08 West expansion joint

09 Spall on east expansion joint end dam

10 North fascia

11 South fascia

12 Vertical crack on north fascia

13 Sign on north fascia

14 Typical soffit

15 South exterior soffit

16 North exterior soffit

17 Cracks and delamination on north exterior soffit at east end

18 Delamination on north exterior soffit

19 Delamination on north exterior soffit

20 Spalls and delamination on south exterior soffit

21 Delamination on south exterior soffit

22 Board covering suspected spall

23 North exterior girder

24 Typical girders

25 Delamination on south exterior girder end

26 Spall on south exterior girder end at west end

27 Vertical cracks on exter girder ends at north east

28 Typical west diaphragm

29 East abutment

30 West abutment

31 Spall with exposed rebar on west abutment

32 Narrow crack on west abutment

33 Minor spall on west abutment

34 Vertical crack on west abutment

35 Delamination on west abutment at north side

36 Crack on concrete pedestal on west abutment at south end

37 Typical north bearing

38 North east wingwall

39 South east wingwall

40 Pattern crack on south east wingwall

41 North ballast wall

42 Delamination and spall on north ballast wall

43 East retaining wall section north of bridge

44 East retaining wall section south of bridge

45 East Retaining wall section under bridge

46 West retaining wall section south of bridge

47 Typical section loss with exposed rebar on east retaining wall

48 Typical section loss with exposed rebar on east retaining wall

49 Typical section loss with exposed rebar on east retaining wall

50 Typical section loss with exposed rebar on west retaining wall

51 Cracks and spalls on east retaining wall on section south of bridge

52 Section loss on east retaining wall

53 South sidewalk

55 Transverse crack on north sidewalk (1)

55 Transverse crack on north sidewalk (2)

56 South barrier wall

57 North barrier wall

58 Spall on south barrier wall

59 South barrier railing system

60 North barrier railing system

61 Impact damage on south handrailing at west end

62 South east guiderail

63 North railing

64 South Railing

65 East approach

66 East approach slab

67 West approach slab

68 Cracks at joint between east approach slab and approach

69 Potholes on end dam of east expansion joint

70 Pothole on east approach slab next to expansion joint

71 Cracks on west approach slab

72 Longitudinal and transverse cracks on east approach slab

73 Exposed rebar on north concrete curb

74 South east embankment

75 Utilites on girder

76 Sign on bridge

77 Plaque on Bridge

78 Plaque on bridge

79 Plaque on Bridge


80 Chain link fence at south side

81 Chain link fence at north east end

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 117**

SUMMARY ACTION REPORT

ADDITIONAL INVESTIGATIONS	Priority	Inspection Date
Investigations, Inspections, Surveys Recommended		
Biennial OSIM	Normal	17-Dec-2021

REPAIR AND REHABILITATION REQUIRED	Priority		Comments
Repair and Rehabilitation Required	**6-10 Years**	**1 - 5 Years**	
Barrel	X		Rehabilitate

MAINTENANCE NEEDS	Priority		
Maintenance Needs	**2 Years**	**1 Year**	**Urgent**
Utilities - Other - Fix lighting covers	X		
Inlet Components - Repair Bridge Concrete - Fix isolated concrete spall	X		
Retaining Walls - Repair Bridge Concrete - Seal cracks	X		
Wearing Surface - Rout and Seal - Seal cracks on wearing surface	X		

INVENTORY DATA:

Structure Name	Lorne Bridge Pedestrian Underpass		
Under Structure:	☐ Navigable Water ☐ Non-Navigable Water ☐ Rail ☐ Road ☑ Pedestrian ☐ Other		
Main Hwy/Road #			
On Structure:	☐ Rail ☑ Road ☐ Pedestrian ☐ Other		
Road Name:	Colborne Street West		
Structure Location	0.3km south of Brant Avenue		
Latitude	43.136886	Longitude	-80.270774
Owner(s)	City of Brantford	Heritage Designation	☐ Not Cons. ☐ Cons./Not App. ☐ List/Not Desig. ☐ Desig./not List ☐ Desig. & List
MTO Region	Southwestern	Road Class	☐ Freeway ☑ Arterial ☐ Collector ☑ Local
MTO District	-	Posted Speed	50 km/h No. of Lanes 5
Old County	Brant	AADT	27133 % Trucks 25
Geographic Twp.	-	Special Routes	☐ Transit ☐ Truck ☐ School ☐ Bicycle
Structure Type	Rigid Frame, Vertical legs	Detour Length Around Structure	8.00 (km)
Total Deck Length	4.00 (m)	Fill on Structure	2.00 (m)
Overall Str. Width	23.80 (m)	Skew Angle	- (Degrees)
Total Deck Area	95.20 (m2)	Direction of Structure	E - W
Roadway Width	13.60 (m)	No. of Spans	1
Span Lengths	3.00 (m)		

Overall Condition Rating	Fair
Bridge Condition Index (BCI)	69.0

HISTORICAL DATA

Year Built	1980	Last OSIM Inspection	8/16/2017
Year of Last Major Rehab.	-	Last Enhanced OSIM Inspection	-
Current Load Limit	- (tonnes)	Last Bridge Master Inspection	-
Load Limit By-Law #	-	Last Evaluation	-
By-Law Expiry Date	-	Last Underwater Inspection	-
Min. Vertical Clearance	- (m)	Last Condition Survey	-

Rehabilitation History: (Date / Description)

BRIDGE **Structure ID: 117**

Scheduled Improvements:	
Regional Priority Number _____	Programmed Work Year _____
Nature of Program Work:	

Appraisal Indices:		**Comments**
Fatigue		
Seismic		
Scour		
Flood		
Geometrics		
Barrier		
Curb		
Load Capacity		

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 117**

FIELD INSPECTION INFORMATION			
Date of Inspection:	17-Dec-2019	Type of Inspection:	☑ OSIM ☐ Enhanced OSIM
Inspector:	Sabrina Dexter, Transportation Structures Engineer		
Others in Party:	Akhilesh Prabhu, Transportation Structures Intern		
Access Equipment Used:	Binoculars, sounding hammer, measuring tape, digital camera		
Weather:	Overcast		
Temperature:	-3°C		

ADDITIONAL INVESTIGATION REQUIRED	Priority			Estimated Cost
	None	Normal	Urgent	
Rehabilitation/Replacement Study:				$ -
Material Condition Survey				$ -
Detailed Deck Condition Survey:				$ -
Non-destructive Delamination Survey of Asphalt- Covered Deck:				$ -
Concrete Substructure Condition Survey:				$ -
Detailed Coating Condition Survey:				$ -
Detailed Timber Investigation:				$ -
Underwater Investigation:				$ -
Fatigue Investigation:				$ -
Seismic Investigation:				$ -
Structure Evaluation:				$ -
Monitoring				$ -
Monitoring of Deformations, Settlement and Movements:				$ -
Monitoring Crack Widths:				$ -
Load Posting – Estimated Load Limit			**Total Cost**	$ -
Investigation Notes:				

OVERALL STRUCTURAL NOTES:	
Recommended Work on Structure:	☐ None ☑ Minor Rehab. ☐ Major Rehab. ☐ Replace
Timing of Recommended Work:	☐ 1 to 5 Years ☑ 6 to 10 Years
Overall Comments:	
Overall the structure is in good to fair condition, with lighting covers that need fixing; wide sealed and unsealed cracks on the wearing surface; spalls on the interior and exterior faces of the barrier walls; missing seals, light to medium spalls and leakage at joints; and disintegration of concrete on south headwall. Minor rehabilitation is recommended in 6-10 years.	
Date of Next Inspection:	17-Dec-2021

Suspected Performance Deficiencies

00 None
01 Load carrying capacity
02 Excessive deformations (deflections & rotation)
03 Continuing settlement
04 Continuing movements
05 Seized bearings
06 Bearing not uniformly loaded/unstable
07 Jammed expansion joint
08 Pedestrian/vehicular hazard
09 Rough riding surface
10 Surface ponding
11 Deck drainage
12 Slippery surfaces
13 Flooding/channel blockage
14 Undermining of foundation
15 Unstable embankments
16 Other

Maintenance Needs

01 Lift and swing bridge maintenance
02 Bridge cleaning
03 Bridge handrail maintenance
04 Painting steel bridge structures
05 Bridge deck joint repair
06 Bridge bearing maintenance
07 Repair of structural steel
08 Repair of bridge concrete
09 Repair of bridge timber
10 Bailey bridges maintenance
11 Animal/pest control
12 Bridge surface repair
13 Erosion control at bridges
14 Concrete sealing
15 Rout and seal
16 Bridge deck drainage
17 Scaling (loose Concrete or ACR Steel)
18 Other

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Accessories		**Length:**		0.00
Element Name:	Utilities		**Width:**		0.00
Location:	On Soffit		**Height:**		0.00
Material:			**Count:**		4
Element Type:	Lighting		**Total Quantity:**		4.0
Environment:	Benign		**Limited Inspection:**		☐
Protection System					
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.0	0.0	1.0	3.0

Comments:
3 of 4 lighting cover broken. Replace the lighting covers.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☑ 2 Years
18 Other

Element Group:	Deck		**Length:**		3.10
Element Name:	Wearing Surface		**Width:**		13.60
Location:	Top Surface of Road		**Height:**		0.00
Material:	Asphalt		**Count:**		1
Element Type:			**Total Quantity:**		42.1
Environment:	Severe		**Limited Inspection:**		☐
Protection System	None				
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Sq.m	0.0	26.7	10.0	5.4

Comments:
Wide sealed and unsealed longitudinal and transverse cracks. Medium alligator cracks on north lane. Light segregation at barriers. Potholes noted.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☑ 2 Years
15 Rout and seal

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Barrier	**Length:**	3.10
Element Name:	Barrier/Parapet Walls	**Width:**	0.00
Location:	Exterior	**Height:**	0.60
Material:	Cast-in-place concrete	**Count:**	2
Element Type:	Parapet Wall	**Total Quantity:**	3.7
Environment:	Severe	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	1.1	2.0	0.6

Comments:
Medium vertical cracks with moisture. Severe spall at SE.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Barrier	**Length:**	3.00
Element Name:	Barrier/Parapet Walls	**Width:**	0.25
Location:	Interior	**Height:**	0.60
Material:	Cast-in-place concrete	**Count:**	2
Element Type:	Parapet Wall	**Total Quantity:**	5.1
Environment:	Severe	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	2.1	2.0	1.0

Comments:
Medium vertical cracks with moisture. Severe spall at SE.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Barrier	**Length:**	0.13
Element Name:	Posts	**Width:**	0.13
Location:		**Height:**	0.50
Material:	Steel	**Count:**	8
Element Type:	Steel Post	**Total Quantity:**	8.0
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.0	8.0	0.0	0.0

Comments:
Light corrosion.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Barrier	**Length:**	2.45
Element Name:	Hand Railings	**Width:**	0.00
Location:	On top of Parapet Wall	**Height:**	0.00
Material:	Steel	**Count:**	3
Element Type:	Twin Pipe Hand Rail	**Total Quantity:**	7.3
Environment:	Moderate	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.0	5.8	1.0	0.5

Comments:
Light staining on bottom rail. Impact damage at north west.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Barrier	**Length:**	3.10
Element Name:	Railing Systems	**Width:**	0.00
Location:	At four corners	**Height:**	0.00
Material:	Steel	**Count:**	2
Element Type:	Steel Beam on Steel Post	**Total Quantity:**	6.2
Environment:	Moderate	**Limited Inspection:**	☐
Protection System	Hot dip galvanizing		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m	0.0	6.2	0.0	0.0

Comments:
Light staining of bottom rail. Minor dents in spindles.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Culvert	**Length:**	23.80
Element Name:	Barrel	**Width:**	3.05
Location:	Soffit + Wall	**Height:**	2.40
Material:	Precast Concrete	**Count:**	1
Element Type:	Box	**Total Quantity:**	259.4
Environment:	Benign	**Limited Inspection:**	☐
Protection System	None		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	231.4	16.0	12.0

Comments:
Joint seals missing or in poor condition leading to leakage and rust staining. Light to medium spalling at joints. Bottom covered in asphalt with transverse cracks.

Performance Deficiencies: 00 None

Recommended Work: ☑ Rehab. ☐ Replace ☐ 1 - 5 Years ☑ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Culvert	**Length:**	3.00
Element Name:	Outlet Components	**Width:**	0.00
Location:	North Headwall	**Height:**	0.95
Material:	Cast-in-place concrete	**Count:**	1
Element Type:	-	**Total Quantity:**	2.9
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	1.9	1.0	0.0

Comments:
Narrow-medium vertical cracks. Light disintegration at edges.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Culvert	**Length:**	3.00
Element Name:	Inlet Components	**Width:**	0.00
Location:	South Headwall	**Height:**	0.95
Material:	Cast-in-place concrete	**Count:**	1
Element Type:	-	**Total Quantity:**	2.9
Environment:	Benign	**Limited Inspection:**	☐
Protection System	None		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	0.9	1.0	1.0

Comments:
Narrow-medium vertical cracks. Light disintegration at edges. Spalling and disintegration on south headwall.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☑ 2 Years
08 Repair of bridge concrete

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Embankments and Streams	**Length:**	-
Element Name:	Embankments	**Width:**	-
Location:	NE, NW, SE & SW	**Height:**	-
Material:	Vegetation	**Count:**	4
Element Type:		**Total Quantity:**	4.0
Environment:	Benign	**Limited Inspection:**	☐
Protection System	None		

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	Each	0.0	4.0	0.0	0.0

Comments:
Stable and vegetated.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

Element Group:	Retaining Walls	**Length:**	14.60
Element Name:	Barrier Systems on Walls	**Width:**	0.00
Location:		**Height:**	0.00
Material:	Steel	**Count:**	2
Element Type:	Steel Post and Lattice	**Total Quantity:**	29.2
Environment:	Benign	**Limited Inspection:**	☐
Protection System			

Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	All	0.0	29.2	0.0	0.0

Comments:
Light corrosion.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

BRIDGE **Structure ID: 117**

ELEMENT DATA

Element Group:	Foundations		**Length:**		
Element Name:	Foundation (Below ground level)		**Width:**		
Location:			**Height:**		
Material:			**Count:**		
Element Type:			**Total Quantity:**		0.0
Environment:			**Limited Inspection:**		☐
Protection System	None				
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	N/A	0.0	0.0	0.0	0.0

Comments:

No sign of defects during the inspection.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years
00 None

Element Group:	Retaining Walls		**Length:**		5.80
Element Name:	Walls		**Width:**		0.00
Location:	At four corners		**Height:**		2.05
Material:	Cast-in-place Concrete		**Count:**		4
Element Type:			**Total Quantity:**		47.6
Environment:	Moderate		**Limited Inspection:**		☐
Protection System	None				
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	40.6	4.0	3.0

Comments:

Full height medium-wide vertical cracks. Mediumwide diagonal cracks. Walls have been coated. Retaining walls are a separate item to inlet and outlet component because this site is categorized as a bridge.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☑ 2 Years
08 Repair of bridge concrete

BRIDGE **Structure ID: 117**

ELEMENT DATA					
Element Group:	Sidewalks/Curb		**Length:**		3.00
Element Name:	Sidewalks and Medians		**Width:**		1.50
Location:	North and South		**Height:**		0.00
Material:	Cast-in-place Concrete		**Count:**		2
Element Type:			**Total Quantity:**		9.0
Environment:	Severe		**Limited Inspection:**		☐
Protection System	None				
Condition Data:	**Units**	**Excellent**	**Good**	**Fair**	**Poor**
	m^2	0.0	6.0	2.0	1.0

Comments:

Medium-wide transverse and longitudinal cracks. New patch noted at utilites.

Performance Deficiencies: 00 None

Recommended Work: ☐ Rehab. ☐ Replace ☐ 1 - 5 Years ☐ 6 - 10 Years

Maintenance Needs: ☐ Urgent ☐ 1 Year ☐ 2 Years 00 None

ONTARIO STRUCTURE INSPECTION MANUAL - INSPECTION FORM

BRIDGE **Structure ID: 117**

Structure Name: Lorne Bridge Pedestrian Underpass
Structure Number: 117

Element Group	Element Name	Sub-Element	Unit (Qty.)	Total Element Qty.	Element Qty. in Excellent Condition (1.00)	Element Qty. in Good Condition (0.75)	Element Qty. in Fair Condition (0.4)	Element Qty. in Poor Condition (0)	Element Condition Index	Estimated Life Span	Estimated Remaining Service Life (ERSL)*	Performance Deficiency**	Maintenance Need**
Accessories	Utilities		Each	4.0	0.00	0.00	1.00	3.00	N/A	N/A	N/A	00	18
Deck	Wearing Surface		Sq.m	42.1	0.00	26.70	10.00	5.40	57	15	9	00	15
Barrier	Barrier/Parapet Walls	Exterior	Sq.m	3.7	0.00	1.10	2.00	0.60	44	35	15	00	00
	Barrier/Parapet Walls	Interior	Sq.m	5.1	0.00	2.10	2.00	1.00	47	35	16	00	00
	Posts		Each	8.0	0.00	8.00	0.00	0.00	75	35	26	00	00
	Hand Railings		m	7.3	0.00	5.80	1.00	0.50	65	35	23	00	00
	Railing Systems		m	6.2	0.00	6.20	0.00	0.00	75	35	26	00	00
Culvert	Barrel		Sq.m	259.4	0.00	231.40	16.00	12.00	69	100	69	00	00
	Outlet Components		Sq.m	2.9	0.00	1.90	1.00	0.00	63	50	31	00	00
	Inlet Components		Sq.m	2.9	0.00	0.90	1.00	1.00	37	50	19	00	08
Embankments and Streams	Embankments		Each	4.0	0.00	4.00	0.00	0.00	N/A	N/A	N/A	00	00
Foundations	Foundation (Below ground level)		N/A	0.0	0.00	0.00	0.00	0.00	N/A	N/A	N/A	00	00
Retaining Walls	Walls		Sq.m	47.6	0.00	40.60	4.00	3.00	67	40	27	00	08
	Barrier Systems on Walls		m	29.2	0.00	29.20	0.00	0.00	75	40	30	00	00
Sidewalks/Curb	Sidewalks and Medians		Sq.m	9.0	0.00	6.00	2.00	1.00	59	35	21	00	00

Conditon Index 69.0

** OSIM codes

01 North Elevation

02 South elevation

03 Roadway at top of culvert looking south

04 Transverse and longitudinal sealed and unsealed cracks on wearing surface

05 Barrel, looking north

06 Barrel, looking south

07 Typical barrel soffit

08 Barrel east wall

09 Barrel west wall

10 Active leakage of construction joints at south

11 Broken lighting cover on soffit

12 Spall on south face

13 Light to medium spalls on joints and active leakage on soffit

14 Active leakage at construction joint at north end on soffit

15 Poor seal condition on construction joints

16 North east retaining wall

17 North west retaining wall

18 South east retaining wall

19 South west retaining wall

20 Vertical crack on south east retaining wall

21 Vertical crack on south west retaining wall

22 Narrow vertical crack on north west retaining wall

23 North barrier wall

24 Typical narrow vertical cracks on north barrier wall

25 Spall on south barrier wall

26 North barrier railing

27 Impact damage on North barrier railing

28 North Sidewalk

29 Large longitudinal crack on north sidewalk

30 North Railing

31 Chain link fence on north face

32 East approach

33 West approach

34 Potholes and cracks on west approach

35 North east embankment

36 North west embankment

37 South east embankment

38 South west embankment

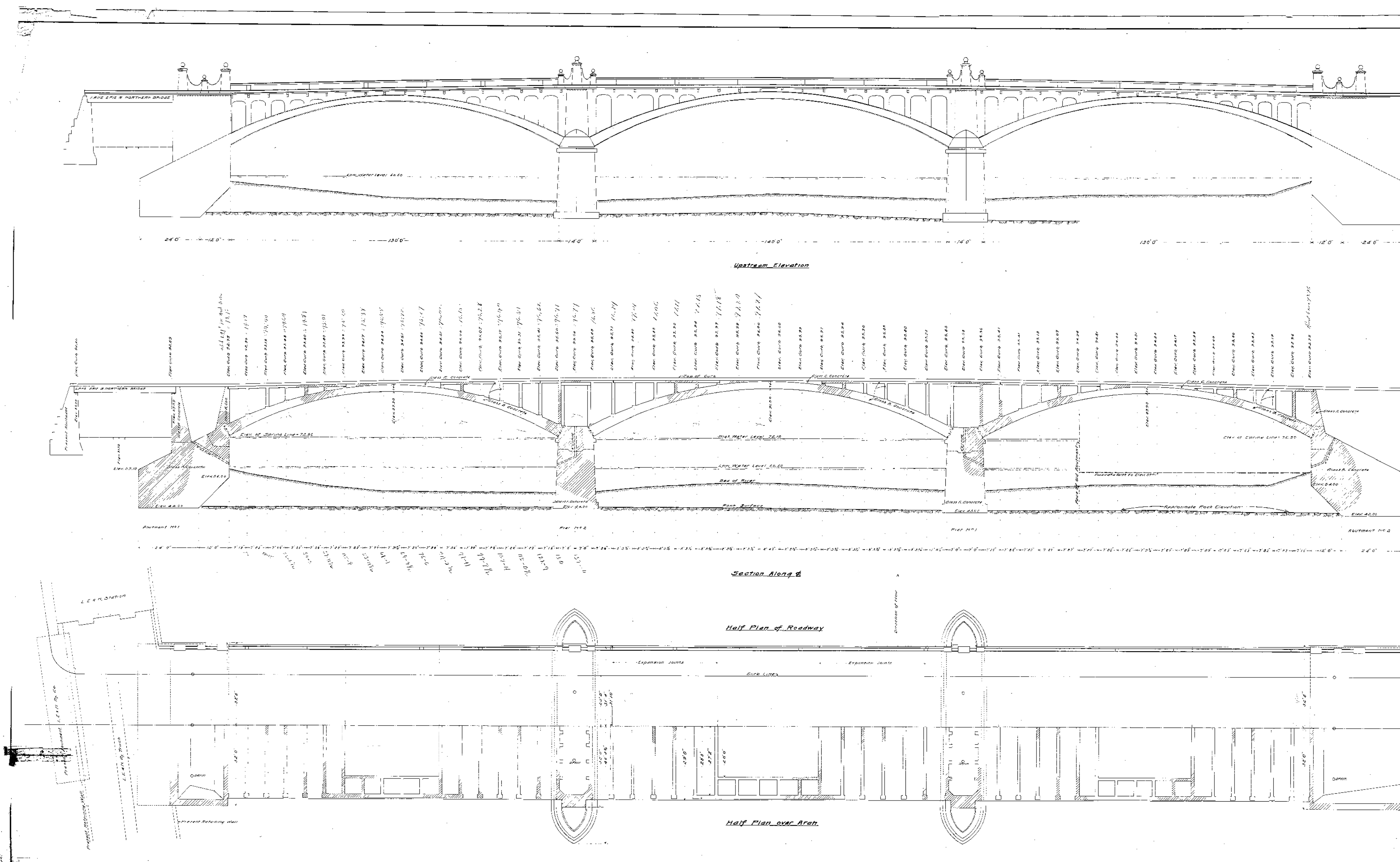
39 Plaque on concrete post

BluePlan ENGINEERING

2021 Structural Evaluation Report

Appendix II

Select Historical Structural Drawings



LORNE BRIDGE
BRANTFORD ONT.
GENERAL ELEVATION, SECTION, AND PLAN.

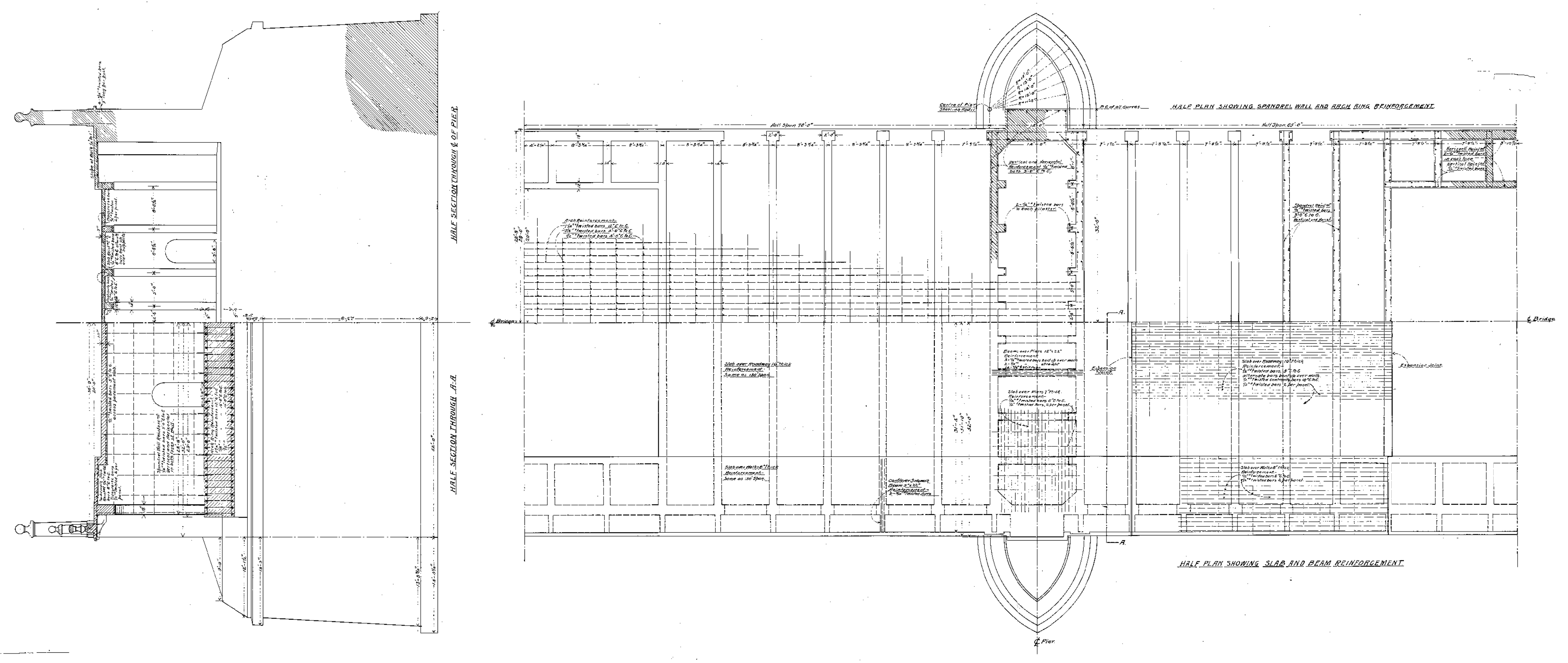
SCALE. 1 IN. = 10 FT.	DATE. Feby 26 1923.

J. P. Adams
CITY ENGINEER

DRAWN BY: E.T. McLaren	No. LB. 5.

FEB X X 1972

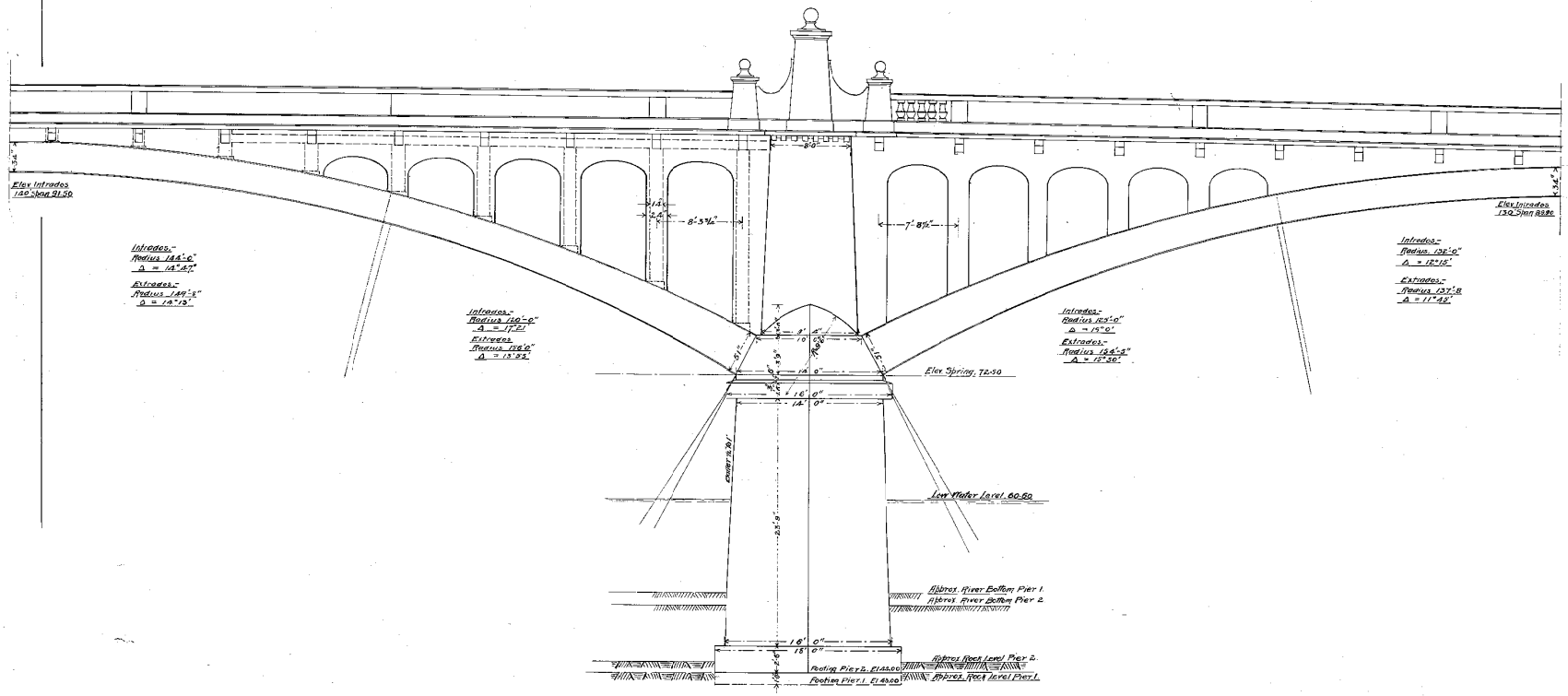
1-533



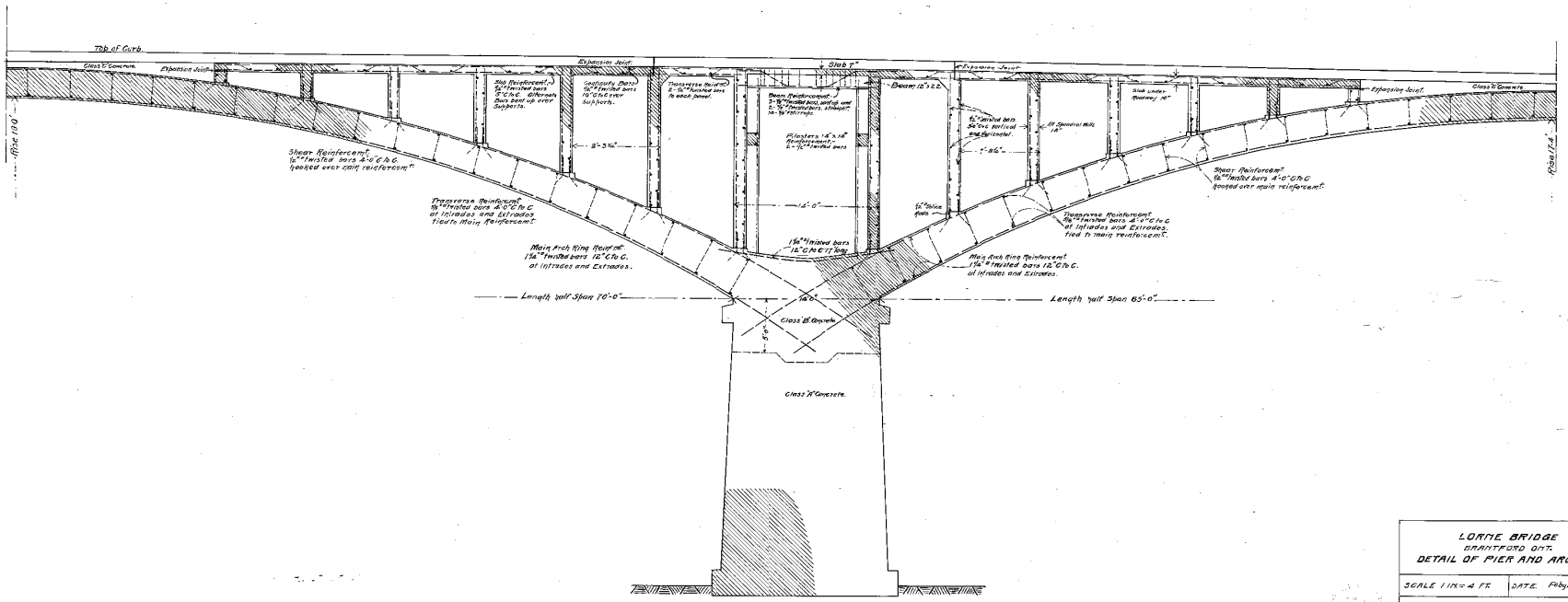
LORNE BRIDGE
BRANTFORD ONT.
DETAIL OF PLAN AND SECTIONS.

SCALE 1 IN. = 4 FT.	DATE. Feby 26. 1923
J. P. Adams. CITY ENGINEER	
DRAWN BY. C. R. Hagey.	No. L. B. 4.

B-68
1-834



ELEVATION OF PIER AND ARCHES.



SECTION THROUGH ℄ OF BRIDGE

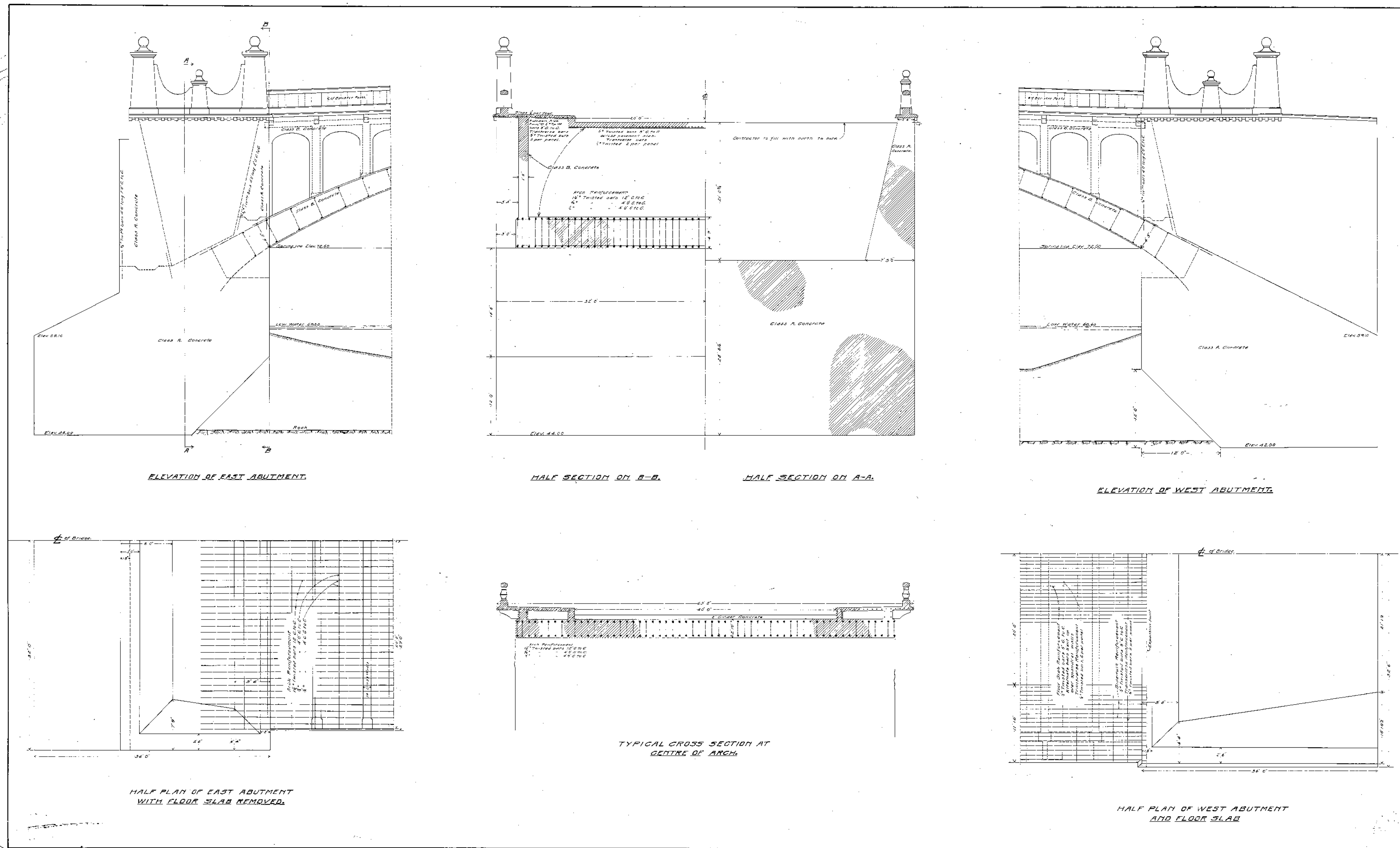
LORNE BRIDGE
BRANTFORD ONT.
DETAIL OF PIER AND ARCHES.

SCALE 1 IN. = 4 FT. | DATE. Feby 20. 1923.

J. P. Adams
CITY ENGINEER.

DRAWN BY. C. A. Hagey. | No. L.B. 5.

1-835



LORNE BRIDGE
BRANTFORD ONT.
DETAIL OF ABUTMENTS AND TYPICAL CROSS SECTION

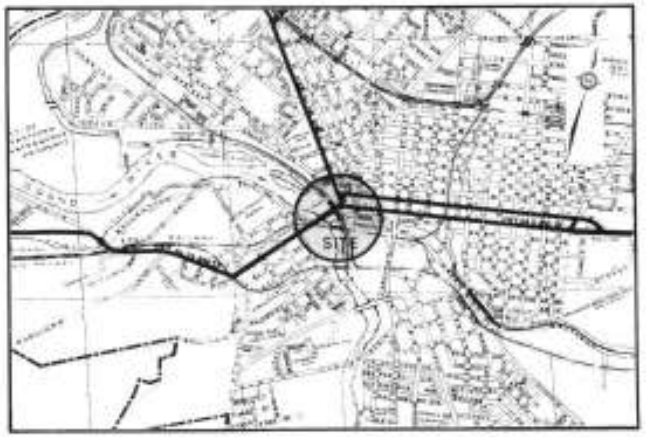
SCALE. 1 IN. = 4 FT.	DATE. Feby 26. 1923
F. P. Adams, CITY ENGINEER	
DRAWN BY E.T. McLaren.	NO. L.B.6.

1-836

B-68

LORNE BRIDGE RECONSTRUCTION

CONTRACT No. 74-I
WORK OF GRADING, DRAINAGE AND GRANULAR BASE, HOT MIX PAVING, STRUCTURES, AND ELECTRICAL WORK
ROAD No. COLBORNE STREET - BRANT AVENUE
HIGHWAY No. NUMBERS 2, 24 AND 53
LOCATION GLADSTONE STREET TO BRANT AVENUE, WEST STREET TO GREENWICH STREET
CITY OF BRANTFORD, ONTARIO
COUNTY OF BRANT
DISTRICT OF HAMILTON (M.T.C. No. 4)

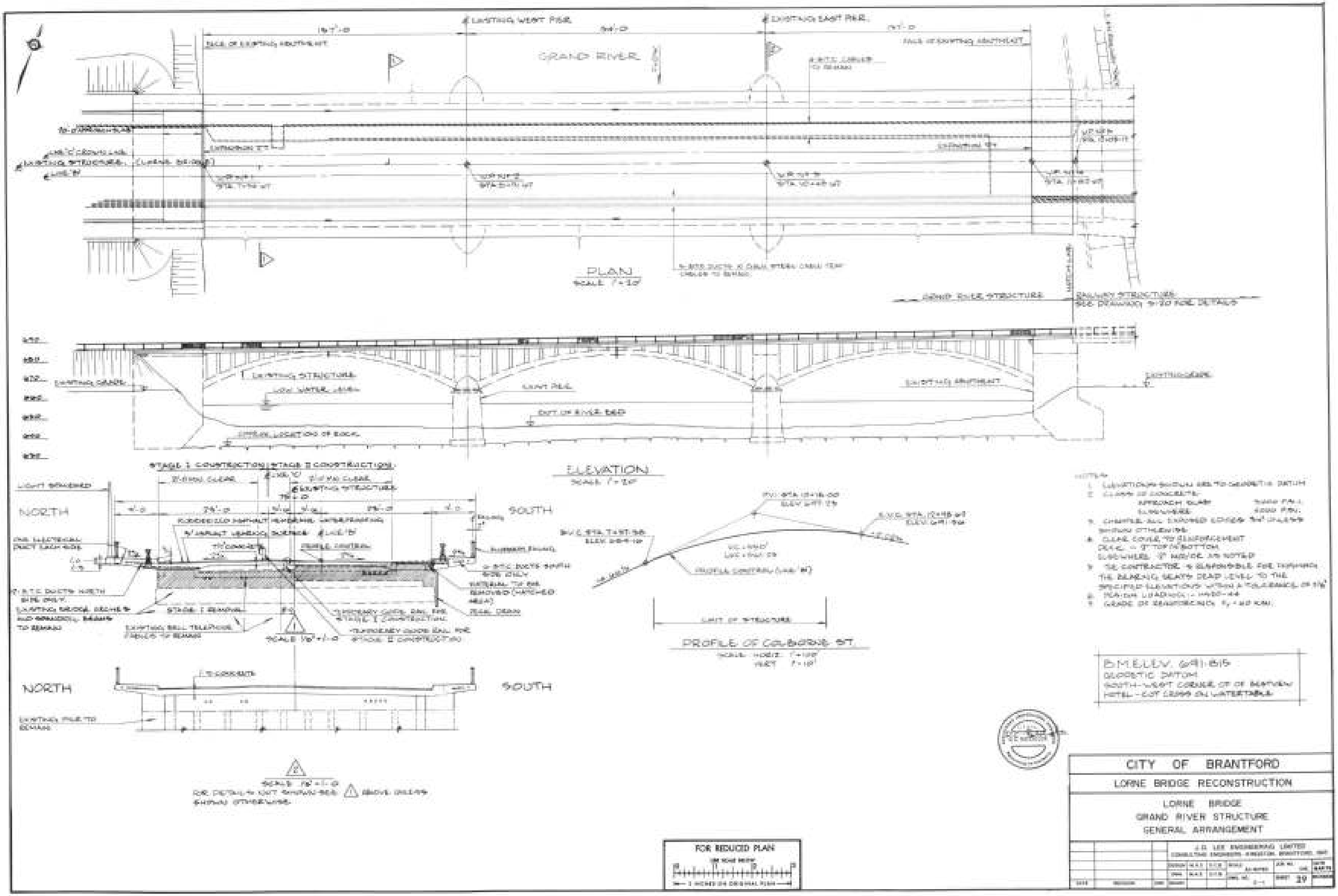


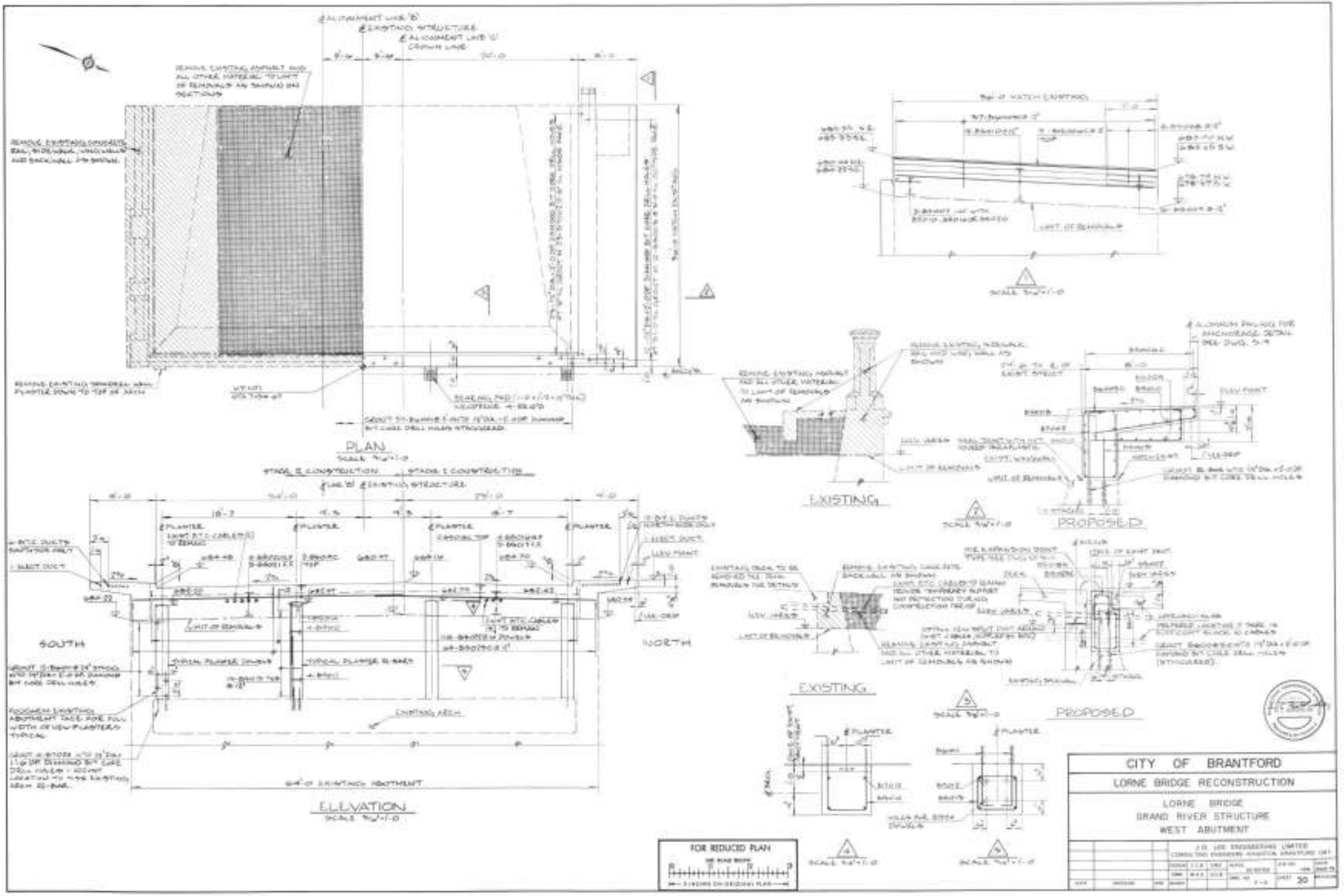
KEY PLAN

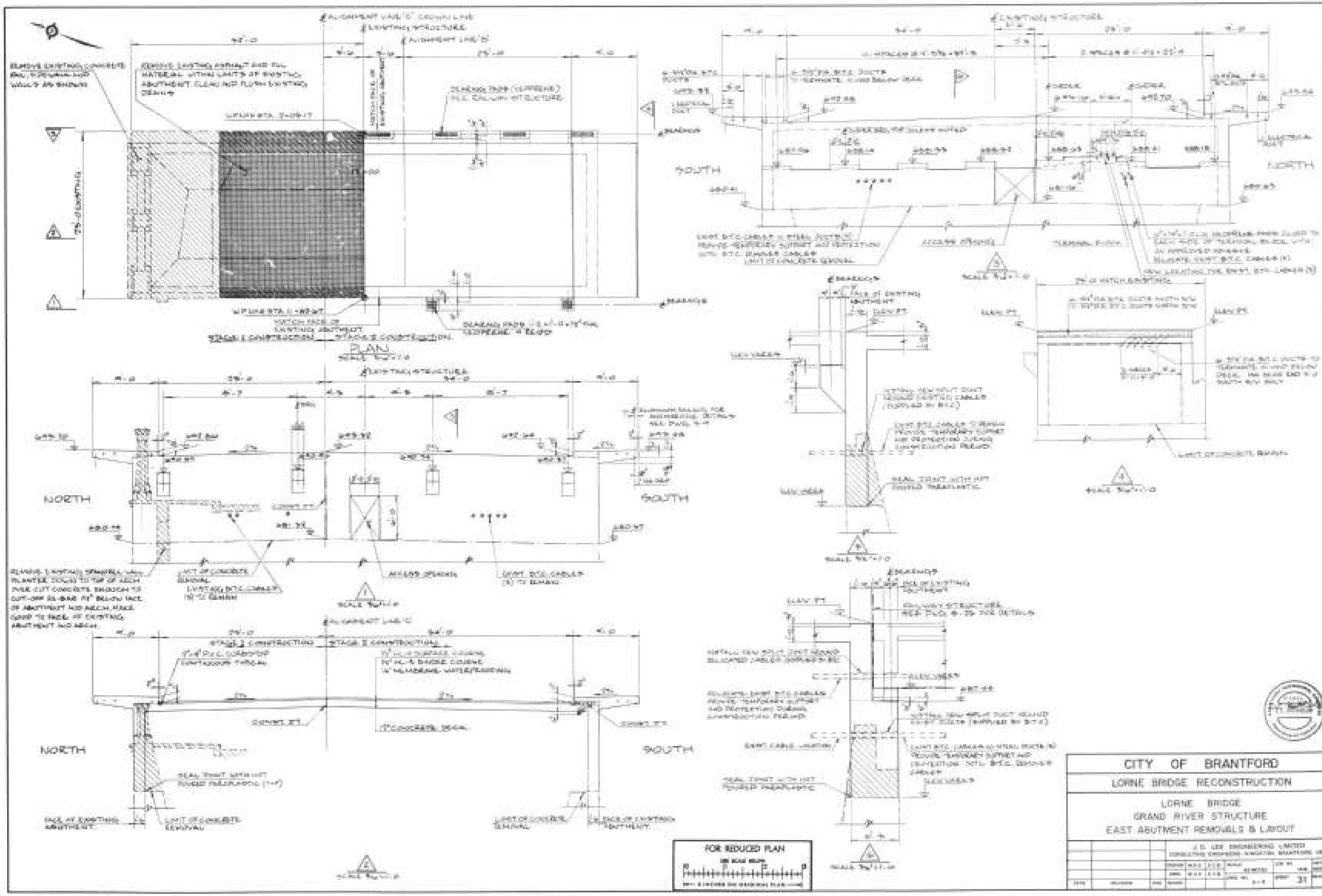
SCALE : 1" = 1600'

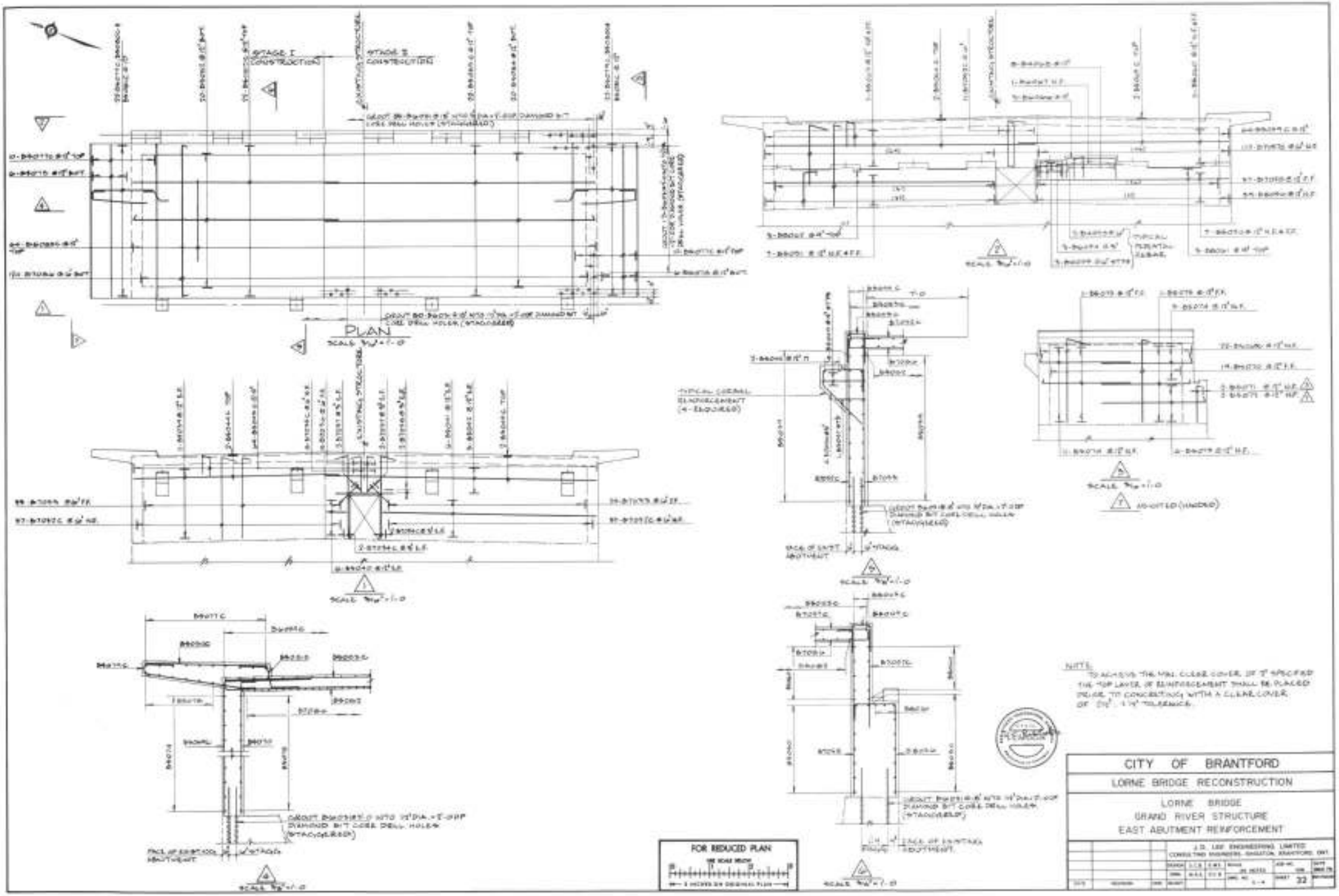
CONTRACT NO. 74-I

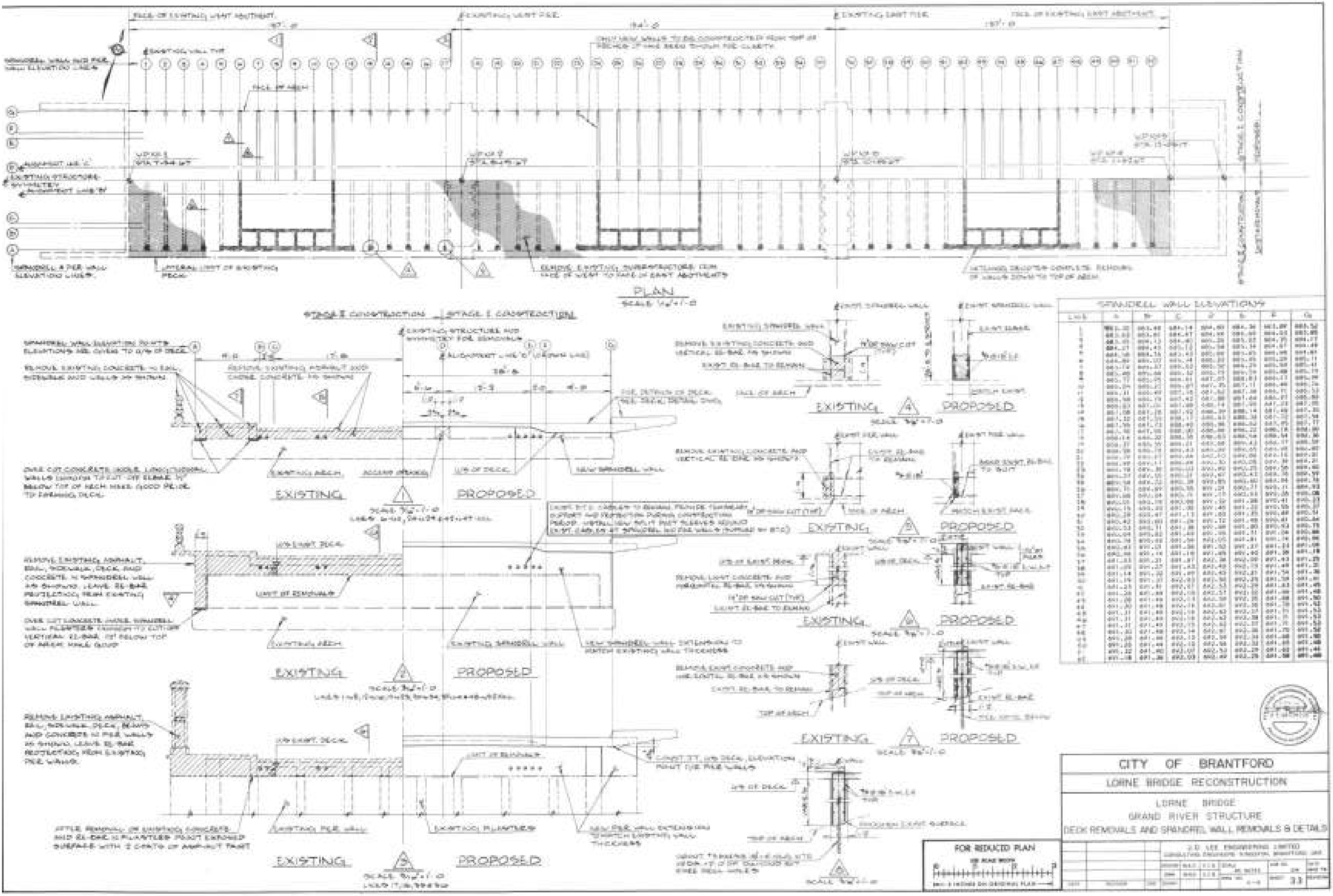
J.D.LEE ENGINEERING LTD.
CONSULTING ENGINEERS
BRANTFORD, KINGSTON, ONTARIO.

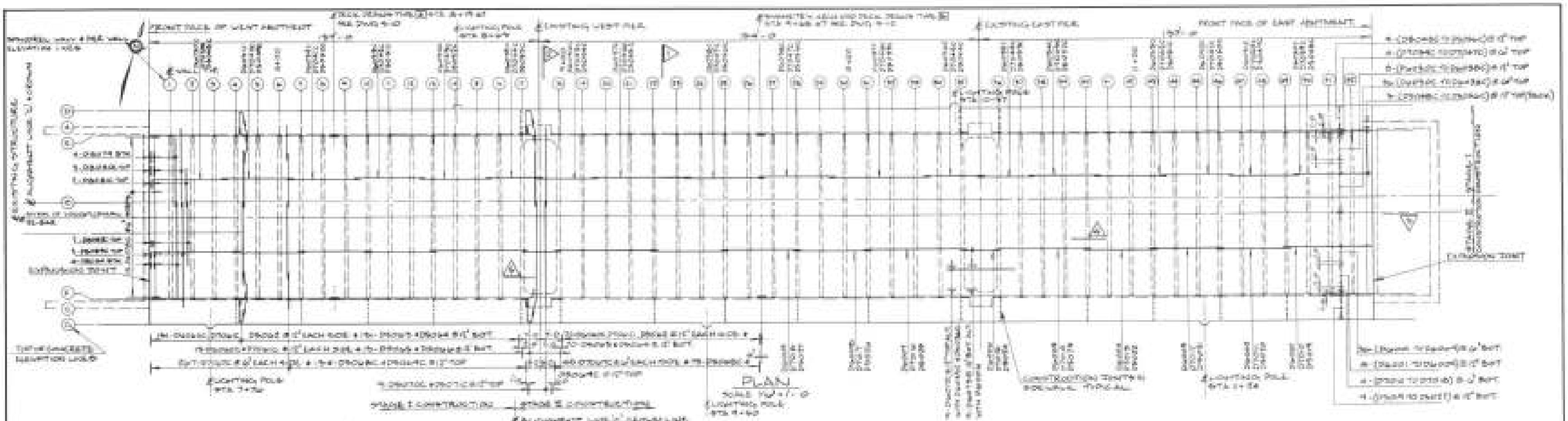

GRAND RIVER
PLAN
SCALE 1"=20'
ELEVATION
SCALE 1"=20'
NORTH
SOUTH
NORTH
SOUTH
PROFILE OF COLBORNE ST.
B.M. ELEV. 691.815
GEODETIC DATUM
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
GRAND RIVER STRUCTURE
GENERAL ARRANGEMENT
FOR REDUCED PLAN

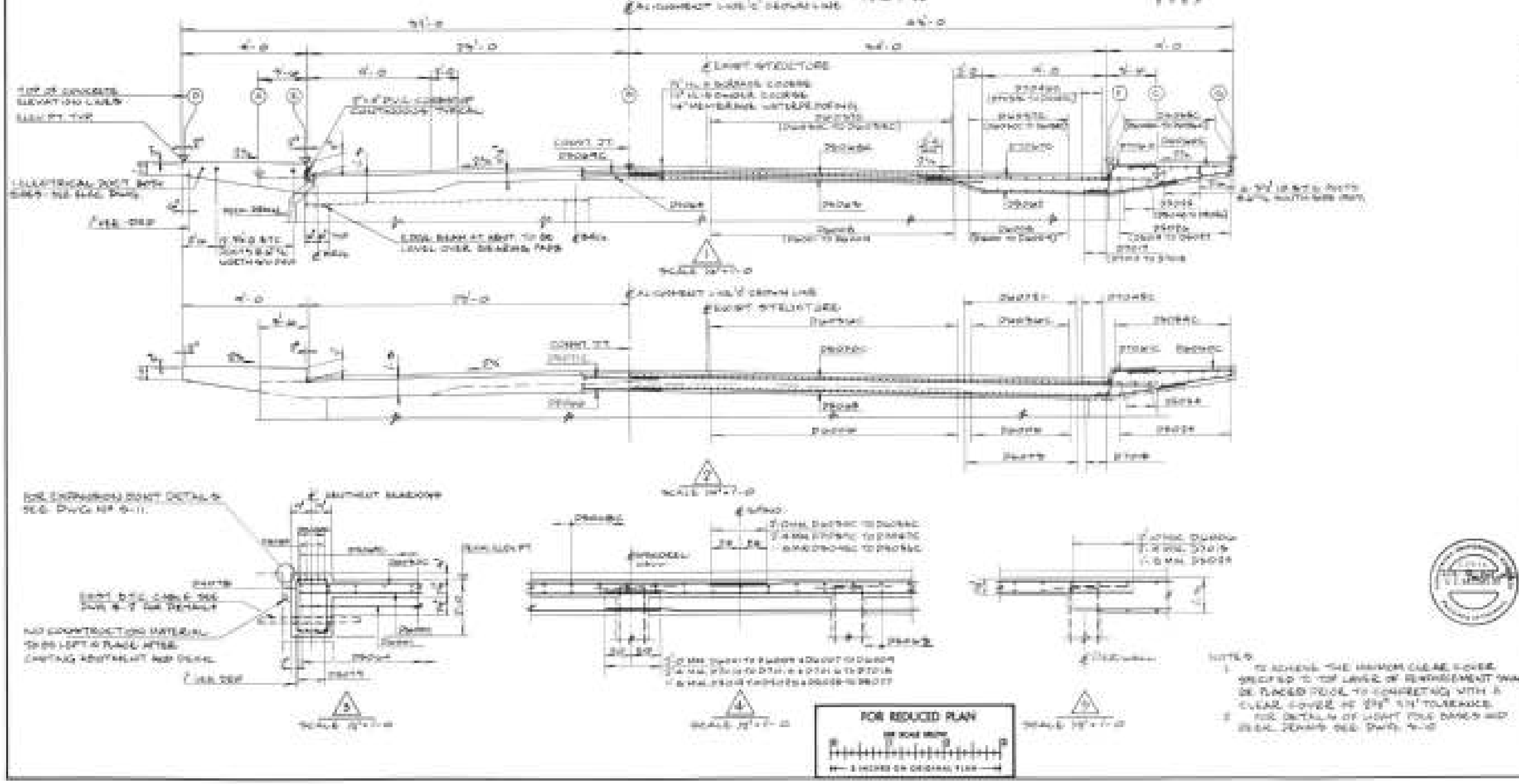

PLAN
SCALE
STAGE 1 CONSTRUCTION
STAGE 2 CONSTRUCTION
SOUTH
NORTH
ELEVATION
SCALE
EXISTING
PROPOSED
EXISTING
PROPOSED
SCALE
SCALE
SCALE
SCALE
FOR REDUCED PLAN
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
GRAND RIVER STRUCTURE
WEST ABUTMENT
J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - MUNICIPAL INFRASTRUCTURE
30


PLAN
NORTH
SOUTH
FOR REDUCED PLAN
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
GRAND RIVER STRUCTURE
EAST ABUTMENT REMOVALS & LAYOUT


PLAN
SCALE
NOTES:
TO ACHIEVE THE MIN. CLEAR COVER OF 3" SPECIFIED THE TOP LAYER OF REINFORCEMENT SHALL BE PLACED SNUG TO CONCRETING WITH A CLEAR COVER OF (3") ± 1/4" TOLERANCE.
FOR REDUCED PLAN
USE SCALE BELOW
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
GRAND RIVER STRUCTURE
EAST ABUTMENT REINFORCEMENT
J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS, BRANTFORD, ONT.
SHEET 32


PLAN
EXISTING
PROPOSED
SPANDREL WALL ELEVATIONS
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
GRAND RIVER STRUCTURE
DECK REMOVALS AND SPANDREL WALL REMOVALS & DETAILS
FOR REDUCED PLAN





SCREED ELEVATIONS

STATION	A	B	C	D	E	F	G
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES:
1. TO ACHIEVE THE MINIMUM CLEAR COVER SPECIFIED TO TOP LAYER OF REINFORCEMENT SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 2⅜" ±¼" TOLERANCE.
2. FOR DETAILS OF LIGHT POLE BASES AND DECK DRAINS SEE DWG S-10

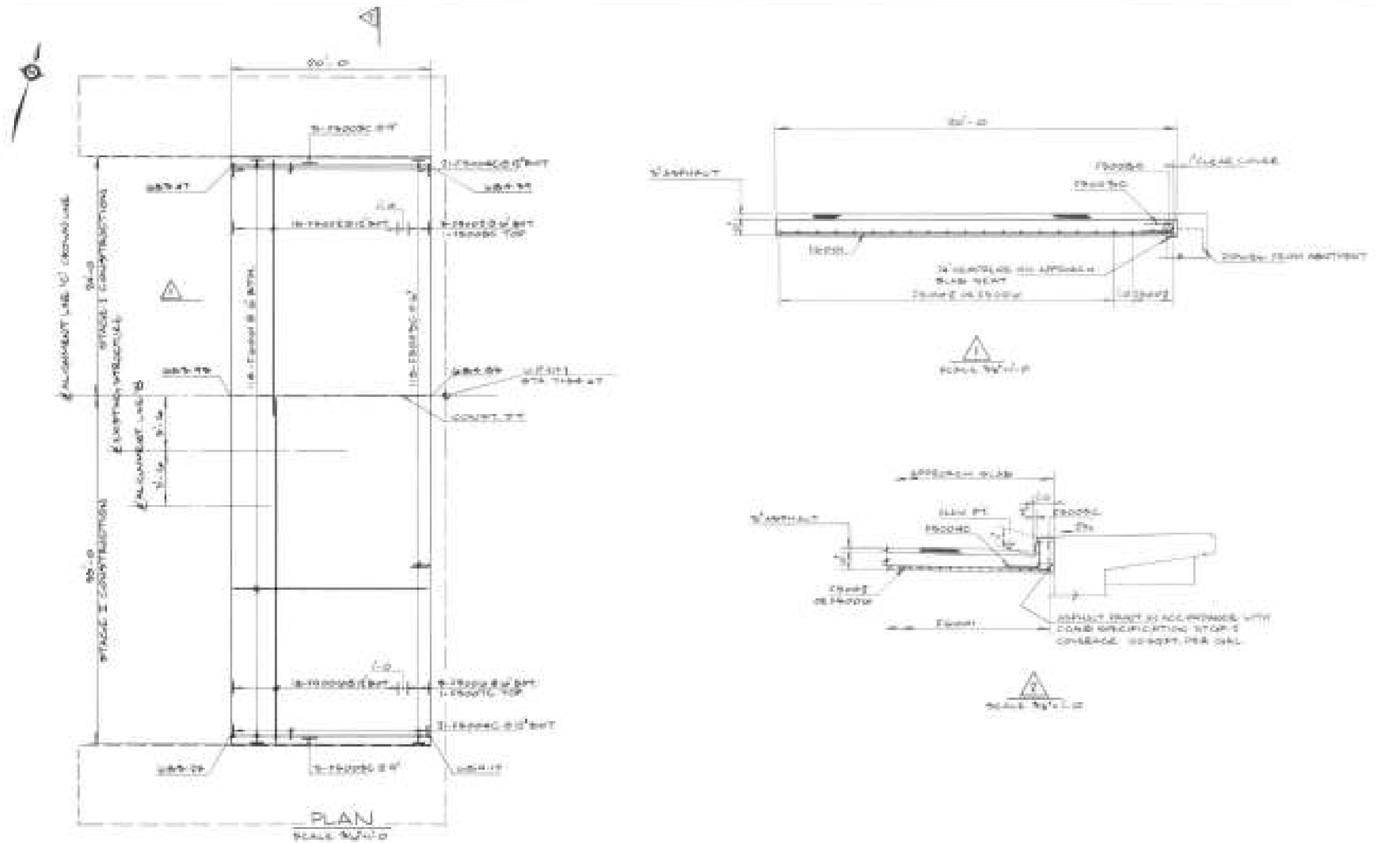
CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE
GRAND RIVER STRUCTURE
DECK LAYOUT AND REINFORCEMENT

J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS, BRANTFORD, ONT.

34



NOTES

1. CLASS OF CONCRETE: [illegible]
2. CLEAR COVER TO REINFORCING 2" EXCEPT AS NOTED
3. ALL ELEVATIONS ARE TO TOP OF CONCRETE

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE
GRAND RIVER STRUCTURE
WEST APPROACH SLAB

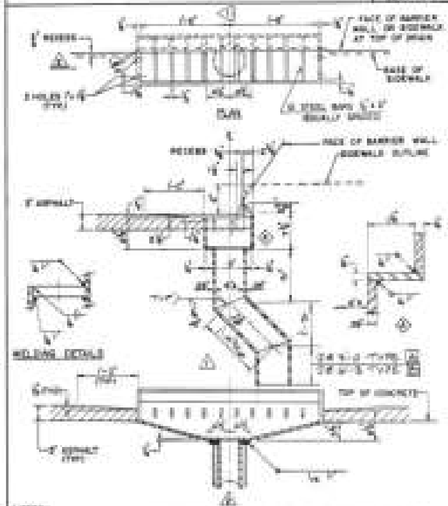
J.D. LEE ENGINEERING LIMITED

FOR REDUCED PLAN

SHEET 36

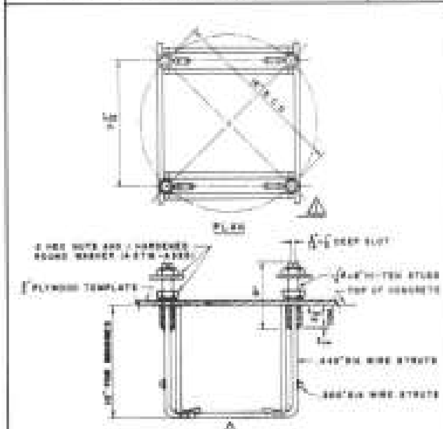
DECK DRAIN DETAILS

SS9-38
SEPT. 1976



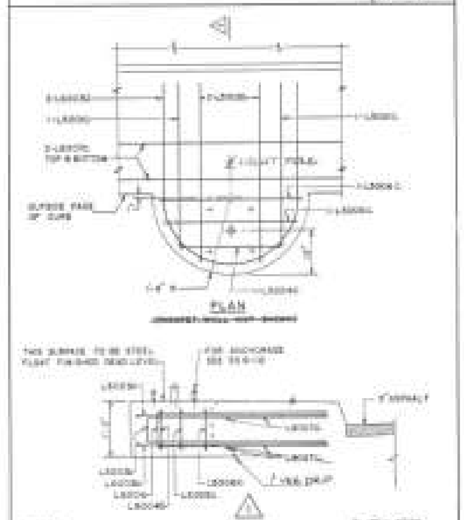
ANCHORAGE FOR LIGHTING POLE
(15" BOLT CIRCLE DIA.)

SS9-10
OCT. 1973



LIGHTING POLE BASE DETAILS - TYPE I

APRIL 1977

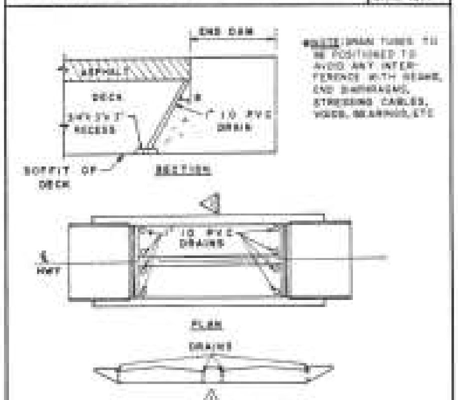


NOTES:

- REINFORCING STEEL FOR ... NOT SHOWN
- 2" CLEAR COVER
- READ IN CONJUNCTION WITH BRIDGE ELECTRICAL DETAILS

DRAINAGE OF ASPHALT WEARING SURFACE

SS9-50
APRIL 1977

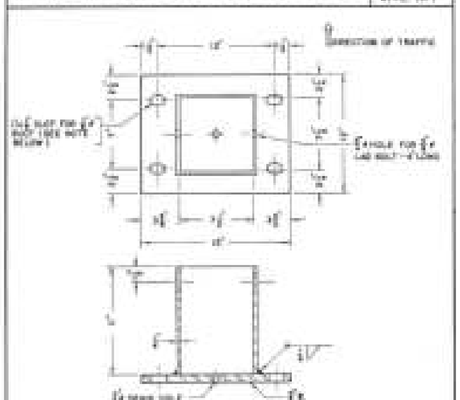


NOTES

- 1 1/2" PVC DRAINAGE TUBES TO BE SUPPLIED AND PLACED BY THE CONTRACTOR. PVC TUBES TO BE RIGID TYPE
- TUBES TO BE PLACED AT ALL LOW POINTS OF THE BRIDGE DECK TO PREVENT PONDING OF WATER, AS SHOWN, AND/OR AS DIRECTED BY THE ENGINEER.
- NO WATERPROOFING COMPOUND SHALL BE ALLOWED TO SEAL THE TUBES PRIOR TO PLACING ASPHALT.

STEEL BASE FOR 6"x6" GUIDE RAIL POSTS

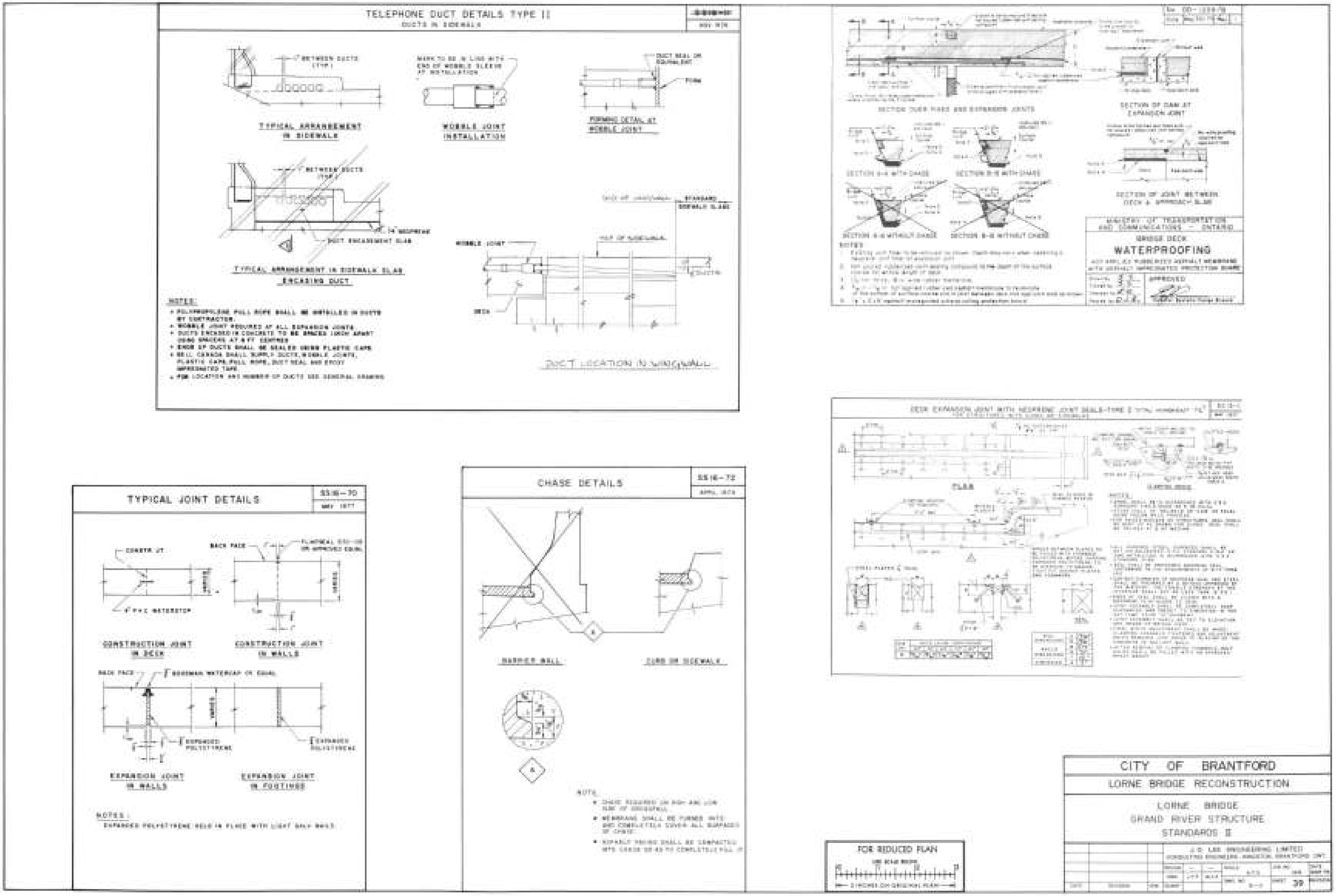
SS10-20
APRIL 1977



TEMPORARY GUIDE RAIL ON STRUCTURES

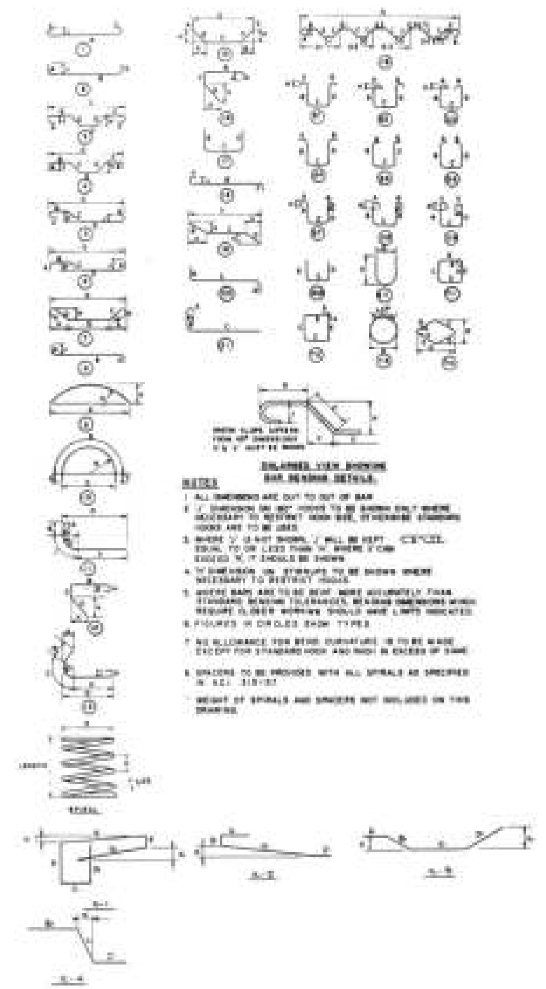
FOR REDUCED PLAN

CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE GRAND RIVER STRUCTURE STANDARDS I
J.D. LEE ENGINEERING LIMITED CONSULTING ENGINEERS
SHEET 38


TELEPHONE DUCT DETAILS TYPE II
DUCTS IN SIDEWALK
TYPICAL ARRANGEMENT IN SIDEWALK
WOBBLE JOINT INSTALLATION
FORMING DETAIL AT WOBBLE JOINT
TYPICAL ARRANGEMENT IN SIDEWALK SLAB ENCASING DUCT
DUCT LOCATION IN WINGWALL
NOTES:
SECTION OVER FIXED AND EXPANSION JOINTS
SECTION OF DAM AT EXPANSION JOINT
SECTION OF JOINT BETWEEN DECK & APPROACH SLAB
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS — ONTARIO
BRIDGE DECK
WATERPROOFING
DECK EXPANSION JOINT WITH NEOPRENE JOINT SEALS
PLAN
TYPICAL JOINT DETAILS
SS16-70
CONSTRUCTION JOINT IN DECK
CONSTRUCTION JOINT IN WALLS
EXPANSION JOINT IN WALLS
EXPANSION JOINT IN FOOTINGS
NOTES:
EXPANDED POLYSTYRENE HELD IN PLACE WITH LIGHT GALV NAILS
CHASE DETAILS
SS16-72
APRIL 1973
BARRIER WALL
CURB OR SIDEWALK
NOTE
FOR REDUCED PLAN
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
GRAND RIVER STRUCTURE
STANDARDS II
J.D. LEE ENGINEERING LIMITED
39

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
					WEST ABUTMENT														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			NOT USED																
[illegible]			NOT USED																
					EAST ABUTMENT														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			NOT USED																

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							DECK												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				NOT USED															
[illegible]				NOT USED															
[illegible]				NOT USED															
[illegible]				NOT USED															
[illegible]				NOT USED															
[illegible]				NOT USED															
[illegible]				NOT USED															
[illegible]				NOT USED															



ENLARGED VIEW SHOWING BAR BENDING DETAILS

NOTES

1. ALL DIMENSIONS ARE OUT TO OUT OF BAR
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. FIGURES IN CIRCLES SHOW TYPES
7. NO ALLOWANCE FOR BEND CURVATURE IS TO BE MADE [illegible]
8. SPACERS TO BE PROVIDED WITH ALL SPIRALS AS SPECIFIED IN A.C.I. [illegible]
9. WEIGHT OF SPIRALS AND SPACERS NOT INCLUDED ON THIS DRAWING

LEGEND
BARS WITH A SUFFIX [illegible] ARE COATED BARS

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

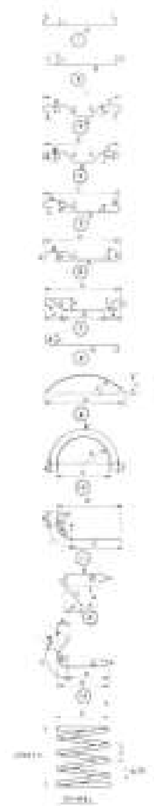
LORNE BRIDGE
GRAND RIVER STRUCTURE
BAR LIST

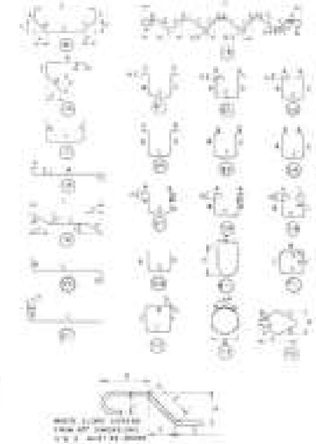
J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS [illegible] BRANTFORD, ONT.

SHEET 40

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
						DECK (CONT'D)													
[illegible]	4	25	46'-6	STR															
[illegible]	4	25	23'-9	STR															
[illegible]	6	25	57'-4	STR															
[illegible]	8	25	54'-0	STR															
					WEST APPROACH SLAB														
[illegible]	116	10	19'-6	STR															
[illegible]	74	15	29'-6	STR															
[illegible]	16	15	[illegible]	10	[illegible]												6"		[illegible]
[illegible]	47	15	5'-0	17		[illegible]													[illegible]
[illegible]	16	15	19'-6	STR															
[illegible]	74	15	32'-10	STR															
[illegible]	1	15	34'-10	STR															
[illegible]	1	15	25'-6	STR															
					LIGHT POLE BASE														
[illegible]	10	15	[illegible]	17		6'-0	[illegible]												
[illegible]	10	15	[illegible]	17		6'-0	[illegible]												
[illegible]	10	20	[illegible]	10	[illegible]												[illegible]		[illegible]
[illegible]	5	15	7'-10	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]								[illegible]
[illegible]	5	15	6'-0	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]								[illegible]
[illegible]	5	15	9'-2	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]								[illegible]
[illegible]	20	25	81'-0	STR															

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE





STANDARD BAR BENDING DETAILS

NOTES

1. ALL DIMENSIONS ARE OUT TO OUT OF BAR

6. FIGURES IN CIRCLES SHOW TYPES

8. SPACERS TO BE PROVIDED WITH ALL SPIRALS AS SPECIFIED IN A.C.I. 315

WEIGHT OF SPIRALS AND SPACERS NOT INCLUDED ON THIS DRAWING.

LEGEND:
BARS WITH A SUFFIX 'E' DENOTE PRE-COATED BARS

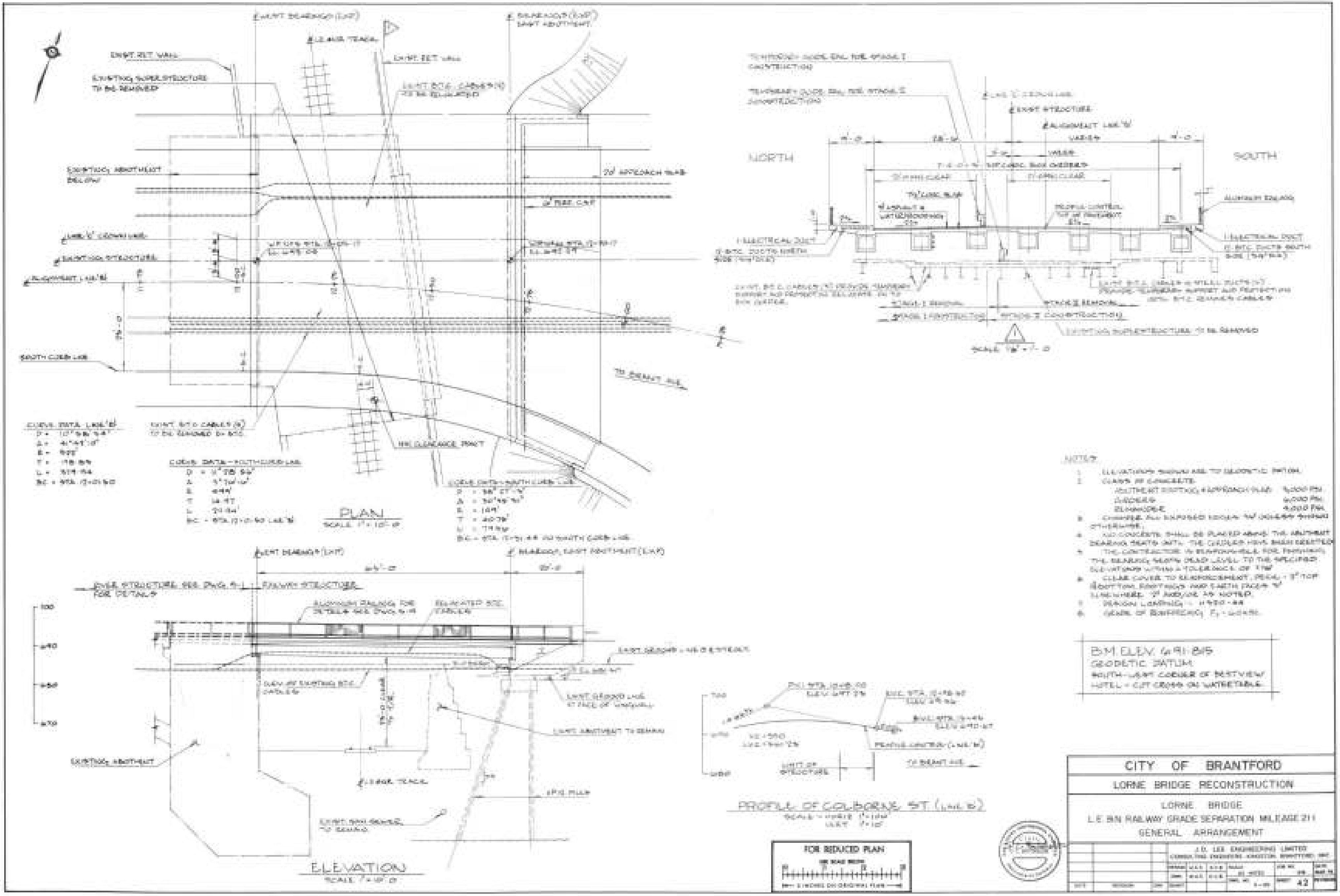
CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

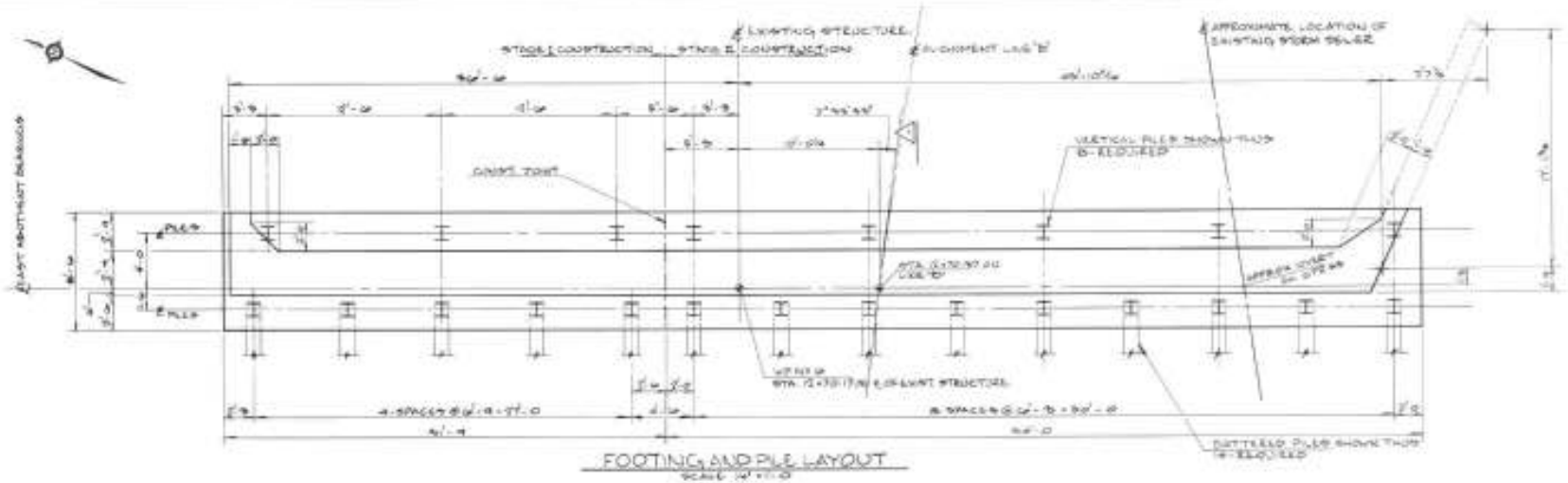
LORNE BRIDGE
GRAND RIVER STRUCTURE
BAR LIST

J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - PLANNERS, BRANTFORD, ONT.

SHEET 41

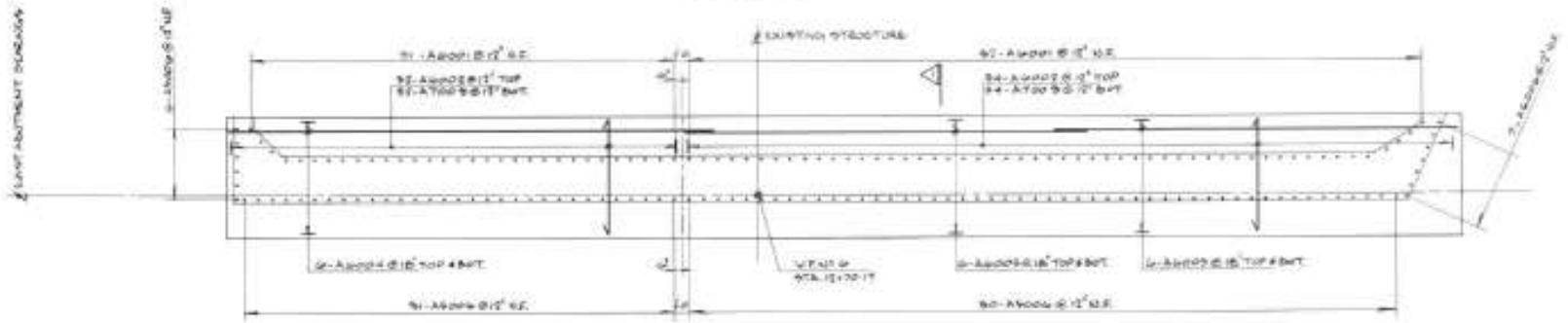


PLAN
ELEVATION
PROFILE OF COLBORNE ST
NORTH
SOUTH
EXIST. RET. WALL
EXISTING SUPERSTRUCTURE TO BE REMOVED
EXISTING ABUTMENT BELOW
20' APPROACH SLAB
SOUTH CURB LINE
TO BRANT AVE.
MIN. CLEARANCE POINT
EXISTING ABUTMENT
EXIST. ABUTMENT TO REMAIN
1-ELECTRICAL DUCT
ALUMINUM RAILING
NOTES
B.M. ELEV. 691.815
GEODETIC DATUM
FOR REDUCED PLAN
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
L.E. BN RAILWAY GRADE SEPARATION MILEAGE 21.1
GENERAL ARRANGEMENT
J.D. LEE ENGINEERING LIMITED
42



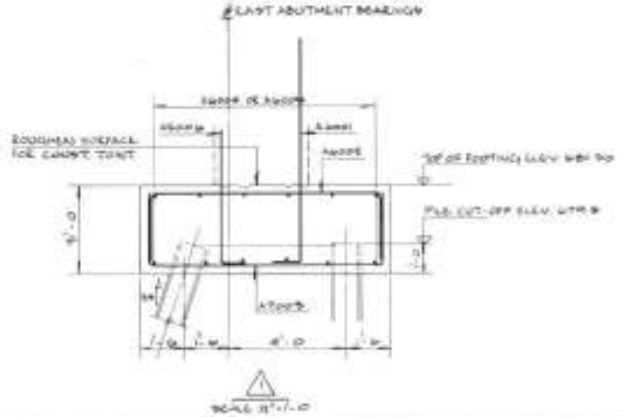
FOOTING AND PILE LAYOUT

SCALE 1/4" = 1'-0



FOOTING REINFORCEMENT

SCALE 1/4" = 1'-0



SCALE 1/2" = 1'-0

NOTES

1. ALL PILES HP12 x 53 STEEL 'H' PILES
2. APPROXIMATE TIP ELEV. is 99.00 (MSD DATUM)
3. DESIGN LOAD PER PILE = 140 KIPS
4. NO PILES ARE TO BE DRIVEN UNTIL THE EXISTING STORM SEWER HAS BEEN LOCATED

FOR REDUCED PLAN

USE SCALE RATIO

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

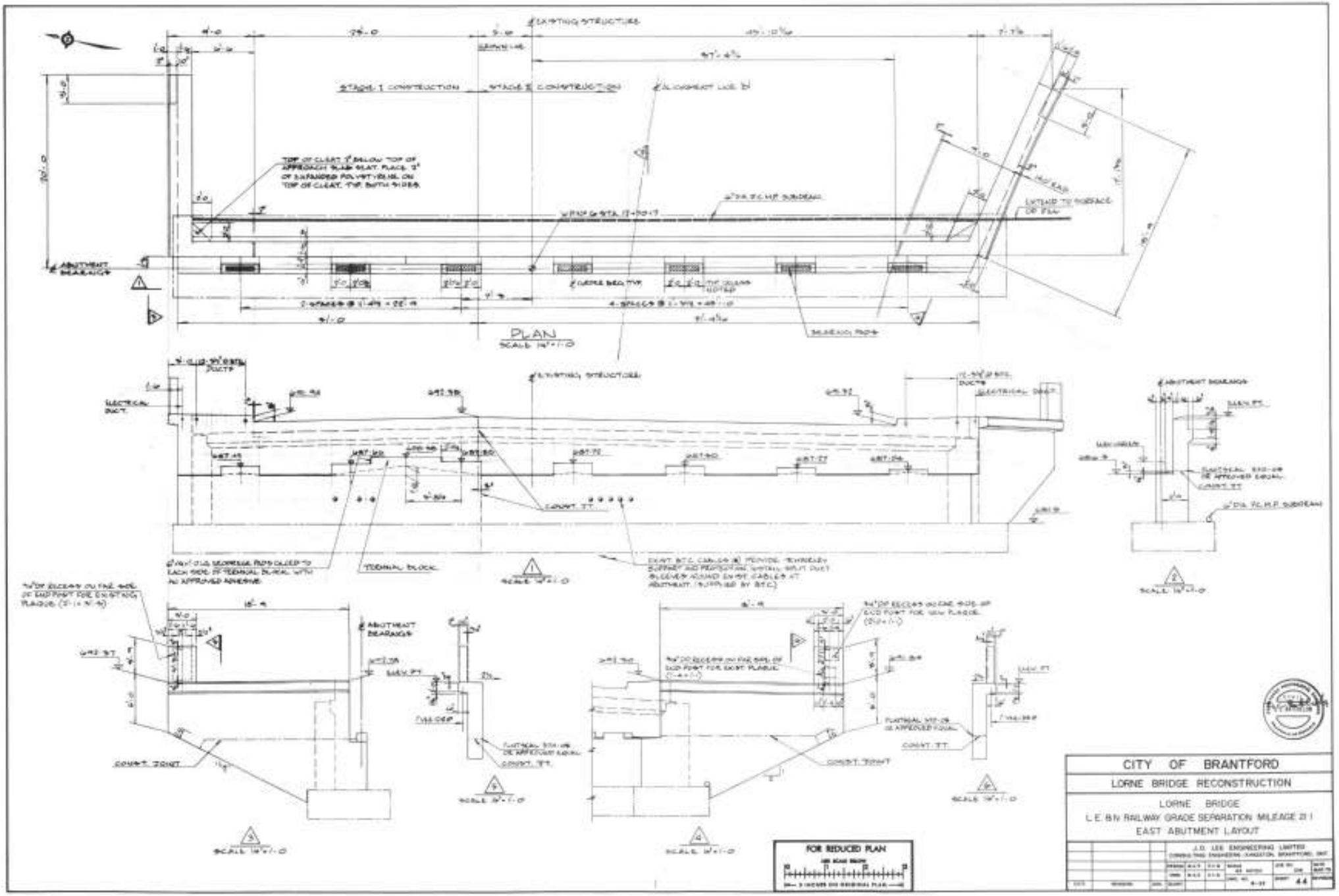
LORNE BRIDGE

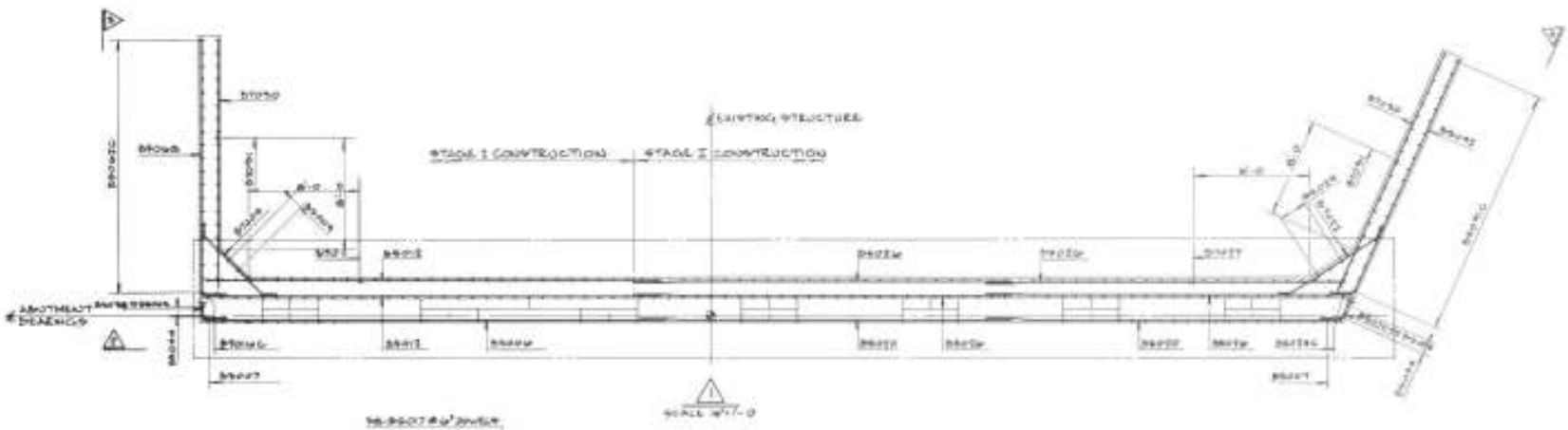
L.E. B/N RAILWAY GRADE SEPARATION MILEAGE 21.1

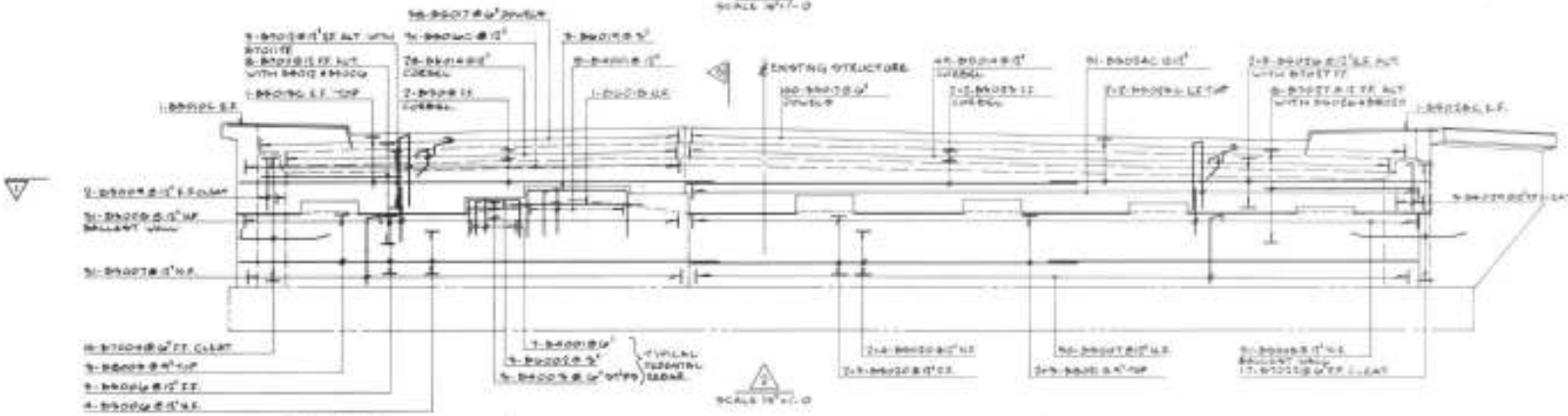
EAST ABUTMENT FOOTING LAYOUT & REINFORCEMENT

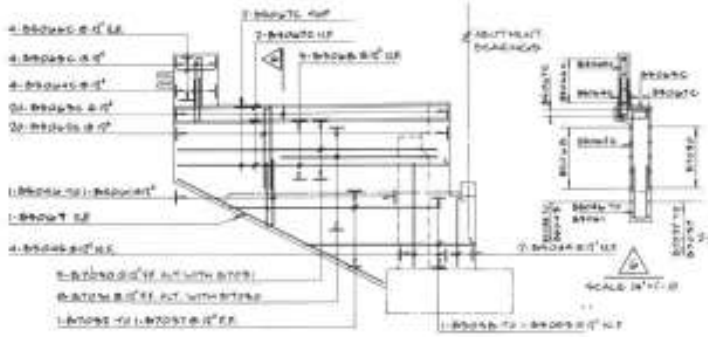
J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - KINGSTON, BRANTFORD, ONT.

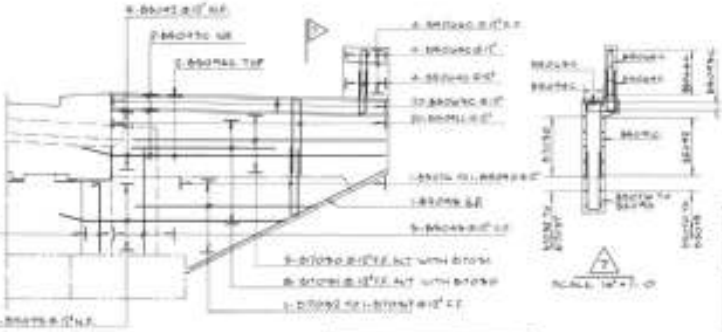
SHEET 43


EXISTING STRUCTURES
STAGE 1 CONSTRUCTION
STAGE 2 CONSTRUCTION
ALIGNMENT USE 'B'
TOP OF CLEAT 3" BELOW TOP OF APPROACH SLAB SEAT. PLACE 3" OF EXPANDED POLYSTYRENE ON TOP OF CLEAT. TYP. BOTH SIDES.
ABUTMENT BEARINGS
PLAN
SCALE 1/4"=1'-0
ELECTRICAL DUCT
TERMINAL BLOCK
COUNT. JOINT
SCALE 1/4"=1'-0
SCALE 1/4"=1'-0
SCALE 1/4"=1'-0
SCALE 1/4"=1'-0
SCALE 1/4"=1'-0
FOR REDUCED PLAN
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
L.E. & N. RAILWAY GRADE SEPARATION MILEAGE 21
EAST ABUTMENT LAYOUT
J.D. LEE ENGINEERING LIMITED
SHEET 44









FOR REDUCED PLAN

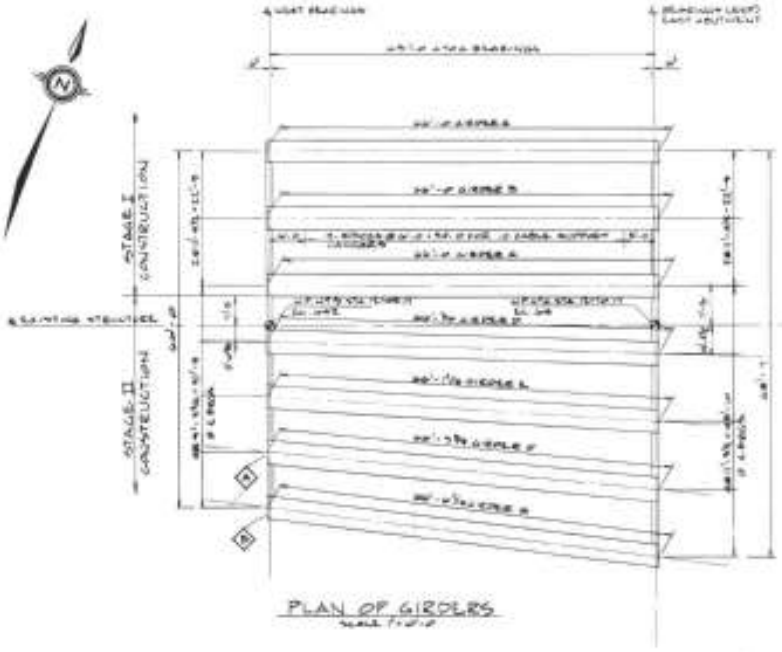
CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

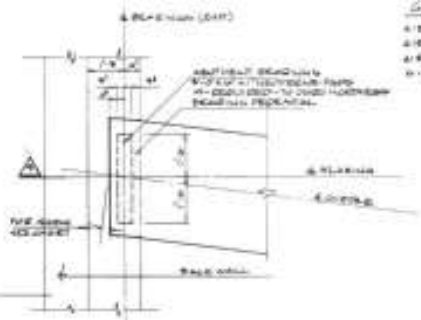
LORNE BRIDGE
L.E. B/N RAILWAY GRADE SEPARATION MILEAGE 21
EAST ABUTMENT REINFORCEMENT

J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - KINGSTON, BRANTFORD, ONT.

SHEET 45



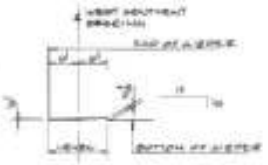
PLAN OF GIRDERS



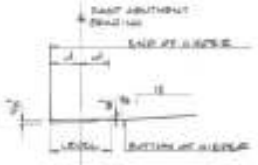
BEARING DETAILS

GIRDER SKEW

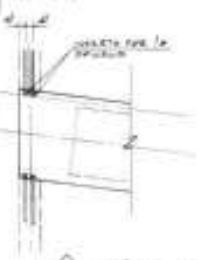
GIRDER A	
GIRDER B	
GIRDER C	
GIRDER D	



BEVELLED RECESS AT WEST END OF GIRDER



BEVELLED RECESS AT EAST END OF GIRDER

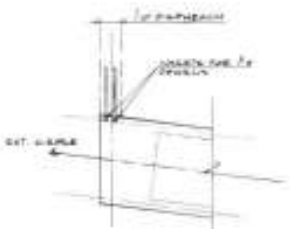


TYPICAL INTERIOR GIRDER

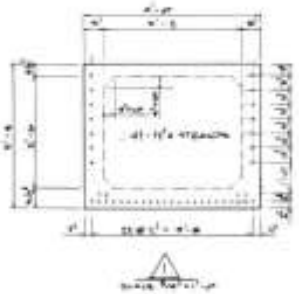
PLAN OF END BLOCK

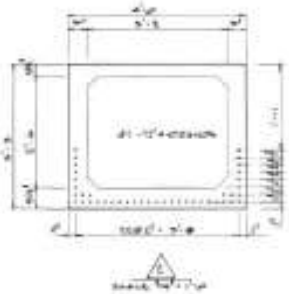
NOTES

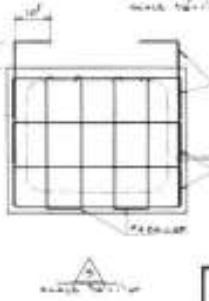
HALF ELEVATION OF BOX GIRDER

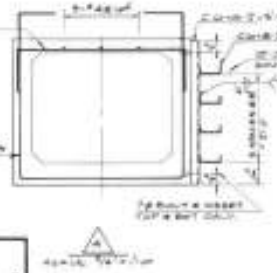


TYPICAL EXTERIOR GIRDER









FOR REDUCED PLAN

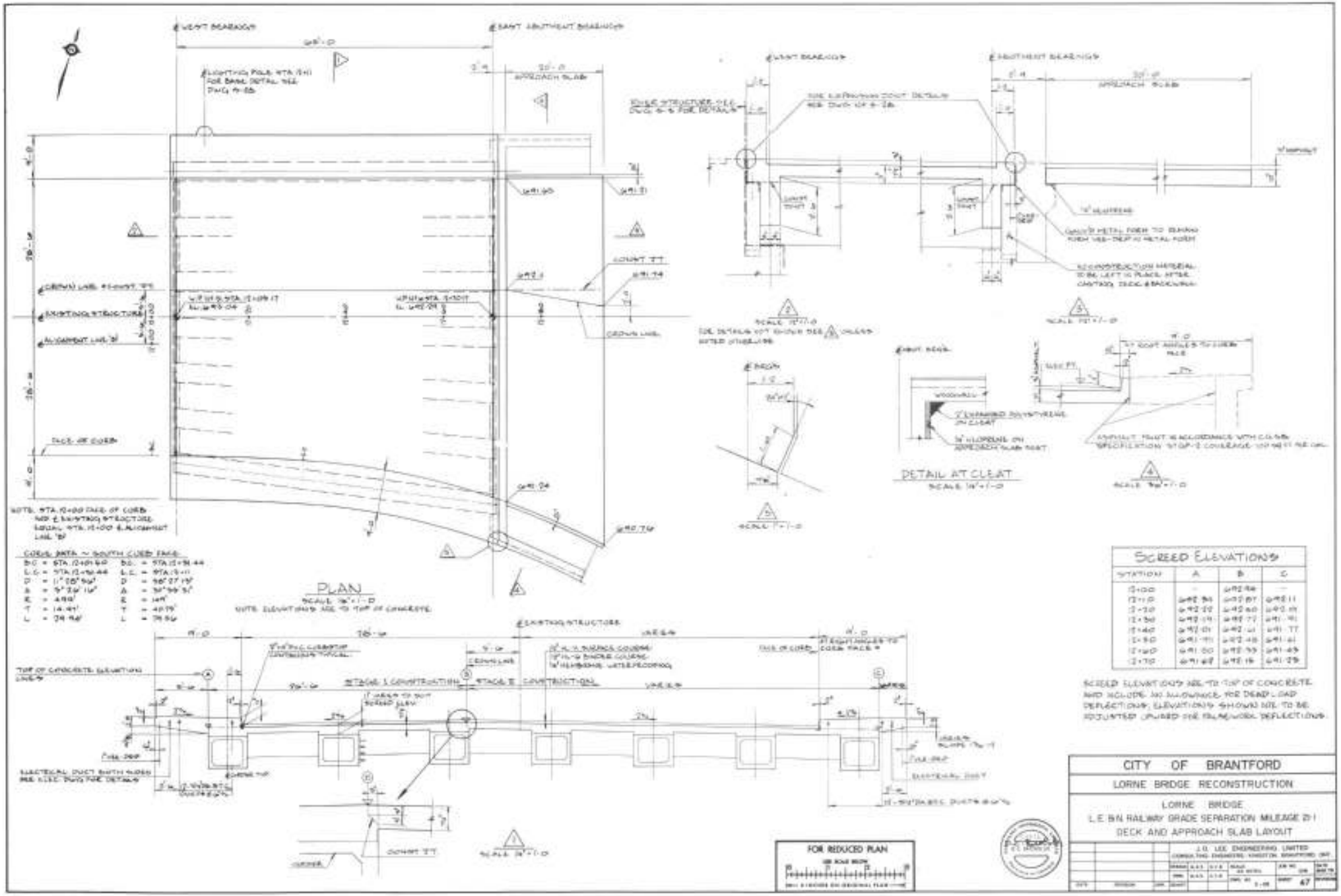
CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE
L.E.B.N. RAILWAY GRADE SEPARATION MILEAGE 211
PRESTRESSED BOX GIRDERS AND BEARINGS

J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - KINGSTON, BRANTFORD, ONT.

SHEET 46



SCREED ELEVATIONS			
STATION	A	B	C
12+00	–	692.96	–
12+10	692.84	693.07	692.11
12+20	692.92	693.20	692.19
12+30	693.19	693.32	692.41
12+40	693.01	693.21	692.27
12+50	692.91	693.18	692.21
12+60	692.80	693.13	692.29
12+70	692.69	693.19	692.29

SCREED ELEVATIONS ARE TO TOP OF CONCRETE AND INCLUDE NO ALLOWANCE FOR DEAD LOAD DEFLECTIONS. ELEVATIONS SHOWN ARE TO BE ADJUSTED (RAISED) FOR FALSEWORK DEFLECTIONS.

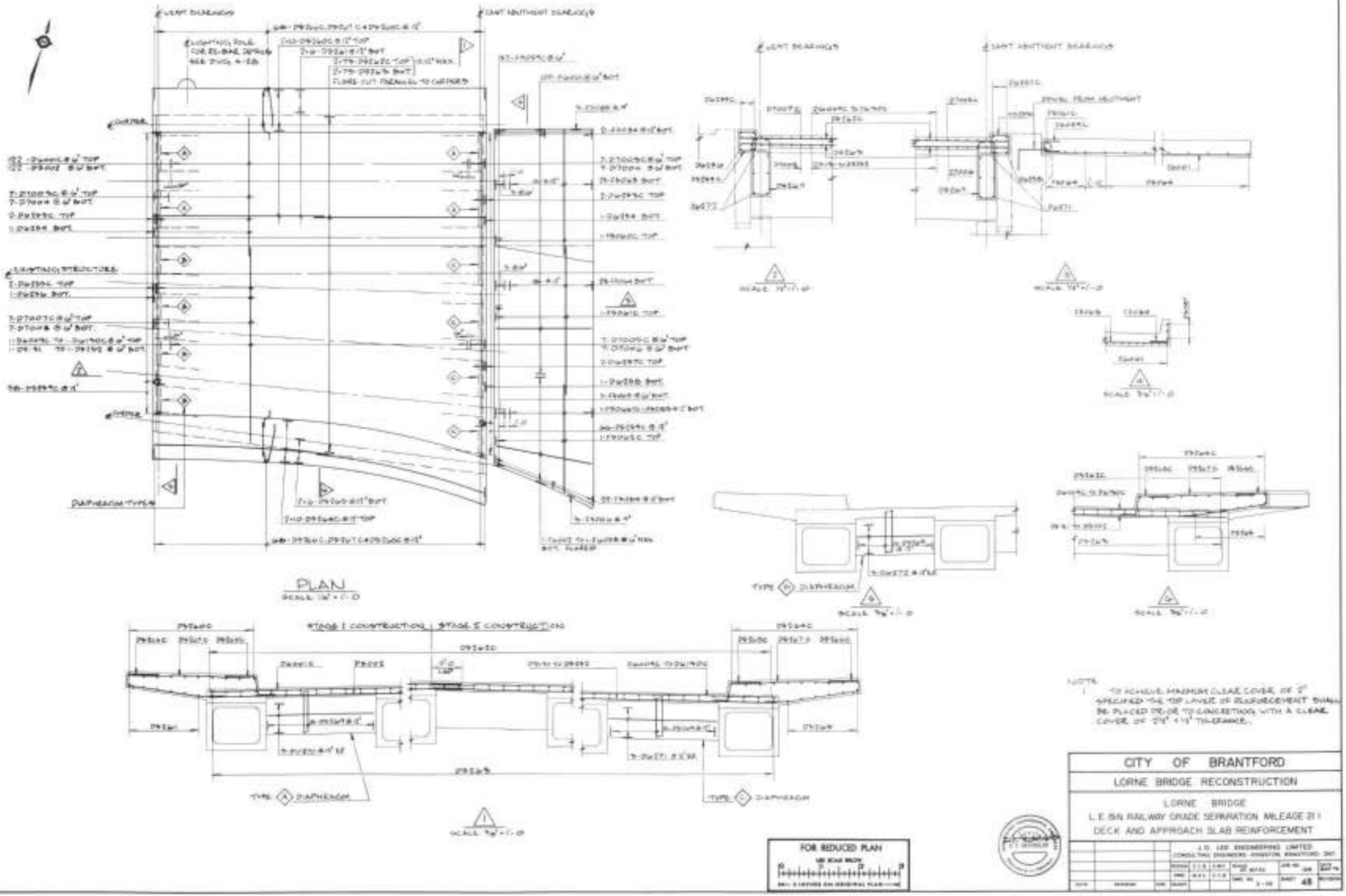
CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE
L.E. B/N RAILWAY GRADE SEPARATION MILEAGE 21.1
DECK AND APPROACH SLAB LAYOUT

J.G. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS, KINGSTON, BRANTFORD, ONT.

SHEET 67



NOTE

1. TO ACHIEVE MINIMUM CLEAR COVER OF 2" SPECIFIED THE TOP LAYER OF REINFORCEMENT SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 2¼" ± ½" TOLERANCE.

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE

L.E.B.N. RAILWAY GRADE SEPARATION MILEAGE 21.1

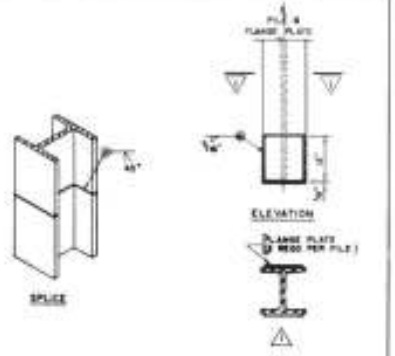
DECK AND APPROACH SLAB REINFORCEMENT

J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS, KINGSTON, BRANTFORD, ONT.

SHEET 48

SPLICE & DRIVING SHOE DETAILS FOR STEEL 'H' PILES

SS 9-1

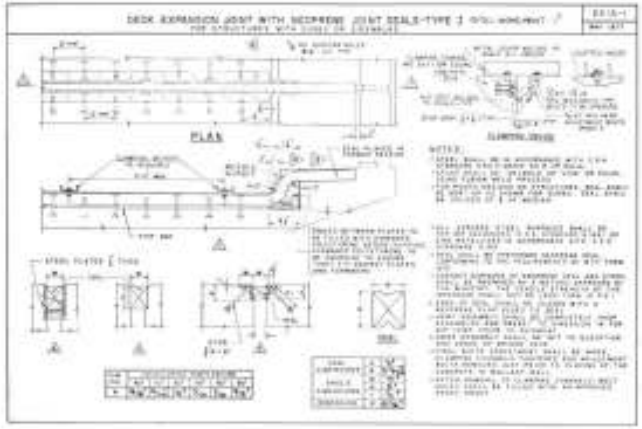


PILE	HP 10x42	HP 12x53	HP 12x74	HP 14x73
FLANGE PLATES	½ x 8 x 12	½ x 11 x 12	½ x 11 x 12	½ x 13 x 12

NOTES:
- THE PILE SPLICE SHALL BE A FULL BUTT WELD AS SHOWN, PERPENDICULAR TO ℄ OF PILE.
- WELDING SHALL CONFORM TO THE LATEST ISSUE OF CSA SPECIFICATION W59 AND SHALL BE DONE BY A WELDER QUALIFIED UNDER CSA STANDARD W47

DECK EXPANSION JOINT WITH NEOPRENE JOINT SEALS-TYPE 2 (FULL WIDTH)

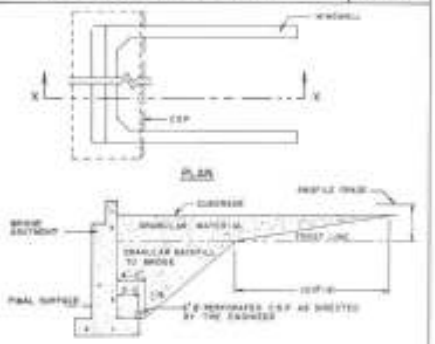
SS 9-1



MINIMUM GRANULAR BACKFILL REQUIREMENTS

(PERFORATED C.S.P. AT TOP OF FOOTING)

SS 9-3



SECTION X-X

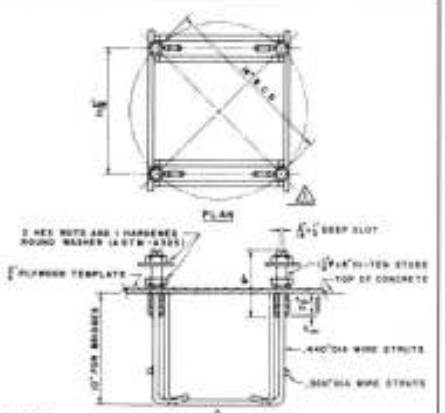
CSP/ST No.	APPROX. FROST PENETRATION 'H'
1200	6 FT
1800	6 FT
2400, 3000 AND 3600	6 FT
4200, 4800 AND 5400	7 FT

- LATERAL LIMITS OF BACKFILL TO BE 1.8H(2) FROM TOE TO INSIDE FACE OF WINGWALL
- H = DEPTH OF GRANULAR
- SECTION X-X PERPENDICULAR TO ℄ ABUT WING

ANCHORAGE FOR LIGHTING POLE

(18" BOLT CIRCLE DIA.)

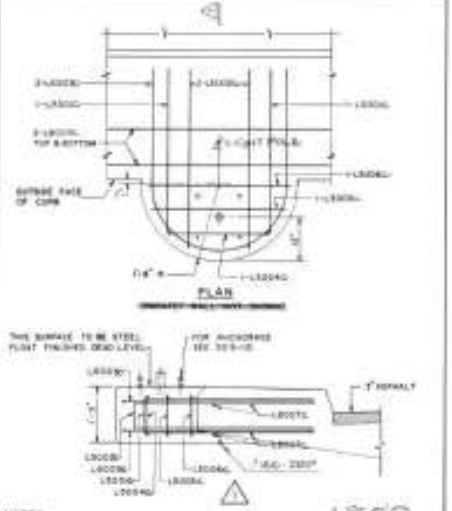
SS 9-10



NOTES:
- ANCHORAGE STRUTS AND COILS TO BE S.A.E. STANDARD 10-20 STEEL.
- HIGH TENSILE STUDS TO BE A.S.T.M. SPECIFICATION A449, A193, GRADE B-7 STEEL.
- STEEL HEX NUTS AND HARDENED STEEL WASHERS SHALL BE IN ACCORDANCE WITH A.S.T.M. SPECIFICATION A325.
- THE COMPLETE ANCHORAGE ASSEMBLY INCLUDING STUDS, NUTS & WASHERS SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH C.S.A. STANDARD G-164.
- EXPOSED PORTION OF STUDS SHALL BE COATED WITH NON-STAINING WAX/GREASE.
- A ¾" THICK PLYWOOD SETTING TEMPLATE SHALL BE PROVIDED FOR ACCURATE POSITIONING OF ANCHORAGE WITHIN THE CONCRETE FORM.
- UPPER NUTS SHALL BE TIGHTENED BY "TURN-OF-NUT" METHOD AS SPECIFIED IN A.S.T.M. SPECIFICATION A325.

LIGHTING POLE BASE DETAILS - TYPE I

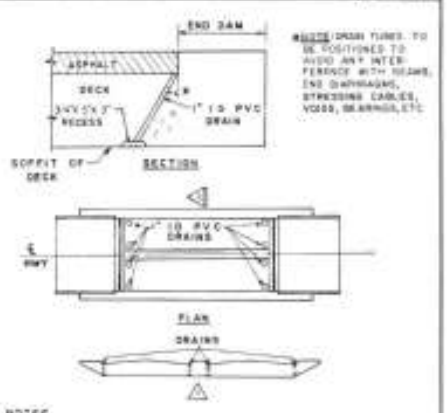
SS 9-11



NOTES:
- REINFORCING STEEL FOR ~~CURB AND PARAPET WALL~~ NOT SHOWN
- 2" CLEAR COVER
- READ IN CONJUNCTION WITH BRIDGE ELECTRICAL DETAILS

DRAINAGE OF ASPHALT WEARING SURFACE

SS 9-50



*NOTE: DRAIN TUBES TO BE POSITIONED TO AVOID ANY INTERFERENCE WITH HOUSING, END DIAPHRAGMS, STRESSING CABLES, VOIDS, BEARINGS, ETC.

NOTES
- 10 PVC DRAINAGE TUBES TO BE SUPPLIED AND PLACED BY THE CONTRACTOR. PVC TUBES TO BE RIGID TYPE
- TUBES TO BE PLACED AT ALL LOW POINTS OF THE BRIDGE DECK TO PREVENT PONDING OF WATER, AS SHOWN, AND/OR AS DIRECTED BY THE ENGINEER
- NO WATERPROOFING COMPOUND SHALL BE ALLOWED TO SEAL THE TUBES PRIOR TO PLACING ASPHALT

FOR REDUCED PLAN

ONE HALF SIZE

0 5 10 15 20

← 5 INCHES ON ORIGINAL PLAN →

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

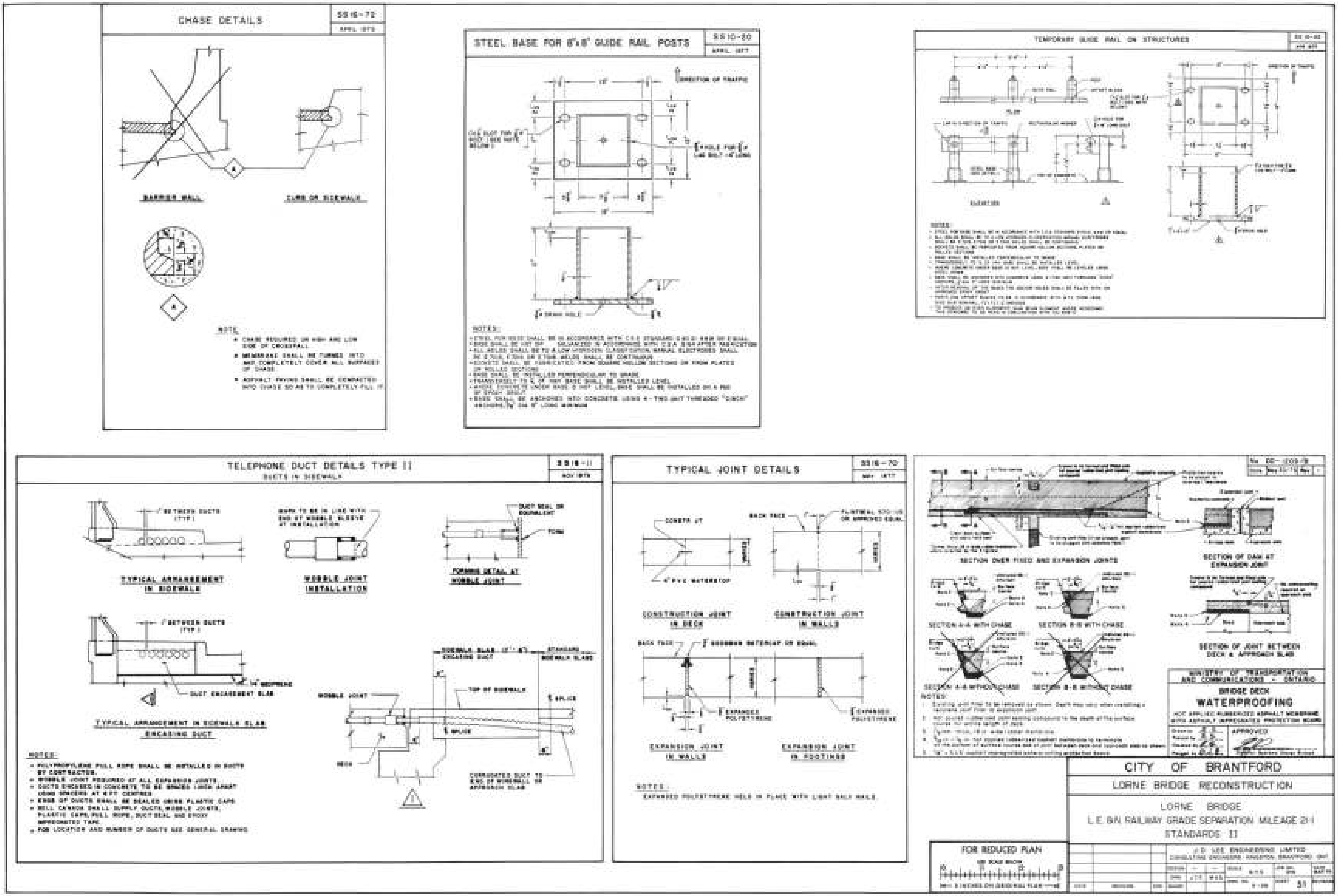
LORNE BRIDGE

L.E. B.N. RAILWAY GRADE SEPARATION MILEAGE 21

STANDARDS 1

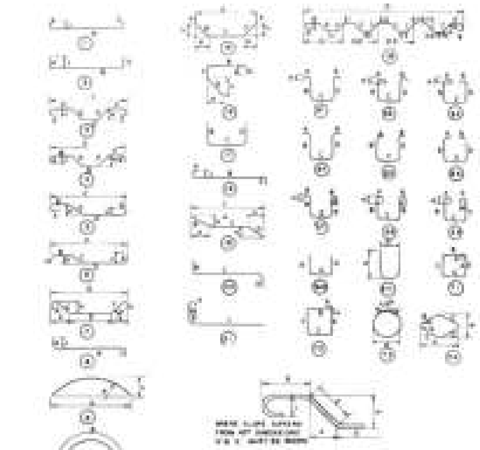
J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - KINGSTON, BRANTFORD, ONT.

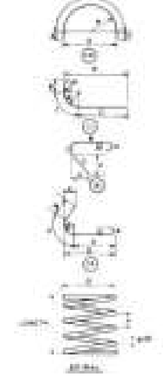
DATE	REVISIONS	DES.	CHKD.	DRAWN	CHKD.	SCALE	JOB NO.	SHEET NO.
						N.T.S.		30


CHASE DETAILS
SS16-72
APRIL 1979
BARRIER WALL
CURB OR SIDEWALK
NOTE:
CHASE REQUIRED ON HIGH AND LOW SIDE OF CROSSFALL.
MEMBRANE SHALL BE TURNED INTO AND COMPLETELY COVER ALL SURFACES OF CHASE.
ASPHALT PAVING SHALL BE COMPACTED INTO CHASE SO AS TO COMPLETELY FILL IT.
STEEL BASE FOR 8"x8" GUIDE RAIL POSTS
SS10-20
APRIL 1977
DIRECTION OF TRAFFIC
DRAIN HOLE
NOTES:
TEMPORARY GUIDE RAIL ON STRUCTURES
PLAN
ELEVATION
NOTES:
TELEPHONE DUCT DETAILS TYPE II
DUCTS IN SIDEWALK
SS16-11
NOV 1979
TYPICAL ARRANGEMENT IN SIDEWALK
WOBBLE JOINT INSTALLATION
FORMING DETAIL AT WOBBLE JOINT
TYPICAL ARRANGEMENT IN SIDEWALK SLAB ENCASING DUCT
DUCT ENCASEMENT SLAB
WOBBLE JOINT
TOP OF SIDEWALK
DECK
CORRUGATED DUCT TO END OF WINGWALL OR APPROACH SLAB
NOTES:
POLYPROPYLENE PULL ROPE SHALL BE INSTALLED IN DUCTS BY CONTRACTOR.
WOBBLE JOINT REQUIRED AT ALL EXPANSION JOINTS.
ENDS OF DUCTS SHALL BE SEALED USING PLASTIC CAPS.
FOR LOCATION AND NUMBER OF DUCTS SEE GENERAL DRAWING.
TYPICAL JOINT DETAILS
SS16-70
MAY 1977
CONSTR. JT
BACK FACE
CONSTRUCTION JOINT IN DECK
CONSTRUCTION JOINT IN WALLS
EXPANSION JOINT IN WALLS
EXPANSION JOINT IN FOOTINGS
EXPANDED POLYSTYRENE
NOTES:
EXPANDED POLYSTYRENE HELD IN PLACE WITH LIGHT NAIL NAILS.
SECTION OVER FIXED AND EXPANSION JOINTS
SECTION OF DAM AT EXPANSION JOINT
SECTION A-A WITH CHASE
SECTION B-B WITH CHASE
SECTION A-A WITHOUT CHASE
SECTION B-B WITHOUT CHASE
SECTION OF JOINT BETWEEN DECK & APPROACH SLAB
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO
BRIDGE DECK
WATERPROOFING
HOT APPLIED RUBBERIZED ASPHALT MEMBRANE WITH ASPHALT IMPREGNATED PROTECTION BOARD
APPROVED
CITY OF BRANTFORD
LORNE BRIDGE RECONSTRUCTION
LORNE BRIDGE
L.E. &N. RAILWAY GRADE SEPARATION MILEAGE 21·1
STANDARDS II
FOR REDUCED PLAN
J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS · KINGSTON · BRANTFORD · ONT.
51

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
					EAST ABUTMENT FOOTINGS														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											[illegible]
					EAST ABUTMENT														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]					[illegible]

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]						[illegible]					[illegible]
					DECK														
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															





ENLARGED VIEW SHOWING BAR BENDING DETAILS

NOTES

1. ALL DIMENSIONS ARE OUT TO OUT OF BAR
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. FIGURES IN CIRCLES SHOW TYPES.
7. [illegible]
8. SPACERS TO BE PROVIDED WITH ALL SPIRALS AS SPECIFIED [illegible]
9. WEIGHT OF SPIRALS AND SPACERS NOT INCLUDED ON THIS DRAWING

LEGEND
BARS WITH [illegible] SUFFIX [illegible] ARE COATED BARS

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

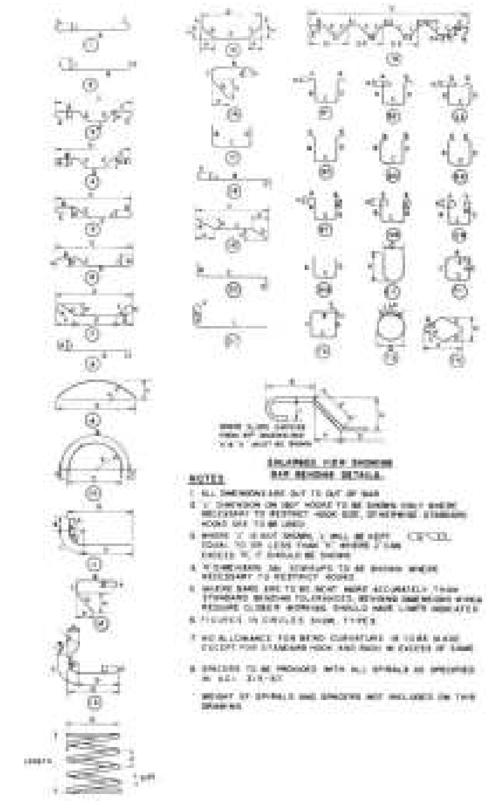
LORNE BRIDGE
L.E.&N. RAILWAY GRADE SEPARATION MILEAGE 21.1
BAR LIST

J.R. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS [illegible] BRANTFORD, ONT.

SHEET 92

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
						DECK CONT'D													
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															

MARK	No BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]															



ENLARGED VIEW SHOWING BAR BENDING DETAILS

NOTES

1. ALL DIMENSIONS ARE OUT TO OUT OF BAR [illegible]

LEGEND

BARS WITH A SUFFIX [illegible] COATED BARS

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE

L.E.&N. RAILWAY GRADE SEPARATION MILEAGE 21·1

BAR LIST

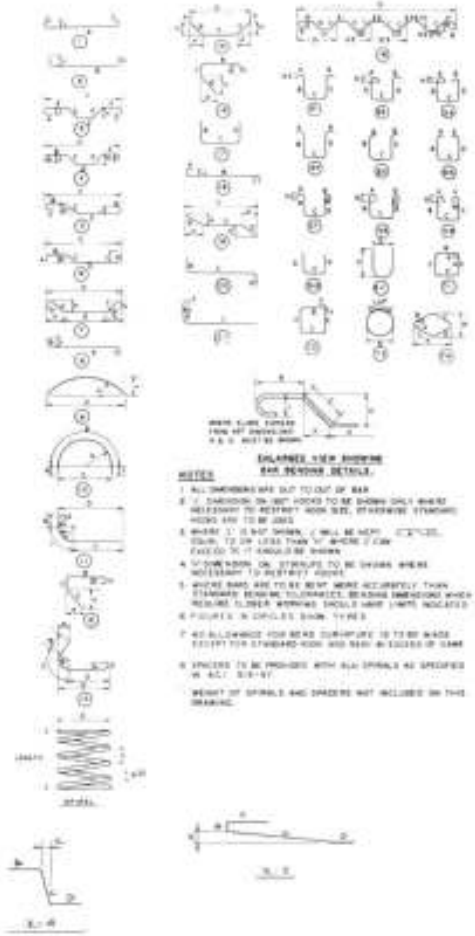
J.D. LEE ENGINEERING LIMITED

CONSULTING ENGINEERS [illegible]

SHEET 33

MARK	NO BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
						DECK (CONT'D)													
D6201	1	15	49'-6	STR															
D6202	1	15	49'-6	STR															
D6203	4	15	28'-6	STR															
D6204	2	15	28'-6	STR															
D6205	2	15	49'-6	STR															
D6206	1	20	49'-0	STR															
D6207	1	20	49'-6	STR															
D6208	124	15	4'-3	TO	0"	12"	8"	12"	1'-4		—								
D6209	89	15	36'-0	STR															
D6210	12	15	36'-0	STR															
D6211	140	15	35'-4	STR															
D6212	140	15	36'-4	STR															
D6213	20	15	36'-9	STR															
D6214	12	15	36'-9	STR															
D6215	156	15	11'-9	T.O	0'-0	0"	9'-4	0"						11½"					
D6216	156	15	8'-6	T.O															
D6217	156	15	6'-9	T.O										6"					
D6218	88	15	7'-0	T.O	0"	3'-8	3'-0	6"			6"								
D6219	24	20	7'-9	STR															
D6220	24	20	7'-4	STR															
D6221	24	20	6'-8	STR															
						APPROACH SLAB													
D6001	1440	20	19'-6	STR															
D6002	1	20	19'-6	STR															
D6003	1	20	19'-6	STR															
D6004	1	20	19'-6	STR															
D6005	1	20	19'-6	STR															
D6006	1	20	19'-6	STR															
D6007	1	20	19'-6	STR															
D6008	1	20	19'-6	STR															
D6009	1	20	19'-6½	STR															
D6010	1	20	19'-6½	STR															
D6011	1	20	19'-6½	STR															
D6012	1	20	19'-6½	STR															
D6013	1	20	19'-6½	STR															
D6014	1	20	19'-6½	STR															
D6015	1	20	19'-6½	STR															
D6016	1	20	19'-6½	STR															
D6017	1	20	19'-6½	STR															
D6018	1	20	19'-6½	STR															
D6019	1	20	19'-6½	STR															
D6020	1	20	19'-6½	STR															
D6021	1	20	19'-6½	STR															
D6022	1	20	19'-6½	STR															
D6023	1	20	19'-6½	STR															
D6024	1	20	19'-6½	STR															
D6025	1	20	19'-6½	STR															
D6026	1	20	19'-6½	STR															
D6027	1	20	19'-6½	STR															
D6028	1	20	19'-6½	STR															
D6029	1	20	19'-6½	STR															
D6030	1	20	19'-6½	STR															
D6031	1	20	19'-6½	STR															
D6032	1	20	19'-6½	STR															
D6033	1	20	19'-6½	STR															
D6034	1	20	19'-6½	STR															
D6035	1	20	19'-6½	STR															
D6036	1	20	19'-6½	STR															
D6037	1	20	19'-6½	STR															
D6038	1	20	19'-6½	STR															
D6039	1	20	19'-6½	STR															
D6040	1	20	19'-6½	STR															
D6041	1	20	19'-6½	STR															
D6042	1	20	19'-6½	STR															
D6043	1	20	19'-6½	STR															
D6044	1	20	19'-6½	STR															
D6045	1	20	19'-6½	STR															
D6046	1	20	19'-6½	STR															
D6047	1	20	19'-6½	STR															
D6048	1	20	19'-6½	STR															
D6049	1	20	19'-6½	STR															
D6050	1	20	19'-6½	STR															
D6051	1	20	19'-6½	STR															
D6052	1	20	19'-6½	STR															
D6053	1	20	19'-6½	STR															
D6054	1	20	19'-6½	STR															
D6055	1	20	19'-6½	STR															
D6056	1	20	19'-6½	STR															
D6057	1	20	19'-6½	STR															
D6058	1	20	19'-6½	STR															
D6059	1	20	19'-6½	STR															
D6060	1	20	19'-6½	STR															
D6061	1	20	19'-6½	STR															
D6062	1	20	19'-6½	STR															
D6063	1	20	19'-6½	STR															
D6064	1	20	19'-6½	STR															
D6065	1	20	19'-6½	STR															
D6066	1	20	19'-6½	STR															
D6067	1	20	19'-6½	STR															

MARK	NO BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	L	M	O	R	SHAPE
D6068	1	20	21'-7	STR															
D6069	147	15	5'-0	T.O	0"	12"	8"	12"									4"		
D6070	1	15	25'-4	STR															
D6071	1	15	49'-0	STR															
D6072	1	15	17'-0	STR															
D6073	24	15	28'-4	STR															
D6074	24	15	49'-0	STR															
D6075	8	15	17'-0	STR															
D6076	1	15	16'-0	STR															
D6077	1	15	11'-6	STR															
D6078	1	15	4'-0	STR															
D6079	1	15	4'-6	STR															
D6080	1	15	50'-0	STR															
D6081	1	15	50'-0	STR															
D6082	1	15	3'-0	STR															
D6083	1	15	42'-0	STR															
D6084	1	15	42'-0	STR															
D6085	1	15	42'-0	STR															
D6086	1	15	42'-0	STR															
D6087	1	15	42'-0	STR															
D6088	1	15	42'-0	STR															
D6089	1	15	42'-0	STR															
D6090	1	15	42'-0	STR															
D6091	1	15	42'-0	STR															
D6092	1	15	42'-0	STR															
D6093	1	15	42'-0	STR															
D6094	1	15	42'-0	STR															
D6095	1	15	42'-0	STR															
D6096	1	15	42'-0	STR															
D6097	1	15	42'-0	STR															
D6098	1	15	42'-0	STR															
D6099	1	15	42'-0	STR															
D6100	1	15	42'-0	STR															
D6101	1	15	42'-0	STR															
D6102	1	15	42'-0	STR															
D6103	1	15	42'-0	STR															
D6104	1	15	42'-0	STR															
D6105	1	15	42'-0	STR															
D6106	1	15	42'-0	STR															
D6107	1	15	42'-0	STR															
D6108	1	15	42'-0	STR															
D6109	1	15	42'-0	STR															
D6110	1	15	42'-0	STR															
D6111	1	15	42'-0	STR															
D6112	1	15	42'-0	STR															
D6113	1	15	42'-0	STR															
D6114	1	15	42'-0	STR															
D6115	1	15	42'-0	STR															
D6116	1	15	42'-0	STR															
D6117	1	15	42'-0	STR															
D6118	1	15	42'-0	STR															
D6119	1	15	42'-0	STR															
D6120	1	15	42'-0	STR															
D6121	1	15	42'-0	STR															
D6122	1	15	42'-0	STR															
D6123	1	15	42'-0	STR															
D6124	1	15	42'-0	STR															
D6125	1	15	42'-0	STR															
D6126	1	15	42'-0	STR															
D6127	1	15	42'-0	STR															
						LIGHT POLE BASE													
LBase1	2	15	12'-9½	17		11'-0	90°	11'-0											
LBase2	2	15	12'-9½	17		11'-0	90°	11'-0											
LBase3	2	20	12'-9	18	0'-0	11'-9	90°	11'-0									4'-0		
LBase4	1	15	11'-0	13	0"	12"	11'-0	12"			12"								
LBase5	1	15	11'-0	13	0"	12"	11'-0	12"			12"								
LBase6	4	20	5'-0	STR															



LEGEND
BARS WITH A SUFFIX I.E. D6006C ARE CENTER BARS

SUFFIX

CITY OF BRANTFORD

LORNE BRIDGE RECONSTRUCTION

LORNE BRIDGE
L.E. B.N. RAILWAY GRADE SEPARATION MILEAGE 21.1
BAR LIST

J.D. LEE ENGINEERING LIMITED
CONSULTING ENGINEERS - KINGSTON, BRANTFORD, ONT.

DESIGN	-	-	SCALE	JOB NO.
DRAWN	BLOCK	D.T.B.	DRAWING NO.	SHEET 54
CHECKED				

DATE | REVISIONS | BY | CHECKED

Prepared By:

City of Brantford

Brant's Crossing Bridge (Structure 104)
Structural Evaluation Report

GMBP File: 119104
May 2021

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

APPENDICES

BRANT'S CROSSING BRIDGE (STRUCTURE 104) STRUCTURAL EVALUATION REPORT

CITY OF BRANTFORD

MAY 2021

GMBP FILE: 119104

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the City of Brantford (City) to complete a load limit evaluation of the Brant's Crossing Bridge (Structure 104), located south of Colborne Street West and spanning the Grand River in the City of Brantford. As a part of this assignment, the existing structure was inspected within an arm's reach and analyzed for the purposes of determining the current load limit and to identify and assess the various rehabilitation and replacement options as part of the Municipal Class Environmental Assessment (MCEA) process.

2. BACKGROUND INFORMATION

2.1 Existing Structure

Structure 104 is a four-span bridge that was originally designed to convey railway traffic but has since been converted to a pedestrian bridge to carry pedestrian traffic and a utility crossing across the Grand River. Based on discussions with City staff, the utility crossing is no longer in active service. Numerous historical drawings were provided by the City. Due to the number of drawings provided for Structure 104, only relevant drawings for this evaluation have been included in the **Appendix I**.

The superstructure consists of two through truss spans (Spans 2 & 3) and two plate girder spans (Spans 1 & 4). Historical drawings, dated 1911 and 1912, indicate the piers and abutments are founded on bedrock using spread footings. It should be noted that the west pier is the abutment of a former bridge in this location that was repurposed as a pier. City staff have indicated that this bridge was converted to a pedestrian bridge in approximately 1997.

2.2 2018 Structural Inspection

Following an ice jam event in the Grand River on February 21, 2018, the structure was subject to a detailed structural inspection in accordance with the Ontario Structure Inspection Manual (OSIM). In order to safely assess all elements of the bridge within an arm's reach, ASI Group Ltd. (ASI) was retained to perform an underwater inspection of the abutment and pier footings and Acuren Group Ltd. (Acuren) was retained to perform a ropes access inspection of all other elements beyond an arm's reach, which included the underside of the structure and top members of the trusses. The ropes access inspection occurred over a period of 4 days from May 28, 2018, to May 31, 2018, and the underwater inspection occurred on June 22, 2018. Structure 104 has been closed since the flooding and ice jam event in February 2018.

The complete Enhanced OSIM Summary Report for Structure 143 is provided in **Appendix II**.

Within the Enhanced OSIM Summary Report, both major and minor deficiencies were noted. Major deficiencies are considered to be critical and should be addressed in the next 1-5 years to maintain the structural integrity of the bridge. Minor deficiencies are not classified as urgent and can be addressed at a later time; however, consideration should be given to addressing all deficiencies under one project.

Critical deficiencies are included in **Table 4** and **Table 5** at the end of this report.

3. NOMENCLATURE

Steel members in each span of Structure 104 generally consist of built-up steel sections. Refer to **Figure 1** below for the standard terminology used for these built-up sections. Refer to **Figure 2 and 3** for standard terminology used for the structural elements in the bridge. Note that Figure 2 and 3 is provided for glossary of terms only; it is not representative of the actual dimensions of Structure 104. Refer to **Figure 4** for a cross section of the pedestrian platform installed in approximately 1997.

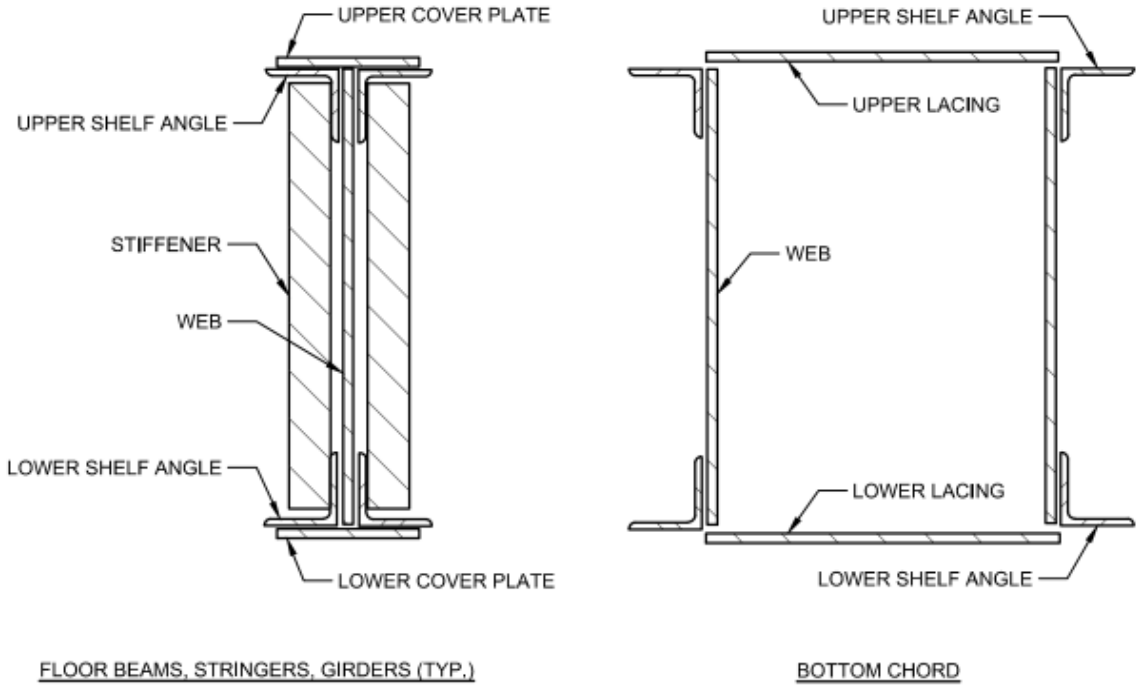


Figure 1: Cross Sections of Typical Built-Up Sections

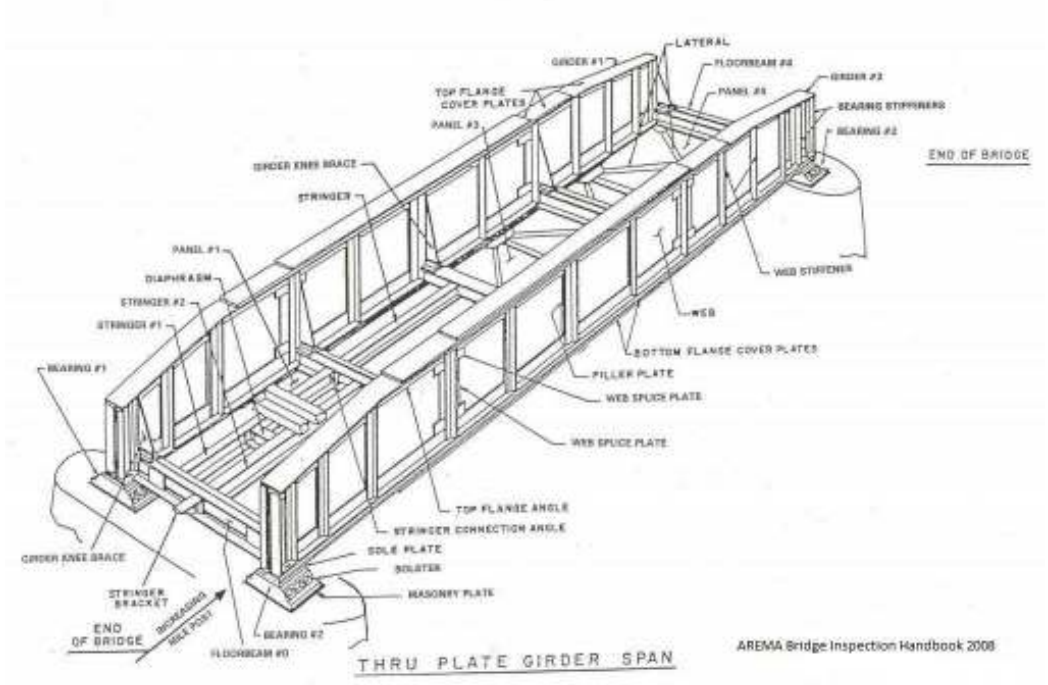


Figure 2: Typical Elements of Through Plate Girder Bridge

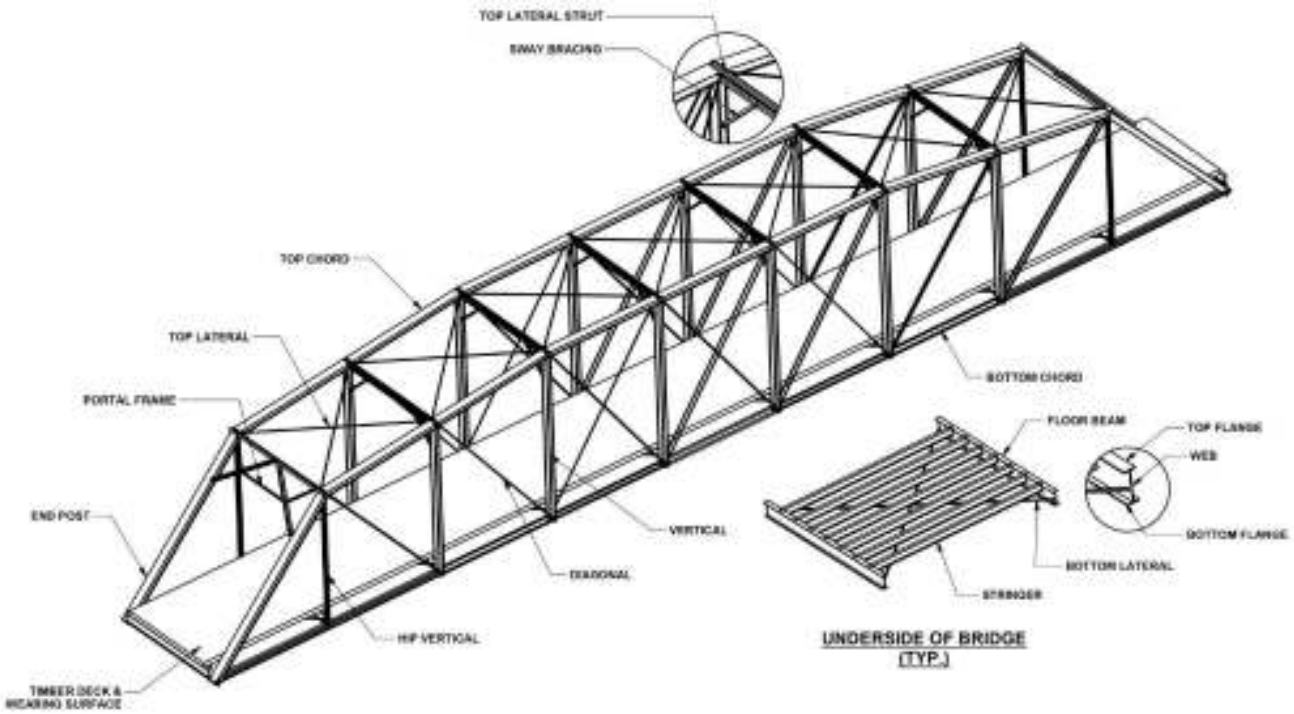


Figure 3: Typical Elements of Steel Truss Bridge

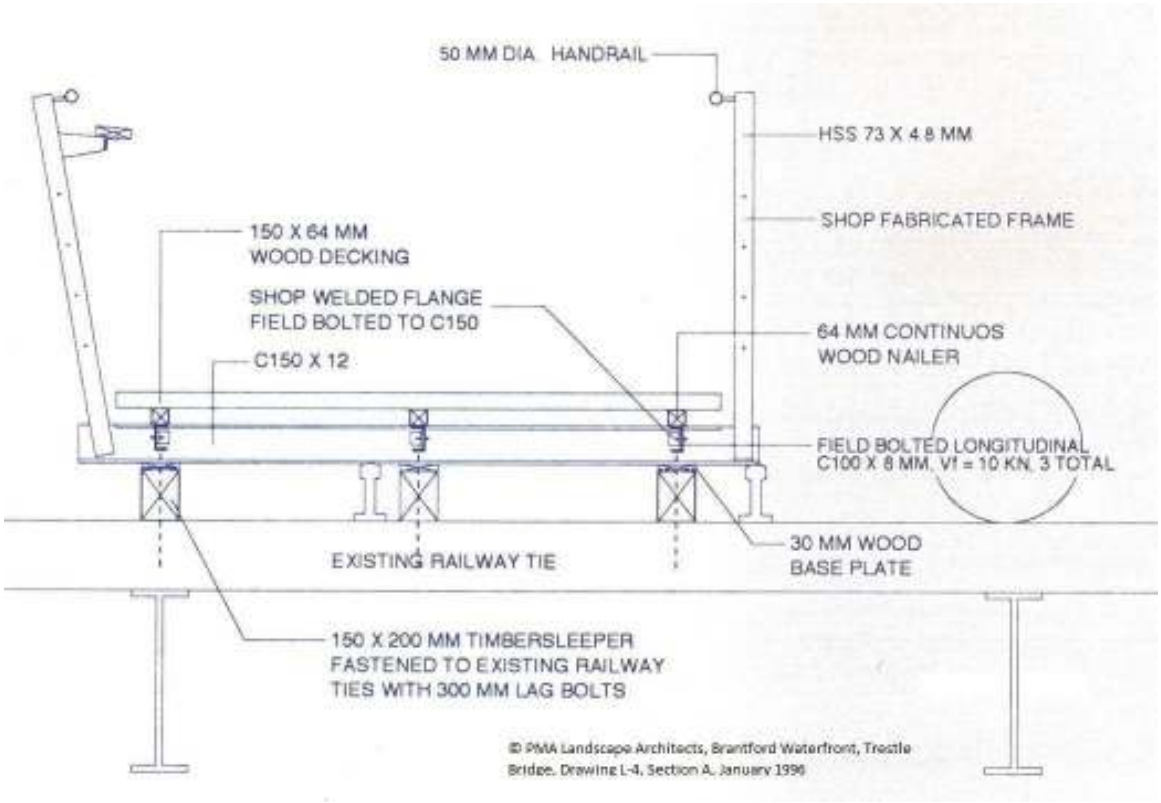


Figure 4: Existing Pedestrian Platform

4. METHODOLOGY

The structural evaluation was made in accordance with Section 14 of the CSA S6-19 Canadian Highway Bridge Design Code (CHBDC). Provided below is a detailed description of the methodology used for this evaluation. It should be noted that our evaluation refers to the capacity of superstructure elements only. Section 14 of the CHBDC does not refer to the evaluation of the substructure. Based on the defects noted during the site visit completed by GMBP, we do not believe that the substructure elements are a limiting factor in the capacity of the evaluated structure.

4.1 Existing Conditions

The historical drawings do not provide details regarding the structural steel sections used to construct Structure 104. Therefore, the structural steel sections for load rating individual elements were derived based on dimensions taken during the Enhanced OSIM inspection. All recorded element dimensions were taken using tape measure and Vernier caliper.

Structural steel strength was determined in accordance with Table 14.1 in Section 14 of the CHBDC, using construction year dating between 1905 and 1932. Based on the table, the existing steel was evaluated using a yield and tensile strength of 210 MPa and 420MPa respectively.

Wood deck strength was determined in accordance with Section 9 of the CHBDC using Red Pine, as specified on the 2006 rehabilitation drawings.

4.2 Evaluation Procedure

4.2.1 Dead Loads

Dead loads, such as the self-weight of all bridge components, were calculated in accordance with the CHBDC Table 3.4 and Clause 14.8 “Permanent Loads”. The weights of materials used for the evaluation of each structure (where applicable) are summarized in **Table 1**.

Table 1: Summary of Dead Loads for Evaluations

Material	Weight
Steel	77.0 kN/m^3
Timber (Rail Ties)	9.5 kN/m^3
Wood Planks (Deck)	6.0 kN/m^3

Dead loads are apportioned into three categories: D1 (factory produced products, cast-in-place concrete – excluding decks), D2 (cast-in-place concrete decks, wood, field-measured asphalt, non-structural components), and D3 (asphalt, where the thickness is assumed to be 90 mm). In general, where the geometry could not be verified by field measurement the dead load was considered to be categorized as a D3 dead load.

For Structure 104, dead loads include the self weight of all steel elements, 305x203mm (12”x8”) rail ties spaced at 355mm (14”), 76x152mm (3”x6”) wood deck, supporting 150x200mm (6”x8”) timber sleepers, and steel rail track.

4.2.2 Live Loads

Two distinct live loads were considered in the load rating evaluation. First, the pedestrian load specified in Clause 3.8.12 of the CHBDC 4.0 kPa was applied to the entire original railway bridge deck width of 4.2m, not the current raised pedestrian sidewalk that has a width of 2.5m. The entire deck width was considered to allow for potential future widening of the pedestrian platform.

The second live load considered was the maintenance vehicle load specified in Clause 3.8.12 of the CHBDC with a gross weight of 80 kN (approximately 18,000 lbs). However, per Clause 3.8.11 of the CHBDC, the maintenance vehicle load only needs to be considered if the sidewalk or pedestrian bridge width is greater than 3.0m. As noted above, the current pedestrian sidewalk has a width of 2.5m; and therefore, the maintenance vehicle does not need to be considered in the load rating. However, to allow for potential future widening of the pedestrian platform, the maintenance vehicle has been considered for the purposes of this report.

As per Clause 3.8.11 of the CHBDC, the maintenance vehicle and pedestrian load were not considered to act simultaneously.

The Live Load Capacity Factor, F, for Ultimate Limit State was calculated to determine the residual strength in the structural elements that is available to resist applied live loads once all permanent loads (i.e., dead loads) have been accounted for by the member’s strength. As per Clause 14.17.2 of the CHBDC, F factors greater than or equal to 1, do not require a load posting, meaning the evaluated bridge is capable of supporting loads used to derive the F factors. The overall bridge posting is determined based on the smallest value of F derived for each individual bridge element.

4.2.3 Load Factors

Reliability Indices were used to determine the appropriate load factors for dead and live loads. These indices were dependent upon the element being analyzed, and its system behaviour, element behaviour and inspection level as outlined below:

- System behaviour, classified as one of the following:
  - (S1) Element failure will lead to total collapse
  - (S2) Element failure will likely not lead to total collapse
  - (S3) Element failure will lead to local failure only
- Element behaviour, classified as one of the following:
  - (E1) Element is subject to a sudden loss of capacity with little or no warning
  - (E2) Element is subject to a sudden loss of capacity with little or no warning but will retain post-failure capacity
  - (E3) Element is subject to gradual failure with warning of probably failure
- Inspection level, classified as one of the following:
  - (INSP1) Element is not accessible for inspection
  - (INSP2) Element is accessible for inspection to the satisfaction of the evaluator
  - (INSP3) Element is accessible for inspection and inspection is directed by the evaluator

Once the system behaviour, element behaviour and inspection level have been determined for the failure mode of each element being evaluated, a Reliability Index can be used to determine the appropriate dead and live load factors. It should be noted that a single element may have different load factors depending on the mode of failure being analyzed (i.e., a concrete beam analyzed for shear may have different load factors for analysis than the same beam analyzed for bending). For the purpose of this evaluation, pedestrian live load factors were assigned based on Table 3.1 in Section 3 of the CHBDC ($\alpha L = 1.7$). The target reliability index, a measure of the level of safety of a component(s), used during the evaluation of various elements, and respective live and dead load factors are summarized the table in **Appendix III**.

In addition to the live load factor, αL, no Dynamic Load Allowance (DLA) was considered for maintenance vehicle loading. According to Clause 3.8.4.5.1 of the CHBDC, maintenance vehicle load of 80 kN includes an allowance for dynamic effect.

5. LOAD LIMIT EVALUATION

Both hand calculations and finite element model analysis were completed to determine the member-by-member shear forces and bending moments as per the CHBDC. The finite element model analysis was completed using a 2D model in S-Frame Version 11 software.

Resistance of steel structural components and the wood deck was determined using Section 9 and 10 of the CHBDC, respectively. To account for an overall light to medium corrosion, an average 15% steel thickness reduction was applied to all steel members. An additional 5% reduction in steel thickness was used to account for potential future steel corrosion that may take place before the next bridge evaluation. As a result, the resistance of steel members was based on 80% of the steel thickness measured in the field. Additionally, some steel members were measured to have less that 80% of the steel thickness remaining. For these steel members with additional section loss, a resistance associated to the remaining section of the member was individually applied. To account for the isolated severe cracking and splintering noted in the wood deck, an average resistance adjustment factor of 0.8 was applied to wood elements.

The existing pedestrian platform is rated for an unfactored 4.8 kPa pedestrian load per the 1996 PMA Landscape Architects drawings for the Brantford Waterfront project.

See **Table 2** and **Table 3** below for the summary of F factors for individual elements.

Table 2: Load Posting Summary for Plate Girder Spans

Element	Pedestrian Live Load Capacity Factor, F	Maintenance Vehicle Live Load Capacity Factor, F	Load Posting
Stringer	> 1.0	< 1.0	Required *1
Floor Beam	> 1.0	> 1.0	Not Required
Plate Girder	> 1.0	> 1.0	Not Required

**1 Load Posting required only for maintenance vehicle (No load rating required for pedestrian loading)*

Table 3: Load Posting Summary for Truss Spans

Element	Pedestrian Live Load Capacity Factor, F	Maintenance Vehicle Live Load Capacity Factor, F	Load Posting
Stringer	> 1.0	> 1.0	Not Required
Floor Beam	> 1.0	> 1.0	Not Required
Plate Girder	> 1.0	> 1.0	Not Required
Top Chord	> 1.0	> 1.0	Not Required
Bottom Chord	> 1.0	> 1.0	Not Required
Vertical	> 1.0	> 1.0	Not Required
Diagonal	> 1.0	> 1.0	Not Required

**1 Load Posting required only for maintenance vehicle (No load rating required for pedestrian loading)*

Upon completion of the structural analysis, it was determined that all structural elements have a Load Capacity Factor, F, larger than 1.0 for the pedestrian load. Therefore, no load limit is required in reference to pedestrian loading.

It was determined that all structural elements, with the exception of existing pedestrian platform and plate girder span stingers, have a Load Capacity Factor, F, larger than 1.0 for the CHBDC 80 kN maintenance vehicle.

As noted in Section 4.2.2, the existing pedestrian platform is 2.5 m wide and therefore the analysis does not need to consider the CHBDC Maintenance vehicle. It is recommended that if a custom City of Brantford maintenance vehicle is currently being utilized, or plans to be utilized, that it be limited to a maximum axle loading of 2.3 kN. Should the pedestrian platform be widened or modified, considerations for the CHBDC maintenance vehicle loading should be considered.

6. CONCLUSION AND RECOMMENDATIONS

Based on the load rating and deficiencies stated in this report, the existing bridge does not require a load posting, provided it is only subject to maintenance vehicle loading with a maximum axle loading of 2.3kN (235kg) or pedestrian loading. If the bridge was maintained by a maintenance vehicle with a maximum gross weight in excess of that stated above, or the CHBDC maintenance vehicle of 80 kN (approximately 8,155kg) as specified in Clause 3.8.11 of the CHBDC, we recommend that the existing pedestrian platform be modified or fully replaced, and all lower shelf angles and web in the stringers listed in **Table 4** be reinforced with additional steel plates and angles.

In addition to the repairs required to increase the load limit, outlined above, there are several other deficiencies identified in the 2018 Enhanced OSIM that should be addressed as part of a capital project in the next 1-5

years to maintain the structure in working order. A summary of the recommended rehabilitation work for Structure 104 is provided in **Table 4** and **Table 5** below. Please refer to Appendix A of the 2018 Enhanced OSIM Summary Report included in **Appendix II** of this report for a diagram describing node locations referenced in the tables below.

Note that replacement of bearing anchor pins is included in the rehabilitation scope of work provided in **Table 4** and **Table 5**. Until the anchor pins are replaced, the bridge is prone to lateral shifting if the watercourse level was to rise above the underside of the structure, similar to the ice jam in 2018.

Please note that the inspection completed was at a single point in time. To our knowledge, this is the first Enhanced OSIM completed on this structure. Therefore, there is no reference benchmark to help assess the rate of deterioration of steel elements. The recommended work implementation timeframes and extension of service life may vary depending on the actual rate of deterioration. Please note that the use of salt to maintain this structure in the winter months is expected to result in accelerated deterioration of the structure. It is therefore recommended that winter maintenance of this structure avoid the use of salt.

In accordance with the 2018 Ontario Structure Inspection Manual (OSIM), with structures greater than 30 years old with critical components in poor condition, it is recommended that an Enhanced OSIM inspection be completed every 6 years in order to monitor member deterioration, until such time that a major rehabilitation is completed to address the poor condition members. The last Enhanced inspection was completed in spring of 2018. Prior to detailed design of major rehabilitation work, it is recommended that an additional Enhanced OSIM take place to confirm the scope of the major rehabilitation work.

Table 4: Option 1 – Rehabilitation Works Required for an Estimated 15 to 30 Year Service Life

Item	Rehabilitation Work	Location
1.0	Reinforce lower shelf angles and web of stringers	• All stringers in west plate girder span
2.0	Concrete repair work	• East and west abutment • East, central, and west piers • All bearing seats, wingwalls and ballast walls • Underpinning of West Pier

3.0	Replace bearing anchor pins	• North and south bearings for each span at:
		  ○ east abutment (2)
		  ○ east pier (4)
		  ○ central pier (4)
		  ○ west pier (4)
		  ○ west abutment (2)

4.0	Replace all roller bearings of truss spans	• East truss span at east pier, two bearings • West truss span at west pier, two bearings
5.0	Reinforce lower shelf angle of plate girders	• West span, north girder, inside lower shelf angle in first two bays from the west
6.0	Reinforce or replace deficient bottom lateral bracing	• Lateral braces in east plate girder span between nodes: A21 to D22, A22 to D21, A24 to D23, A25 to D26, and A26 to D25 • Lateral braces in west plate girder span between nodes: A1 to D2, A4 to D5, A5 to D6, and A6 to D5 • Lateral braces in east truss span between nodes: A14 to D15, A15 to D16, and D15 to A16
7.0	Reinforce or replace deficient lateral connection plates	• Lateral brace plate connections in east plate girder span at nodes: A21, D21, A25, D25, A26, D26 • Lateral brace plate connections in west plate girder span at nodes: D1, D5, D6 • Lateral brace plate connections in east truss span at nodes: A14, D14, A20, and D20 • Lateral brace plate connections in west truss span at nodes: A7, D7, A12, A13, and D13
8.0	Repair Truss Bottom Chords	• Lower shelf angles above all truss span bearings • Lower shelf angles at lateral brace connections • Lower web member of bottom chord at nodes: A8, D8, D10, and D12
9.0	Repair Floor Beam	• West Truss span node A16 to D16.
10.0	Remove debris from steel members	• All four spans, on top of horizontal surfaces such as shelf angles

Table 5: Option 2 – Rehabilitation Works Required for an Estimated 10 to 20 Year Service Life

Item	Rehabilitation Work	Location
1.0	Reinforce lower shelf angles and web of stringers*[1]	• All stringers in west plate girder span
2.0	Concrete repair work	• Bearing seats at top of abutments and piers
3.0	Replace bearing anchor pins	• North and south bearings for each span at: ○ east abutment (2) ○ east pier (4) ○ central pier (4) ○ west pier (4) ○ west abutment (2)
4.0	Replace all roller bearings of truss spans	• East truss span at east pier, two bearings • West truss span at west pier, two bearings
5.0	Reinforce lower shelf angle of plate girders	• West span, north girder, inside lower shelf angle in first two bays from the west
6.0	Repair floor beam	• West Truss span node A16 to D16.
7.0	Remove debris from steel members	• All four spans, on top of horizontal surfaces such as shelf angles

[1] Rehabilitation work required if bridge is to be reopened to maintenance vehicle specified in Clause 3.8.11. of the CHBDC

Further to the recommendations provided above, we strongly suggest that the City ensures the following maintenance procedures are implemented or continued:

- Avoid use of de-icing chemicals, using sand as an alternative
- Regularly cut back and maintain vegetation around the abutments and deck of the structure
- Regularly clean structure of accumulated debris

7. LIMITATIONS

The following limitations are applicable to this load limit evaluation report:

- This report is intended exclusively for the Client(s) named in the report. The material in it reflects our best judgment in light of the information reviewed by GM BluePlan Engineering Limited at the time of preparation. Unless otherwise agreed in writing by GM BluePlan Engineering Limited, this report shall not be used to imply warranty as to the fitness of the property for a particular purpose. This report is not a certification of compliance with past or present regulations. No portion of this report may be used as a separate entity, it is written to be read in its entirety.
- Only the specific information identified has been reviewed. GM BluePlan Engineering Limited is not obligated to identify mistakes or insufficiencies in the information obtained from the various sources or to verify the accuracy of the information. GM BluePlan Engineering Limited may use such specific information obtained in performing its services and is entitled to rely upon the accuracy and completeness thereof.
- This assessment does not wholly eliminate uncertainty regarding the potential for existing or future losses in connection with a property. No physical or destructive testing has been performed unless specifically recorded. Conditions existing, but not recorded, were not apparent given the level of study undertaken. We can perform further investigation on items of concern, if so required.

8. BIBLIOGRAPHY

1. The Canadian Highway Bridge Design Code, CSA S6-19 (CHBDC)

2. Bakht, B. and Jaeger, L.G (1988). Document SRR-88-04 “Bridge Testing – A Surprise Every Time.” The Research and Development Branch, Ministry of Transportation of Ontario

We thank you for engaging in the services of GM BluePlan Engineering Limited, and trust that this report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

Your truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

Adam Galezowski, P.Eng.

Per:

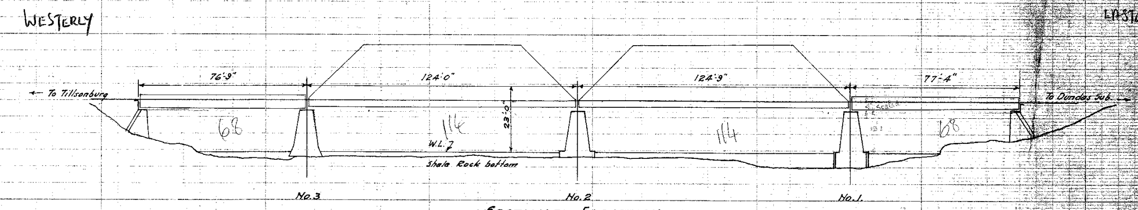
Jens Hummel, P.Eng.

BluePlan ENGINEERING

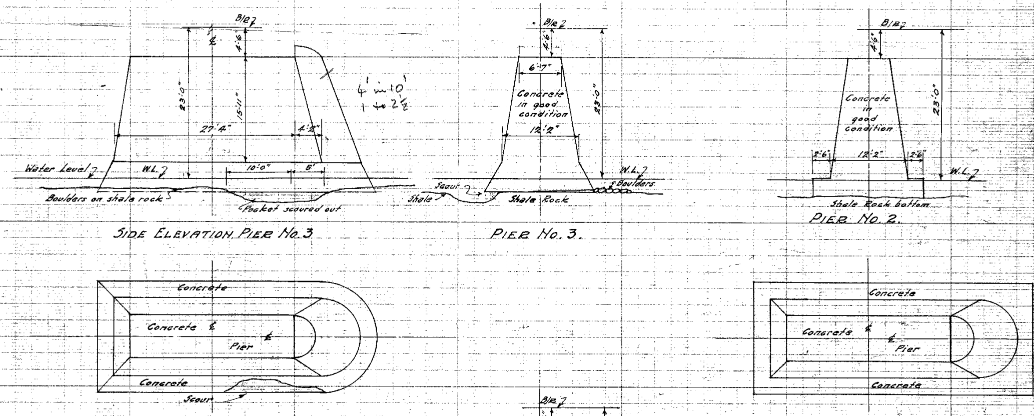
2021 Structural Evaluation Report

Appendix I

Historical Drawings



SECTIONAL ELEVATION
Scale 1" = 30'



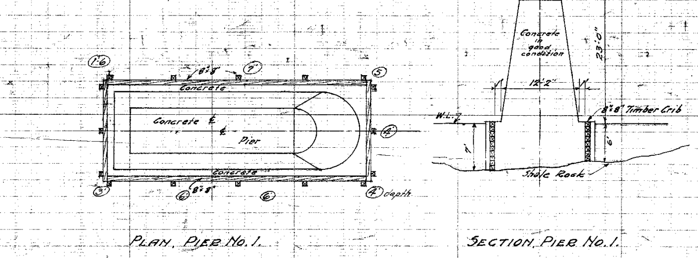
SIDE ELEVATION PIER No.3

PIER No.3.

PIER No.2.

PLAN. PIER No.3.

PLAN. PIER No.2.



PLAN. PIER No.1.

SECTION. PIER No.1.

SCALE 1" = 10'

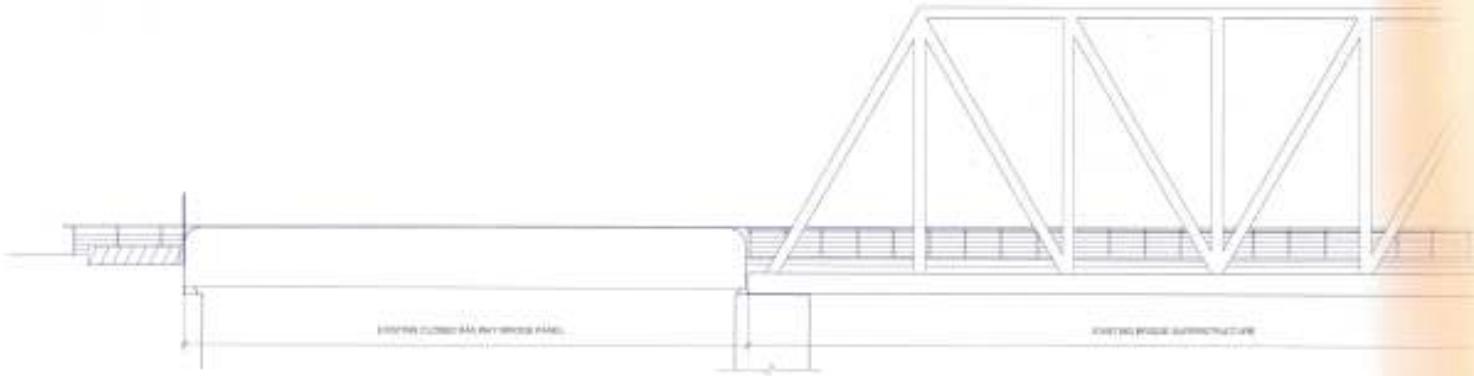
CANADIAN NATIONAL RAILWAYS
CENTRAL REGION
LONDON DIV'N. BURFORD SUBDIV.

BRIDGE M.P. 9.5
OVER GRAND RIVER
AT BRANTFORD

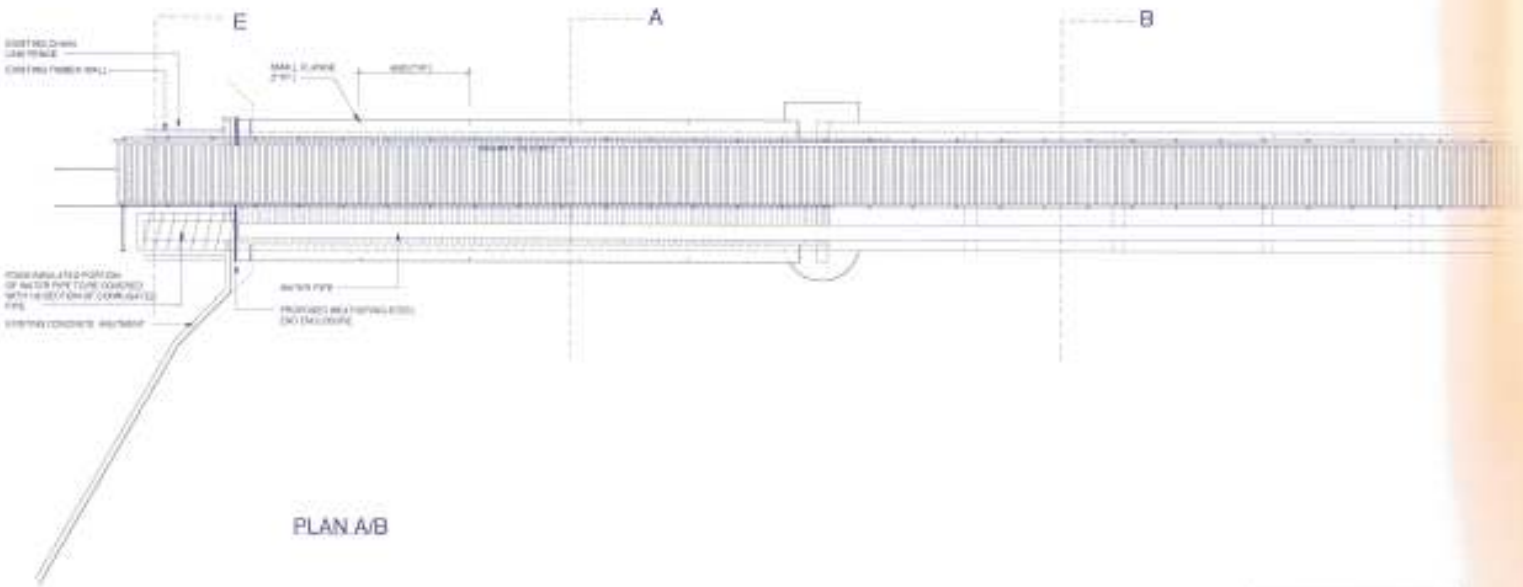
INFORMATION FROM INSPECTION BY DIVING CREW MAY 25th 1934

Drawn by N.F.

Inspector



ELEVATION A/B



PLAN A/B

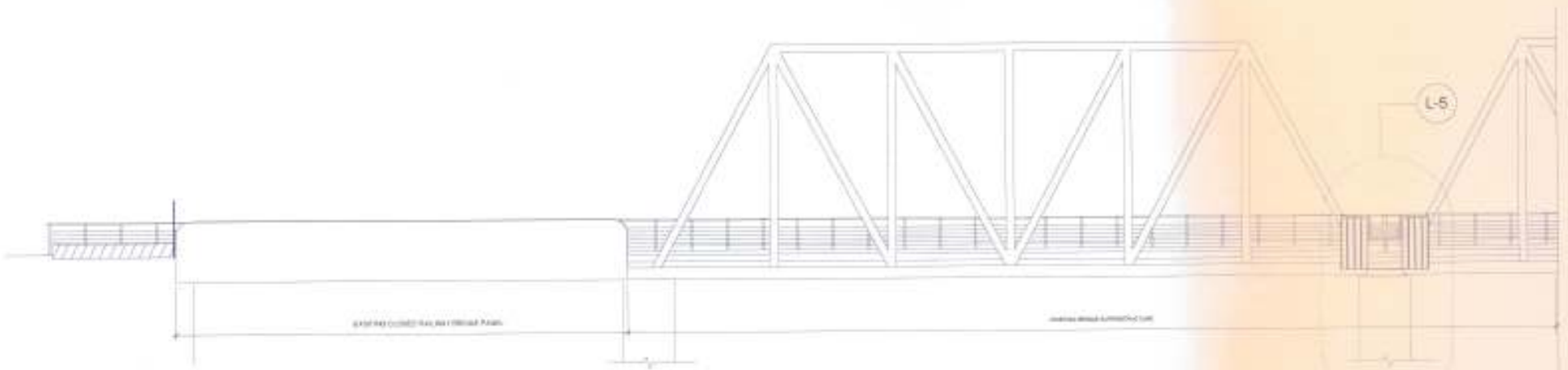
PMA

Brantford Waterfront
Brantford, On.

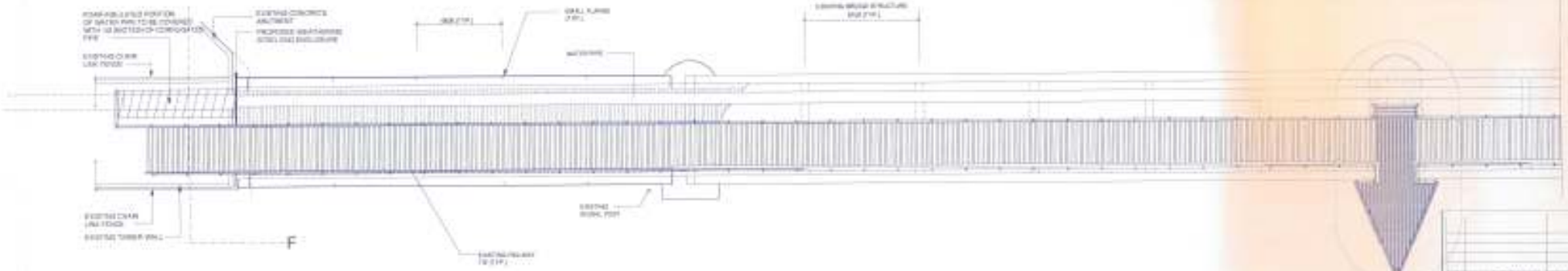
Trestle Bridge
East Side

95053

L-1



ELEVATION C/D



PLAN C/D

PMA

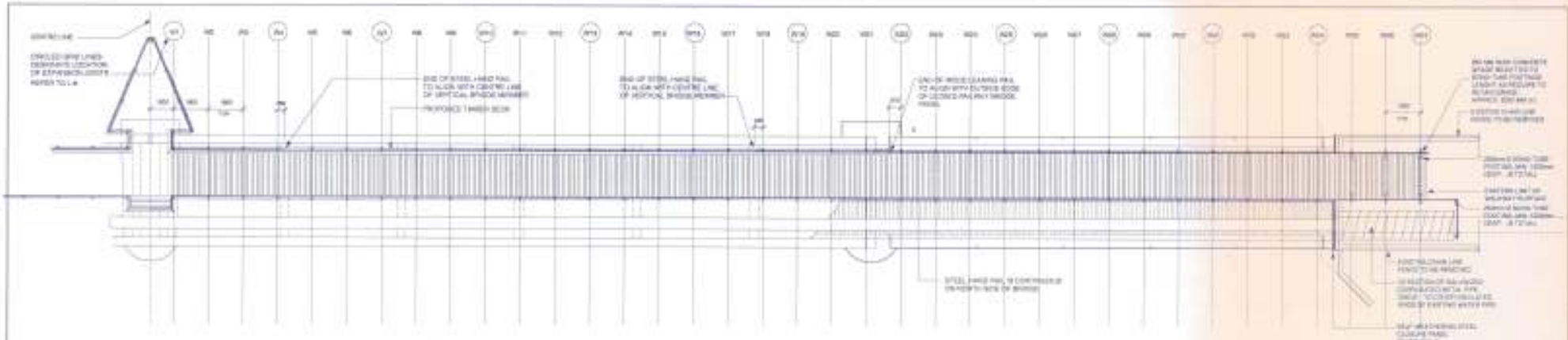
Brantford Waterfront

Brantford, ON

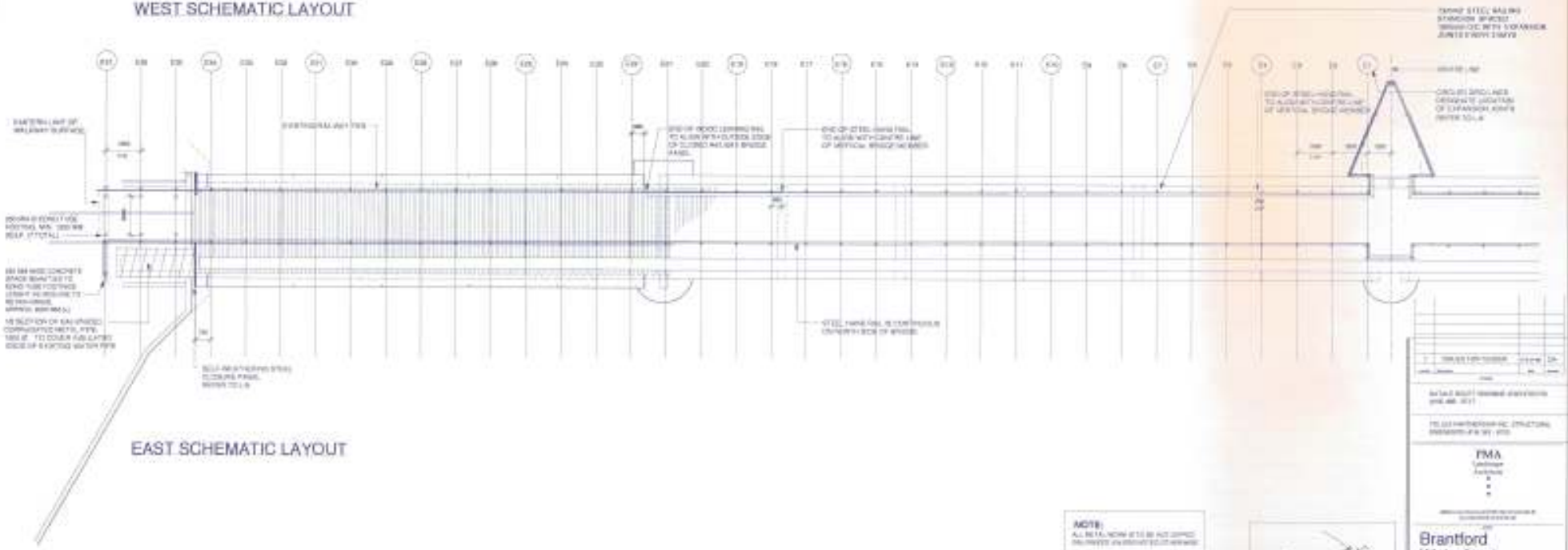
Trestle Bridge West Side

95053

L-2



WEST SCHEMATIC LAYOUT



EAST SCHEMATIC LAYOUT

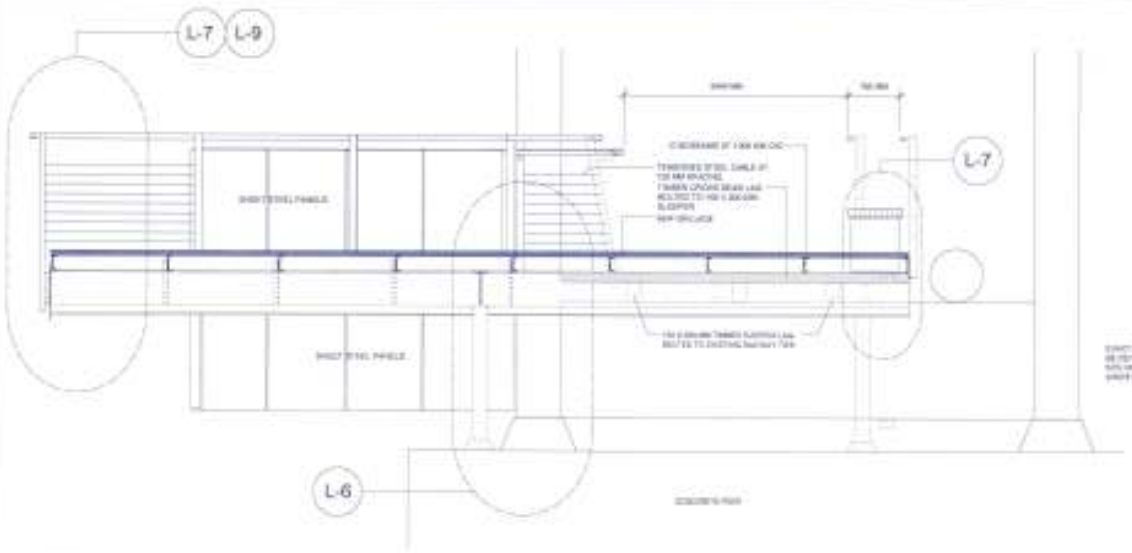
NOTE:
ALL METAL WORK IS TO BE HOT DIPPED GALVANIZED AFTER BEING CUT AND MADE

PMA

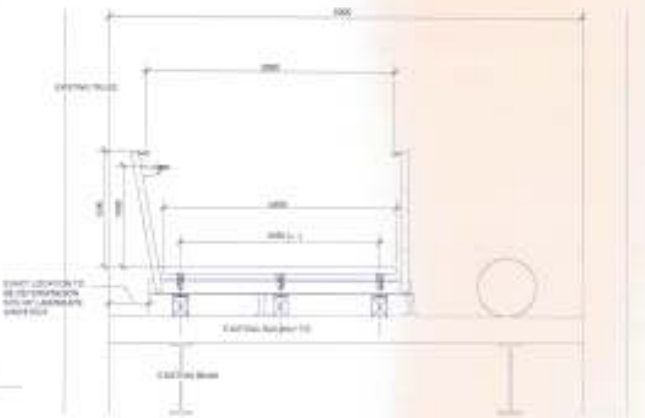
Brantford Waterfront
Brantford, On.

Trestle Bridge Layout Schematic

1:100
DM
FEB '98
95053
L-3



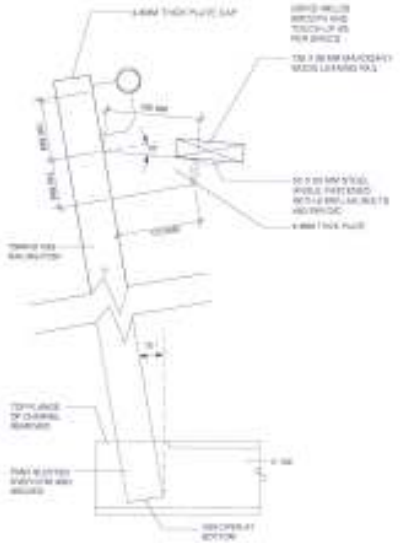
Section C



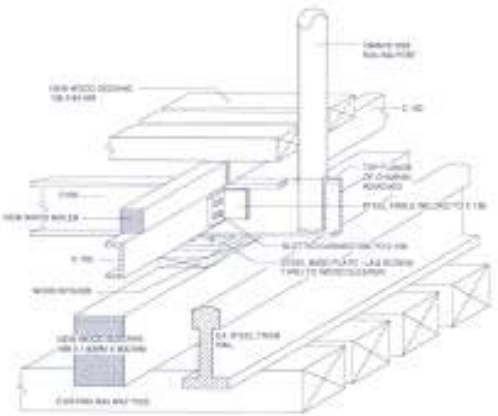
Section B

NOTE:
LIVE LOAD = 4.8 kPa, MAX. GRILLAGE SELF-WEIGHT=1.97 kPa

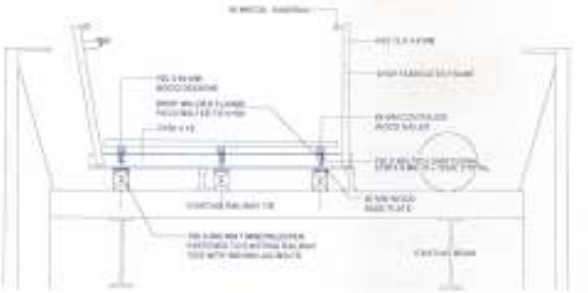
DESIGN ALL HANDRAIL AND STANCHION CONNECTIONS FOR HORIZONTAL LIVE LOAD OF 2.0 kN/m ACTING AT TOP OF HANDRAIL AND FOR A VERTICAL LIVE LOAD OF 1.0 kN/m AS PER THE ONTARIO BUILDING CODE.



canted rail



wood deck axonometric



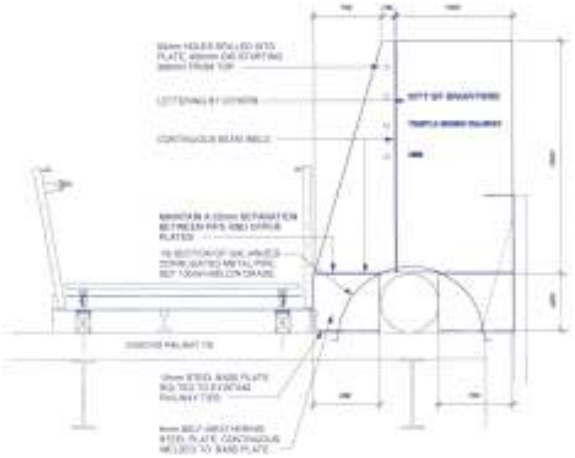
Section A

Brantford Waterfront
Brantford, Ont.

Trestle Bridge Details

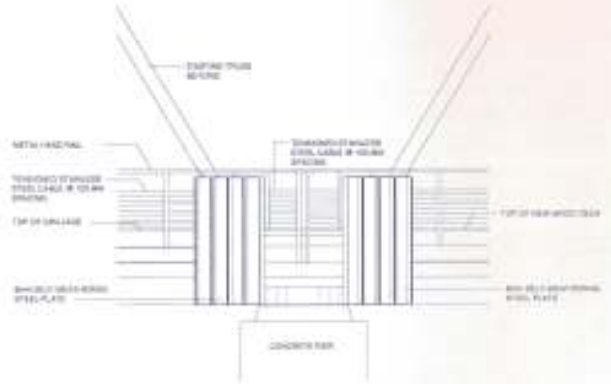
95053

L-4



Section/ Elevation E (Typ. for Section/ Elevation F) - Closure Panel

Scale 1:25

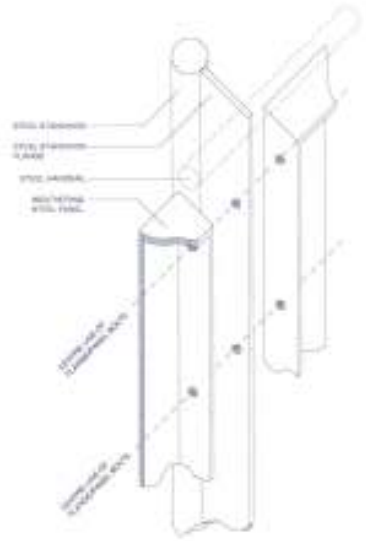


Elevation - Front elevation of lookout, looking north

Scale 1:25

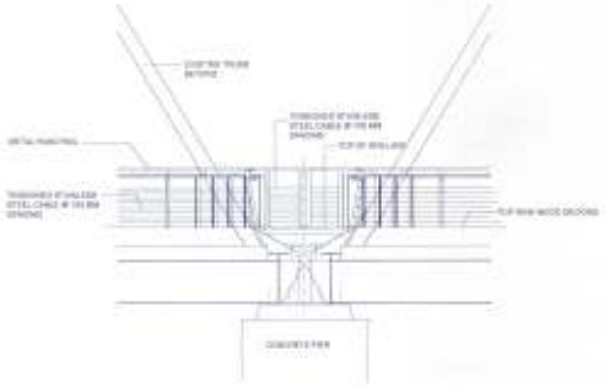
section

elevation - weathering steel panels



steel stanchion at weathering steel panels

Scale 1:50



Section D - Section thru walkway at lookout, looking south

Scale 1:25

NOTE:

PMA

Brantford Waterfront

Brantford, ON.

Trestle Bridge Details

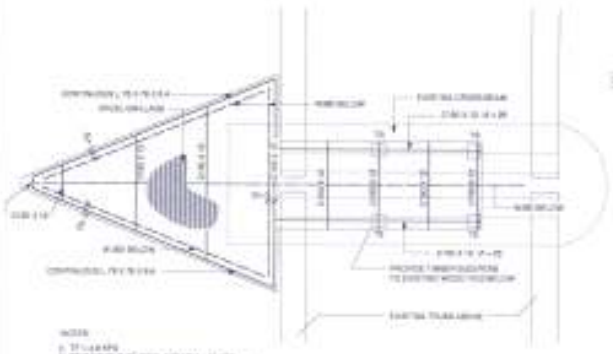
AS SHOWN

SM

95053

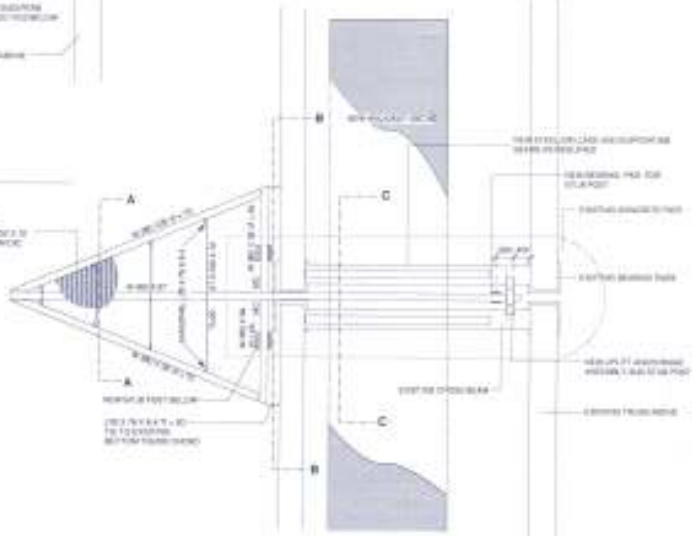
JAN. 98

L-5



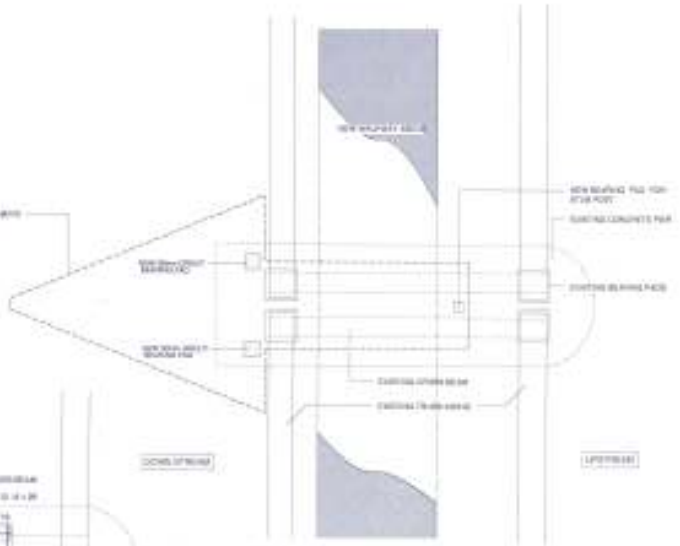
plan - top of grillage support beams

Scale 1:50



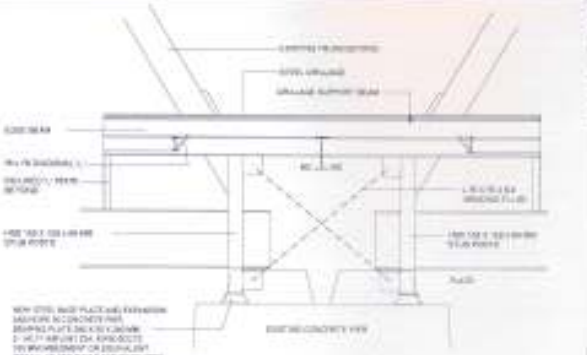
Plan - top of steel structure

Scale 1:50



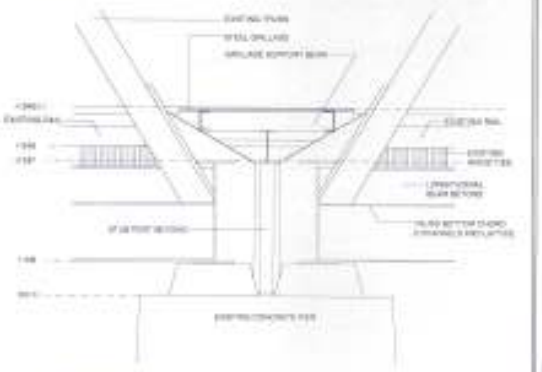
Plan - top of pier

Scale 1:50



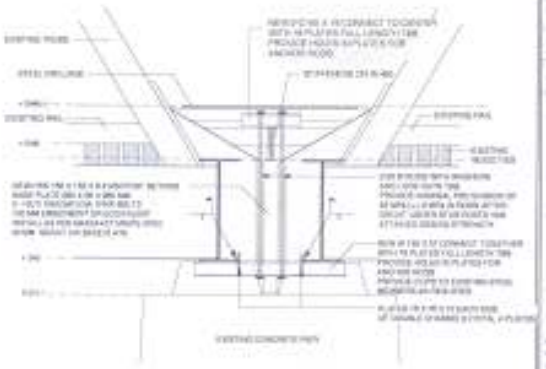
Section A-A

Scale 1:50



Section B-B

Scale 1:50



Section C-C

Scale 1:50

NOTE:

ALL METAL WORK TO BE HOT DIPPED GALVANIZED UNLESS NOTED OTHERWISE

PMA

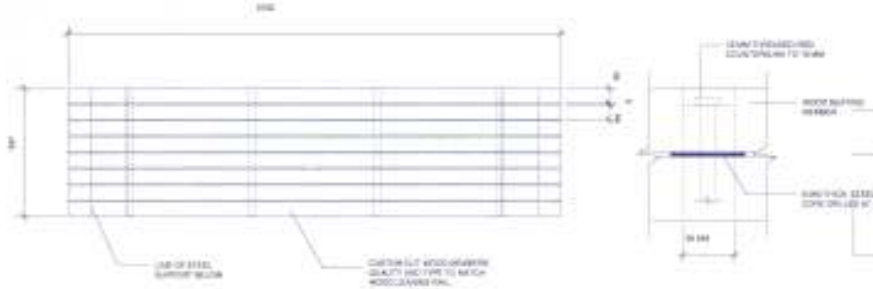
Brantford Waterfront

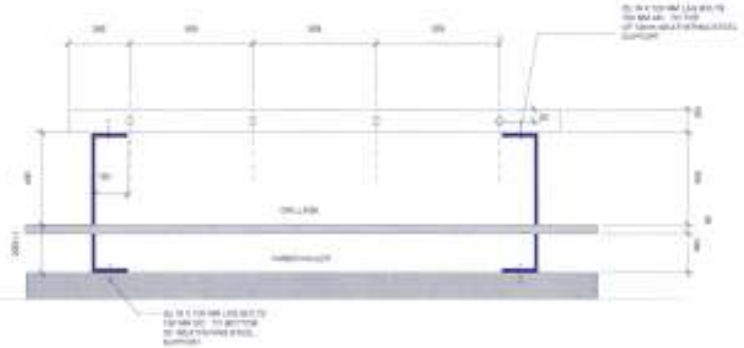
Brantford, ON.

Trestle Bridge Details

95053

L-6

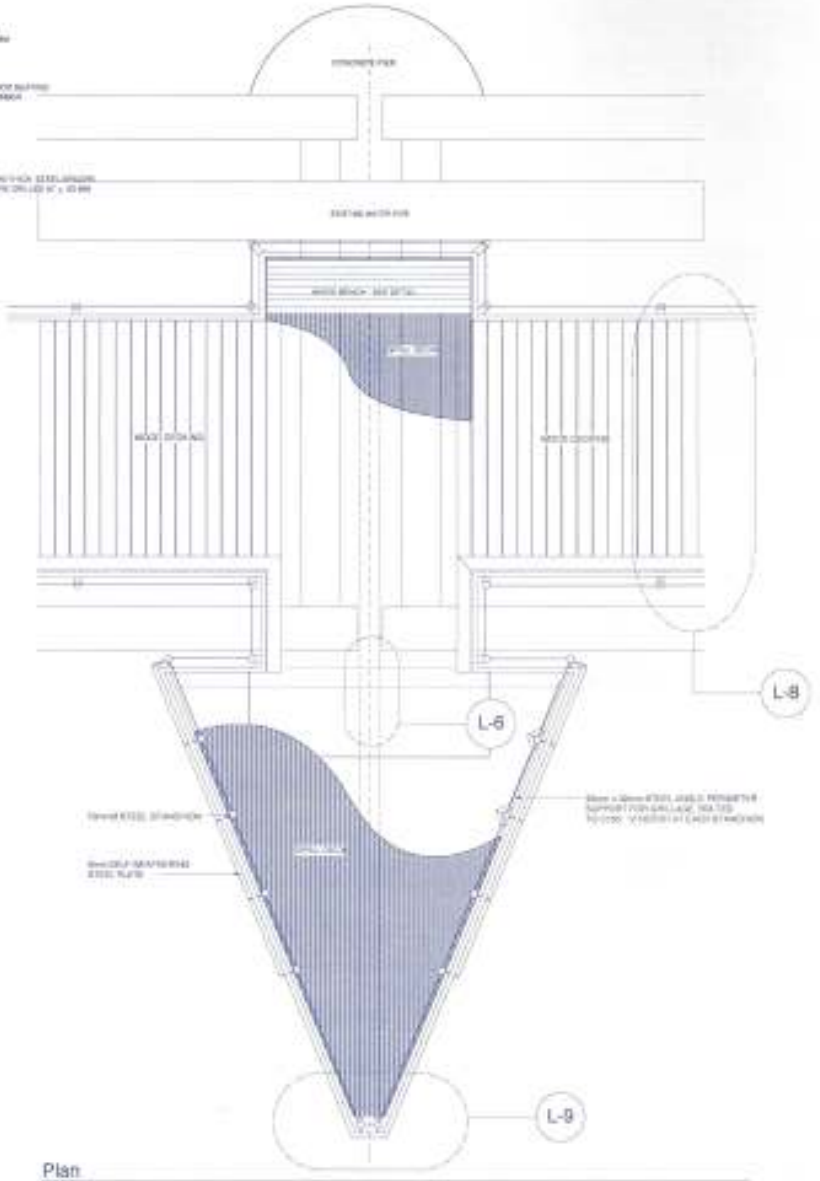




wood bench

NOTE:
LIVE LOAD = 4.8 kPa, MAX. GRILLAGE SELF-WEIGHT= 1.0 kPa

DESIGN ALL HANDRAIL AND STANCHION CONNECTIONS FOR HORIZONTAL LIVE LOAD OF 2.0 kNm ACTING AT TOP OF HANDRAIL AND FOR A VERTICAL LIVE LOAD OF 1.0 kNm AS PER THE ONTARIO BUILDING CODE.



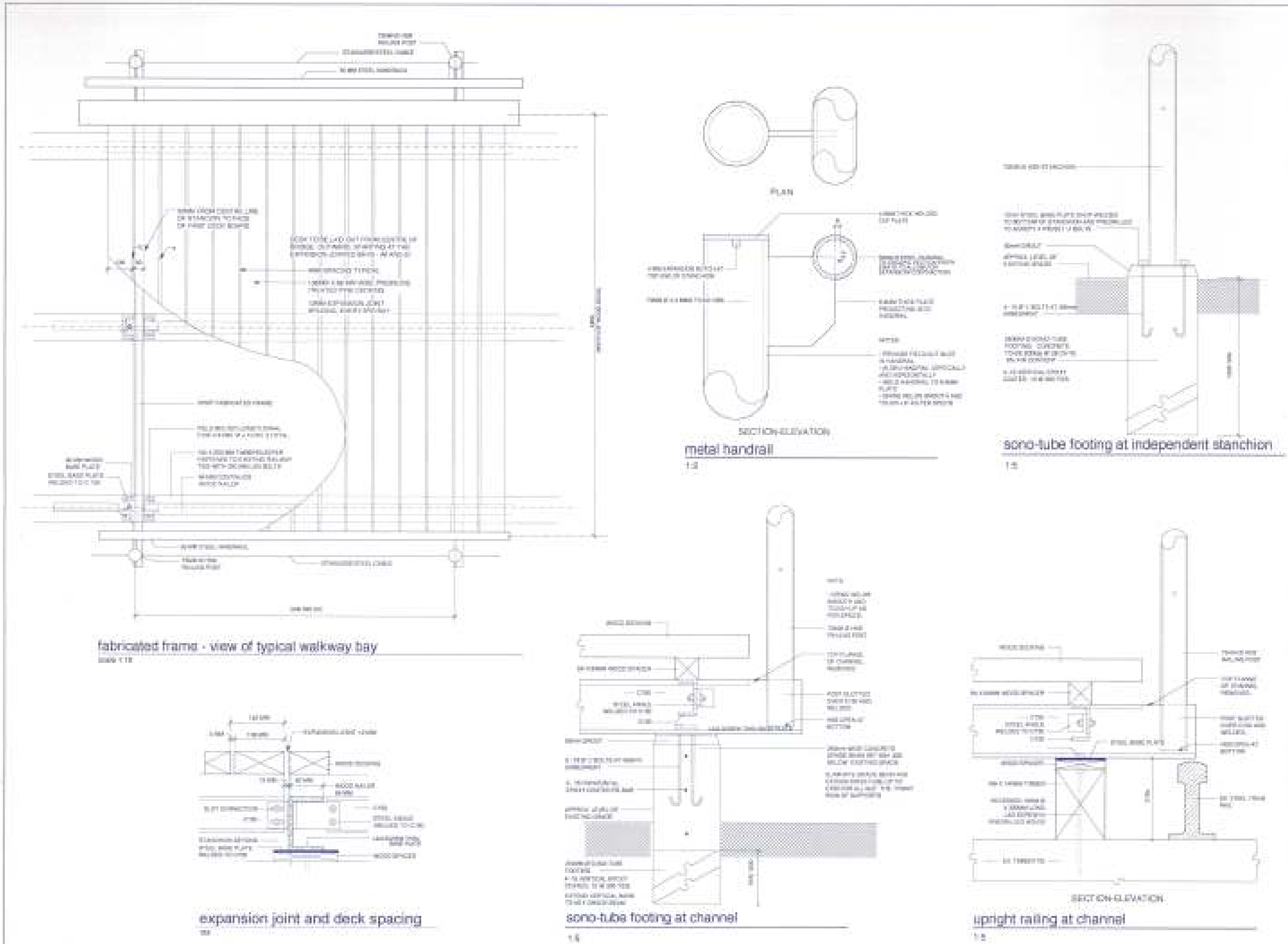
Plan

FMA

Brantford Waterfront
Brantford, ON

Trestle Bridge Details

AS SHOWN
95053
L-7



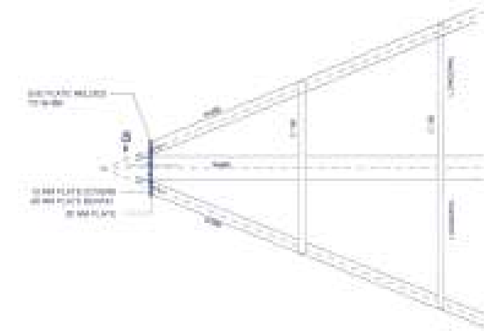
PMA

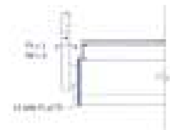
Brantford
Waterfront
Brantford, ON

Trestle Bridge
Details

95053

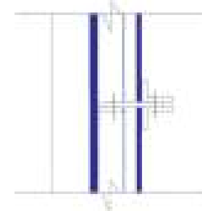
L-8



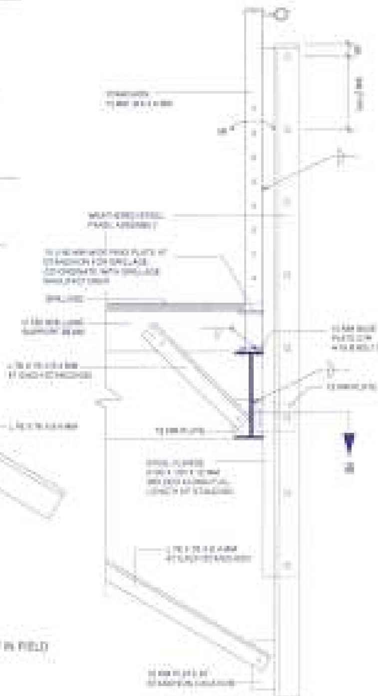


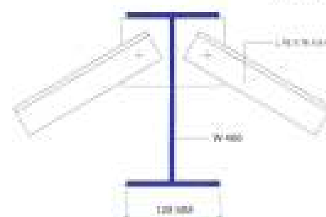
SECTION a

Plan At Platform Tip



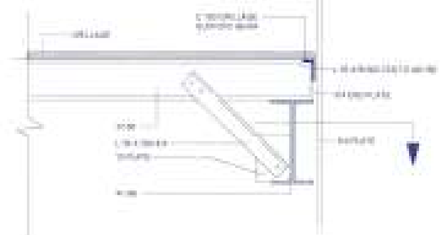
section a





NOTE:
USE BOLTED CONNECTIONS ONLY IN FIELD

section at stanchion



nose section

NOTE:
LIVE LOAD = 4.8 kPa. MAX GRILLAGE SELF-WEIGHT=1.67 kPa

DESIGN ALL HANDRAIL AND STANCHION CONNECTIONS FOR HORIZONTAL LIVE LOAD OF 2.0 kN/m ACTING AT TOP OF HANDRAIL AND FOR A VERTICAL LIVE LOAD OF 1.2 kN/m AS PER THE ONTARIO BUILDING CODE

PMA

Brantford Waterfront
Brantford, ON

Trestle Bridge Details

AS SHOWN

95053

L-9

ABBREVIATIONS

A. BOLT= ANCHOR BOLT
ARCH. = ARCHITECTURAL
@ = AT
BLDG. = BUILDING
BM = BEAM
B. BOT = BOTTOM
C/C OR C.-C. = CENTRE TO CENTRE
CANT. = CANTILEVER
CL. = CLEAR
CONC. = CONCRETE
CONSTR = CONSTRUCTION
CONT. = CONTINUOUS
C/W = COMPACT WITH
DET = DETAIL
DIAG. = DIAGONAL
DIA. Ø = DIAMETER
DIM = DIMENSION
DL = DEAD LOAD
DWG(S) = DRAWING(S)
EA = EACH
EL. = ELEVATION
EQ. = EQUAL
EXIST. = EXISTING
E-W = EAST/WEST
kN = KILONEWTON
kN/m = KILONEWTON PER METRE
kN/m = KILONEWTON PER METRE
kP a = KILOPASCAL
LL = LIVE LOAD, LOWER LAYER
LL/V = LONG LEG VERTICAL
LL/H = LONG LEG HORIZONTAL
m = METRE
MAX. = MAXIMUM
MC = MOMENT CONNECTION
MIN. = MINIMUM
MISC. = MISCELLANEOUS
MOM. = MOMENT
MPa = MEGAPASCAL
N = NEWTON
N.T.S. = NOT TO SCALE
N-S = NORTH-SOUTH
OPNG. = OPENING
Pa = PASCAL
R = REACTION, RADIUS
REQ'D. = REQUIRED
REV. = REVISION, REVISED
SECT. = SECTION
SPECS = SPECIFICATIONS
STD. = STANDARD
STRUCT. = STRUCTURAL
SQ. = SQUARE
T. = TOP
TYP. = TYPICAL
UN. = UNLESS OTHERWISE NOTED
U/S = UNDERSIDE
V. VERT. = VERTICAL

A. GENERAL

1. WHERE DOCUMENTS ARE REFERENCED IN THE GENERAL AND DESIGN NOTES, THEY SHALL BE THE LATEST EDITIONS, UNLESS OTHERWISE NOTED OR SHOWN.

2. READ DRAWINGS IN CONJUNCTION WITH SPECIFICATIONS AND ALL OTHER CONTRACT DOCUMENTS.

3. SUBMIT SHOP DRAWINGS STAMPED BY AN ENGINEER LICENSED TO PRACTICE IN THE PROVINCE OF ONTARIO FOR THE CONSULTANTS REVIEW BEFORE THE FABRICATION OF ANY STRUCTURAL STEEL.

4. HORIZONTAL AND VERTICAL DESIGN CLEARANCE ARE NOTED. THEY SHALL NOT BE EXCEEDED DURING CONSTRUCTION.

B. MATERIALS

1. STRUCTURAL STEEL FINISHING CONFORMS TO CAN/CSA-G40.21 GRADE 350W EXCEPT THAT HSS MEMBERS ARE TO BE GRADE 350W, CLASS H, UNLESS OTHERWISE NOTED OR SHOWN.

2. NON-SHRINK GROUT 35MPa MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS.

3. GLUED LAMINATED TIMBER CONFORM TO CSA 0141.

4. ANCHOR BOLTS CONFORM TO ASTM 307 UNLESS OTHERWISE NOTED OR SHOWN.

C. FOUNDATIONS

1. FOUND ALL FOOTINGS ON NATURALLY CONSOLIDATED UNDISTURBED SOIL CAPABLE OF SAFELY SUSTAINING AN UNFACTORED BEARING PRESSURE OF 150 kPa. IF THESE CONDITIONS DO NOT PREVAIL AT THE ELEVATIONS SHOWN, ADVISE THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

2. FOUND FOOTINGS BELOW THE LEVEL AT WHICH POTENTIAL DAMAGE RESULTING FROM FROST ACTION CAN OCCUR, BUT A MINIMUM OF 1200 BELOW FINISHED GRADE IF NOT NOTED TO BE FOUNDED LOWER.

3. THE LINE OF SLOPE BETWEEN ADJACENT FOOTINGS OR EXCAVATIONS SHALL NOT EXCEED A RISE OF 1 IN A RUN OF 10.

D. STRUCTURAL STEEL

1. CENTRE BEARING PLATES UNDER BEAMS UNLESS OTHERWISE NOTED OR SHOWN.

2. BEARING PLATE DIMENSION GIVEN FIRST INDICATES SIDE PARALLEL TO BEAM WEB.

3. NO STRUCTURAL STEEL SHALL BE CUT IN THE FIELD UNLESS REVIEWED AND APPROVED BY THE CONSULTANT.

4. ALL WELDS EXPOSED TO VIEW SHALL BE SEQUENCED SMOOTH AS DESCRIBED ON DRAWINGS.

5. THE FOLLOWING ARE THE ABBREVIATIONS USED FOR THE CONNECTION FORCES GIVEN ON THE DRAWINGS. FORCES INDICATED ARE FACTORED LOADS UNLESS OTHERWISE NOTED OR SHOWN.
VF= VERTICAL SHEAR, kN
HF= HORIZONTAL FORCE, kN
C= COMPRESSIVE FORCE, kN
T= TENSION FORCE, kN
MBF= BENDING MOMENT ABOUT X-AXIS, kN-m
MFF= BENDING MOMENT ABOUT Y-AXIS, kN-m

SUBSCRIPTS D, L AND O REFER TO DEAD, LIVE AND WIND OR EARTHQUAKE LOADS, RESPECTIVELY.

6. WHERE MOMENT CONNECTIONS ARE CALLED FOR BUT VALUES ARE NOT INDICATED, DESIGN CONNECTIONS FOR FULL MOMENT CAPACITY OF THE SMALLER MEMBER JOINED.

7. SPLICES SHALL BE DESIGNED TO DEVELOP THE FULL CAPACITY OF THE MEMBER AT THE POINT OF THE SPLICE. MEMBERS SHALL NOT BE SPLICED AT POINTS OF MAXIMUM STRESS. NO SPLICES SHALL BE MADE UNLESS SHOWN ON THE DRAWINGS OR REVIEWED AND APPROVED BY THE CONSULTANT.

8. PROVIDE WELDED STIFFENER PLATES ON BOTH SIDES OF THE WEB OF BEAMS AT BEAMS RUNNING OVER TOPS OF COLUMNS.

9. CONNECT ALL COLUMNS TO THE BASE PLATES FOR THE LARGER OF THE FOLLOWING FORCES IN ADDITION TO OTHER FORCES SHOWN:
A) 2/3 BRACING FOR THE HORIZONTAL COMPONENTS FROM THE BRACING
B) FOR 2% OF THE FACTORED VERTICAL COLUMN LOAD APPLIED HORIZONTALLY.

10. PROVIDE ALL ANCHOR BOLTS, CAST IN PLATES WITH ANCHORS, AND ANCHORS REQUIRED TO CONNECT STRUCTURAL STEEL TO CAST-IN-PLACE CONCRETE.

11. LENGTH FOR ANCHOR BOLTS IS GIVEN FOR THE STRAIGHT LENGTH WITHOUT THE HOOK.

12. PROVIDE CAMBER TO BEAMS AS SHOWN ON THE PLANS. CAMBERS SHOWN ARE FOR ERECTED IN-PLACE CONDITIONS OF MEMBERS BEFORE INSTALLATION OF STEEL GRATING.

13. INSTALL 75 X75 X6mm ANGLE SEATS FOR STEEL GRATING AT CONNECTIONS, AT HANDRAIL POSTS OR OTHER IRREGULARITIES. TO PROVIDE SUPPORT TO THE STEEL GRATING AS REQUIRED BY GRATING MANUFACTURER.

E. ALTERATIONS AND / OR CONNECTIONS TO EXISTING STRUCTURE

1. PROPOSED SCHEDULE OF WORK TO BE CODRDINATED WITH ALL SUBTRADES, THE CONSULTANT AND THE OWNER.

2. PROPOSED SEQUENCE OF WORK TO BE SUBMITTED TO THE CONSULTANT FOR REVIEW PRIOR TO START OF WORK.

3. INSPECT THE EXISTING BRIDGE AND BECOME FAMILIAR WITH THE EXISTING CONDITIONS. DETAILS SHOWN ARE BASED ON INFORMATION AVAILABLE FROM SITE INSPECTIONS ONLY.

4. CHECK ALL DRAWINGS AGAINST ACTUAL CONDITIONS ON SITE PRIOR TO FABRICATING ANY STRUCTURAL STEEL. REPORT DISCREPANCIES TO THE CONSULTANT BEFORE PROCEEDING WITH THE WORK.

5. PRIOR TO FABRICATION OF STRUCTURAL STEEL, OPEN UP AREAS WHERE CONNECTIONS ARE TO BE MADE TO EXISTING WORK AND TAKE FIELD MEASUREMENTS. MODIFY DETAILS FOR CONNECTING TO SUIT SITE CONDITIONS FOUND AND TO THE APPROVAL OF THE CONSULTANT. CARRY OUT LOCAL REPAIRS TO THE EXISTING WORK AS NECESSARY AND AS DIRECTED BY THE CONSULTANT.

6. SHORE EXISTING WORK AS REQUIRED UNTIL ALL NEW WORK HAS BEEN COMPLETED AND REVIEWED BY THE CONSULTANT.

7. OPENINGS AND HOLES
PREPARE LAYOUTS OF ALL NEW HOLES AND OPENINGS THROUGH EXISTING WORK FOR REVIEW BY THE CONSULTANT.

8. PROVIDE SLOTTED HOLES AND FRICTION TYPE BOLTED CONNECTIONS TO CONNECT NEW STEEL TO EXISTING WORK.

9. SHORE MEMBERS AS REQUIRED TO SUPPORT CRANES, HOISTS AND OTHER CONSTRUCTION EQUIPMENT.

10. CONFORM WITH ALL APPLICABLE CODES AND BY-LAWS CONCERNING SAFETY, NOISE AND VIBRATIONS.

11. MODIFY THE LAY-OUT OF EXPANSION ANCHORS AND OTHER ANCHORING DEVICES REQUIRED TO AVOID EXISTING CONCRETE REINFORCEMENT.

DESIGN NOTES

A. GENERAL

1. THE STRUCTURE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF THE 1990 ONTARIO BUILDING CODE.

2. ALL STRUCTURAL STEEL ELEMENTS HAVE BEEN DESIGNED IN ACCORDANCE WITH CAN/CSA- S16.1, LIMIT STATES DESIGN OF STEEL STRUCTURES.
A) THE STRUCTURAL STEEL DESIGN IS BASED ON "SIMPLE" CONSTRUCTION.
B) THE CONNECTIONS ARE ASSUMED TO BE BEARING TYPE JOINTS. THE BOLTS SHALL BE BROUGHT TO A SNUG-TIGHT CONDITION AS DEFINED IN CAN/CSA-S16.1.

B. LATERAL FORCES ON STRUCTURAL FRAME

1. THE VIEWING PLATFORM HAS BEEN DESIGNED TO RESIST THE HORIZONTAL LINE AVERAGE HOURLY WIND PRESSURE OF 0.3kPa IN ACCORDANCE WITH THE ONTARIO BUILDING CODE, AND THE LIVE LOADS DUE TO EARTHQUAKE APPROPRIATE TO ZONE 2(a=1.4(0.2)v = 0.5) IN ACCORDANCE WITH THE ONTARIO BUILDING CODE, WHICHEVER PRODUCES THE MORE UNFAVOURABLE EFFECT.

C. LIVE AND OTHER LOADS

1. SEE NOTES BELOW FLOOR PLANS. ALL VALUES GIVEN ARE UNFACTORED LOADS UNLESS OTHERWISE NOTED OR [illegible] SHOWN FOR FUTURE EXTENTIONS.

1. THE STRUCTURE HAS NOT BEEN DESIGNED FOR ANY FUTURE EXTENTIONS.

PMA
Landscape Architects

Brantford Waterfront
Brantford, On.

Trestle Bridge
Structural Specifications

95053

L-10

BluePlan ENGINEERING

2021 Structural Evaluation Report

Appendix II

2018 Enhanced OSIM Summary Report

Prepared By:

City of Brantford

Brant's Crossing Bridge (Structure 104) Enhanced OSIM Summary Report

GMBP File: 118074

December 2018

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER |LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

APPENDICES

BRANT'S CROSSING BRIDGE (STRUCTURE 104) ENHANCED OSIM SUMMARY REPORT

CITY OF BRANTFORD

DECEMBER 2018

GMBP FILE: 118074

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the City of Brantford (City) to complete an Enhanced OSIM inspection and summary report of the Brant's Crossing Bridge (Structure 104), located south of Colborne Street West and spanning the Grand River in the City of Brantford. The City requested this inspection in response to flooding and ice jamming events in February of 2018 in order to obtain a more detailed understanding of the condition of the bridge and to estimate costs for rehabilitation or replacement options.

The following is a summary description of the structure based on the results of our Enhanced OSIM inspection. The recommended capital works for rehabilitation and superstructure replacement are summarized below, complete with cost estimates attached. Capital costs have been estimated based on our recent experience in similar bridge construction projects, including recent tender prices received by GMBP, and discussions with suppliers and contractors. The capital cost estimates are presented in 2018 dollar values and do not include HST; however, cost estimates do include associated costs such as engineering design and contingencies. The estimated costs contained in this report should be considered as preliminary, as no pre-design work has been completed that may influence costs of items such as environmental considerations, transportation requirements, geotechnical conditions, regulatory authority requirements, as well as any ancillary work beyond the limits of the bridge.

It should also be noted that projects involving railway bridges converted to pedestrian bridges are quite unique, and can often be difficult to accurately estimate.

1.1 Background

Structure 104 is a four span bridge that was originally designed to convey railway traffic, but has since been converted to a pedestrian bridge to carry pedestrian traffic and a utility crossing across the Grand River. Based on discussions with City staff, the utility crossing is no longer in active service. The superstructure consists of two through truss spans (Spans 2 & 3) and two plate girder spans (Spans 1 & 4). There are no drawings of the superstructure; however, the City provided drawings for the substructure that indicate the piers and abutments are founded on rock using spread footings. The drawings are dated as 1911 and 1912. It should be noted that the west pier is the abutment of a former bridge in this location that was repurposed as a pier. City staff have indicated that this bridge was converted to a pedestrian bridge in approximately 1997.

An ice jam event in the Grand River on February 21, 2018, prompted a preliminary visual inspection that was completed by GMBP. Based on the findings of the preliminary visual inspection, it was recommended that additional inspections be completed in the form of an Enhanced OSIM inspection in order to properly assess the condition of Structure 104 and that the structure be closed due to suspected movements of the superstructure. In order to safely assess all elements of the bridge within an arm's reach, ASI Group Ltd. (ASI) was retained to perform an underwater inspection of the abutment and pier footings and Acuren Group Ltd. (Acuren) was retained to perform a ropes access inspection of all other elements beyond an arm's reach, which included the underside of the structure and top members of the trusses. The ropes access inspection occurred over a period of 4 days from May 28, 2018, to May 31, 2018, and the underwater inspection occurred on June 22, 2018. All inspections were completed under the supervision of Adam Galezowski, P.Eng., of GMBP. Copies of the ASI and Acuren reports are provided in **Appendix A**.

1.2 Nomenclature

For the purpose of this report, all bridge elements have followed a naming convention to inform their location. A sketch of Structure 104 that has adopted this naming convention has been included in **Appendix B**. For definitions of some of the technical terms used in this report refer to **Appendix C**. Steel members in each span generally consist of built-up sections. Refer to **Figure 1** below for the standard terminology used for these built-up sections.

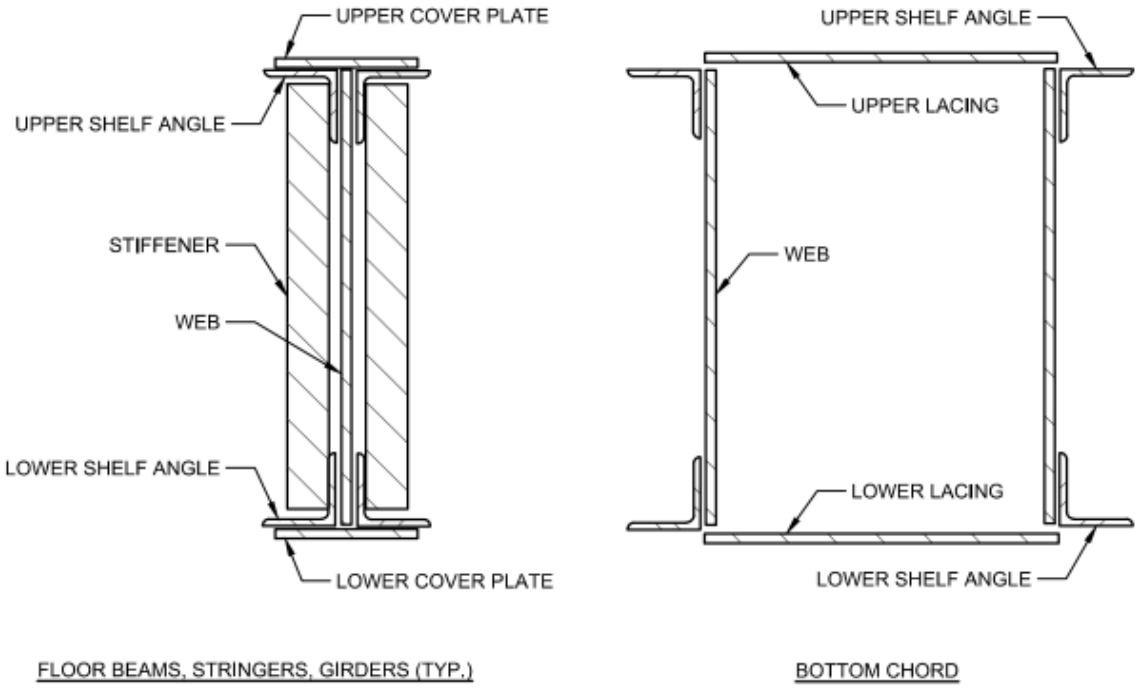


Figure 1: Cross Sections of Typical Built-Up Sections in Structure 104

2. INSPECTION SUMMARY

Table 1 and **Table 2** include a summary of deficiencies observed during the 2018 Enhanced OSIM inspection for the plate girder spans and the truss spans, respectively. The deficiencies have been summarized based on inspection reports provided by ASI and Acuren, as well as our inspector's observations and have been categorized as being major or minor depending on our opinion of their structural significance. Major deficiencies are considered to be critical and should be addressed in the next 1-5 years to maintain the structural integrity of the bridge. Minor deficiencies are not classified as urgent and can be addressed at a later time, though consideration should be given to addressing all deficiencies under one project. Refer to **Appendix D** for photos referenced in the tables below.

Table 1: Plate Girder Spans - Summary of Deficiencies

Structure Element	Observations	Photo Ref#
Abutments/ Wingwalls	Major Deficiencies • Light to severe cracking, spalling and delamination throughout.	G2
	Minor Deficiencies • Minor erosion at water level.	G2
	• Wood blocking beneath floor beam on east abutment.	G3
Abutment Bearings	Major Deficiencies • All bearings appear to be seized.	G4-G5
	• Bearings located on each abutment appear to have shifted as follows: o East Abutment – North Bearing: 25mm west o East Abutment – South Bearing: 25mm north o West Abutment – North Bearing: 40mm south o West Abutment – South Bearing: 40mm south Note: In the absence of previous monitoring data, the above bearing movements were determined based on measured deflections of the bearing anchor bolts.	G4
	• Anchor bolts have severe material loss ranging between 10% - 100% at the base of the bolt. Complete section loss of bolts was noted at the west abutment.	G4-G6
Stringers	Major Deficiencies • Very severe isolated corrosion with 40-100% material loss noted in web above lower shelf angles. The very severe material loss is isolated on stringers in Bay 5.	G11
	• Severe corrosion with 40-60% material loss noted in web above lower shelf angles throughout stringers in Bays 1-4.	-
	• Isolated severe corrosion and impact damage on the interior lower shelf angle leg of the north stringer in Bay 5.	G12
	Minor Deficiencies • Stringer stiffeners have 100% material loss isolated at the base of the member. On average, the material loss extends up to 150mm above the lower shelf angle legs.	G11-G12
	• Overall medium to severe corrosion noted throughout upper and lower shelf angles with up to 10% and 30% material loss respectively.	G11-G12

Structure Element	Observations	Photo Ref#
Girders	Major Deficiencies	
	• Very severe isolated corrosion 50-100% material loss noted in web above lower interior shelf angle. The very severe material loss is isolated in the northern girder of the west span in Bay 6 and 7 and measures up to 75mm in height.	G7
	• Severe isolated corrosion with up to 40% material loss noted in the web above lower interior shelf angle in Bay 22.	G8
	• Severe isolated corrosion with up to 100% material loss noted in lower interior shelf angle on girders in the east span, isolated near the abutment. The isolated material loss extends for approximately 600mm from the east abutment bearings.	G9
	Minor Deficiencies	
	• Approximately 60% of exterior girder stiffeners have isolated 100% material loss at the base of the member. The 100% material loss extends up to 150mm above the lower shelf angles.	G10
	• Severe isolated corrosion with up to 100% material loss noted in the web at the connection with the upper and lower shelf angles of the floor beams in both spans.	G15
	• Overall medium to severe corrosion throughout girders with 10-20% material loss noted in upper and lower shelf angles and their connection rivets.	G7-G10
Floor Beams	Minor Deficiencies	
	• Overall medium to severe corrosion throughout with 10-20% material loss isolated on upper and lower shelf angle legs.	-
Intermediate Diaphragms	Minor Deficiencies	
	• Overall light to medium corrosion throughout with up to 10% material loss.	-
Lateral Bracing	Major Deficiencies	
	• Medium to severe corrosion throughout with 100% isolated material loss noted in 9 members in both spans.	G13
	• Medium to severe corrosion with significant areas of 100% material loss noted in 12 connection plates in both spans.	G14

Table 2: Truss Spans - Summary of Deficiencies

Structure Element	Observations	Photo Ref#
Piers	Minor Deficiencies • Light to severe delamination on faces of all piers. • Severe erosion throughout faces of pier footings and isolated areas of severe erosion at the interface of pier footings and pier shaft. • Undermining of the west pier footing for up to 4m on the east face and the entire west face. The maximum depth of scour was 0.7m and 0.4m on the east and west faces, respectively. ○ Based on a review of drawings provided by the City, the west pier is founded on bedrock. It appears the bedrock has eroded in this location.	T2 T2 -

Pier Bearings	Major Deficiencies
	• All bearings appear to be seized.
	• Roller bearings located on the east pier appear to have shifted as follows:
	  ○ East Pier – North Bearing: 65mm south
	  ○ East Pier – South Bearing: 75mm south
	Note: In the absence of previous monitoring data, the above bearing movements were determined based on measured deflections of the bearing anchor bolts.
	Minor Deficiencies
	• Severe corrosion with complete isolated material loss of vertical plates enclosing all roller bearings.
	• Severe corrosion with 20-30% material loss noted at the base of all bearing anchor bolts in west span.
		T3-T4, T7
		T3-T4
		T4
		T3-T4

Bottom Chords	Major Deficiencies • Very severe corrosion with up to 100% material loss isolated on legs of interior and exterior shelf angles near the lateral brace connections. • Severe corrosion with up to 100% material loss noted in lower shelf angle legs above bearings. • Severe corrosion with up to 100% material loss isolated at the lower web (locations: A8 in Bay 6, D8 in Bay 6, D12 in Bay 10, D12 in Bay 11, and D10 in Bay 11).	T5 T6 T7-T9

Structure Element	Observations	Photo Ref#
Verticals	Major Deficiencies • Light to medium corrosion throughout and severe corrosion with 100% material loss isolated at the bottom 200mm of all vertical members. Minor Deficiencies • Overall light to medium corrosion with severe corrosion with up to 20% material loss isolated at the bottom inside face of all vertical connection plates, connecting vertical members with bottom chords.	T8 -
Stringers	Minor Deficiencies • Very isolated severe corrosion with 100% material loss noted in web above lower shelf angles. The severe corrosion and material loss is isolated to the south stringer in the east span. • Overall light to medium corrosion throughout with 10–30% material loss noted in lower shelf angle legs. • Stringer stiffeners have 100% material loss isolated at the base of the member. On average, the material loss extends up to 200mm above the lower shelf angle legs.	T10 T10 T10
Floor Beams	Major Deficiencies • Severe corrosion with up to 60% and 100% material loss noted in the entire lower shelf angle, throughout the full length of the floor beam from A16 to D16. Minor Deficiencies • Overall light to severe corrosion with up to 30% overall material loss noted throughout all floor beams. Isolated severe corrosion with up to 40% material loss noted in the lower shelf angle legs near the lateral brace plate connections.	T11 -
Intermediate Diaphragms	Minor Deficiencies • Light to medium corrosion throughout with isolated 100% material loss noted in bottom chords at the connections to the stringers.	T12
Lateral Bracing	Minor Deficiencies • Medium to severe corrosion with significant areas of 100% material loss noted in 10 connection plates in both spans. • Medium to severe corrosion throughout with 100% isolated material loss noted in 3 members in both spans. • Rust packing of up to 50mm between vertical legs of angles.	- T13 T14

3. DEFICIENCIES AND CONCERNS

Severe corrosion and material loss was noted throughout steel members of Structure 104. Generally, the areas of severe corrosion noted were located in areas that have a higher exposure to water and chlorides, particularly horizontal surfaces where water and debris is able to sit and accumulate. This is a common issue for steel structures of this design, particularly considering the age of Structure 104. In areas where severe corrosion and material loss is present, a reduction in the capacity of the member is expected. Material loss in main structural members such as girders, stringers, floor beams, verticals and bottom chords are considered to be a major deficiency. Other steel members experiencing severe corrosion and material loss such as intermediate diaphragms and lateral bracing are considered to be secondary structural members. Therefore, we have considered these deficiencies as minor.

We note that Structure 104 was originally designed to convey railway traffic, but has since been converted to a pedestrian bridge that carries pedestrian traffic and a decommissioned utility crossing. Based on preliminary estimates, we anticipate the applied live load has been substantially reduced as compared to the estimated original design live load (assuming Cooper E-40 railway design loading). Conversely, the dead load on the structure has increased since its conversion to a pedestrian bridge with the addition of the pedestrian boardwalk and utility crossing, which were placed on top of the railway track and deck ties. Additionally, the loading effects of maintenance vehicles such as the trackless snow clearing equipment currently used by the City would need to be considered. Without completing a full load limit evaluation for the structure, it is difficult to determine the remaining capacity of each structural element.

Overall, Structure 104 is in fair to poor condition with numerous major deficiencies that should be addressed in 1-5 years. Except for the movement observed in the bearings on the east pier, it does not appear that any of the deficiencies noted were caused by the ice jam events in February of 2018.

To our knowledge, this is the first detailed inspection of Structure 104 since it was converted to a pedestrian bridge in approximately 1997. Therefore, it is difficult to determine the rate of deterioration of the bridge, and its remaining useful service live. Increased frequency of inspections may be warranted to better understand the performance of the structure.

4. EVALUATION OF ALTERNATIVES

We recommend the structure be rehabilitated, replaced or permanently closed in the next 1-5 years to address all major deficiencies. Provided below are additional considerations for the City prior to determining what to do regarding this structure:

- If rehabilitation is preferred, a load limit analysis is recommended to be completed to assess which elements and connections require rehabilitation to support the current pedestrian use of the structure. Based on the results of the analysis, the scope and cost of the rehabilitation may be refined. This may result in a reduced or increased rehabilitation cost estimate. The cost for a load limit analysis is estimated to be approximately $50,000 to $100,000.
- Given the significant capital cost required to rehabilitate, replace or permanently close Structure 104, we recommend the City complete a Schedule ‘B’ or ‘C’ Municipal Class Environmental Assessment (MCEA) to determine the most appropriate alternative for the City to pursue. This is estimated to cost approximately $50,000 to $100,000, and would include, at a minimum, a cultural heritage evaluation report (CHER), heritage impact assessment (HIA), archeological assessment, environmental impact study and hydraulic assessment.

The following summarizes rehabilitation, replacement and removal alternatives for Structure 104. Pre-engineering cost estimates for each alternative have been prepared and presented at the end of this section. Itemized cost estimates are provided in **Appendix D**.

4.1 Alternative 1: Rehabilitation

In this alternative, all major and minor deficiencies would be addressed. Given the limited access to Structure 104, it is expected that the cost to construct temporary work platforms will be substantial as defects are noted throughout the

underside of the superstructure. Therefore, although the minor deficiencies do not need to be addressed in the next 1-5 years, we recommend all deficiencies be addressed under one capital works project.

Bearings would likely be replaced with elastomeric bearings similar to Structure 143 (TH&B Pedestrian Crossing) downstream of Structure 104. As shown in the photo below, a cast-in-place concrete bearing seat may be required to compensate for the difference in height of the new bearings. A hydraulic assessment could be considered to determine whether the superstructure should be raised to increase hydraulic capacity. The costs to complete a hydraulic assessment, raise the bridge, potential modifications to the abutment walls and wingwalls, and potential modifications to the approach pathways have not been included in the cost estimate provided in **Appendix D.** We estimate that raising the existing superstructure would greatly increase the complexity and cost of rehabilitation.

Figure 2: Replaced abutment bearing on Bridge 143

Deficient steel members would be reinforced or replaced, where applicable. Prior to the rehabilitation, the City may wish to complete coupon sampling to determine weldability and existing steel strength. The results of the analysis would determine whether reinforcing plates could be welded to the existing steel, or if plates would have to be bolted.

Concrete patch repairs to the abutments and piers have also been included in the scope of work.

The pre-engineering cost estimate provided in **Appendix D** accounts for the rehabilitation of all known minor and major defects. Upon completion of a load limit analysis for the structure, there may be opportunities to reduce the scope and capital cost of rehabilitation.

Based on our experience, a change in hydraulic capacity of the bridge structure would necessitate the completion of a MCEA.

4.2 Alternative 2: Replacement

In this alternative, the existing superstructure would be removed and replaced. To complete removals, construction of temporary pads and access roads to staging areas within the Grand River may be required. For the purposes of this report we have considered the replacement structure to be four prefabricated steel truss bridge spans. The truss bridge spans could bear on existing piers and abutments, provided that concrete patch repairs are completed as required.

A hydraulic assessment should be considered to determine the capacity of the replacement structure and its bearing elevations. One of the benefits of the prefabricated truss system shown in **Figure 3** below is that the underside of the superstructure would be raised by approximately 1.0 m in comparison to the existing structure while maintaining the

same deck elevation. Therefore, the bearing elevation would need to increase just to maintain the existing deck elevation. This could be accomplished using similar construction details to those provided in **Figure 2** above. If the hydraulic assessment determines that the deck elevation is to be raised above the current elevations, additional modifications to the abutment walls, wingwalls, and the approach pathways would be required. The costs of these additional modifications have not been included in the pre-engineering cost estimate provided in **Appendix D**.

Based on our experience, a change in hydraulic capacity of the bridge structure would necessitate the completion of a MCEA.

It should be noted that the replacement superstructure types assumed for our estimated capital costs would not represent a sympathetic or replica replacement structure type. Replacement superstructures would be similar to a typical pre-fabricated steel truss structure, similar to the WGP Overhead Trail Bridge (Structure 152) shown below.

Figure 3: Prefabricated steel truss superstructure (Structure 152)

4.3 Alternative 3: Removal/Permanent Closure

In this alternative, the crossing would be closed permanently. The existing superstructure would either remain or be removed. The piers and abutments may also be removed; however, these could possibly be left in place as an indication that a structure once stood there and to mitigate the impacts to the environment from removal activities.

Should the crossing have heritage significance, various options would be considered including, but not limited to, removal of the superstructure for relocation to an adjacent location for a monument or commemorative display at the existing location.

Based on our experience, removal of a bridge would necessitate the completion of a MCEA.

The pre-engineering cost estimate provided in **Appendix D** accounts for the removal of the superstructure; however, it was assumed that the abutments and piers would remain and a commemorative plaque/display would be installed on both sides of the Grand River.

4.4 Other Considerations

Given the proposed scope of work for both rehabilitation and superstructure replacement, the potential change in the hydraulic capacity from superstructure modification and the potential heritage significance of the bridge, the City may wish to consider a MCEA to determine the appropriate means for addressing the deteriorated state of Structure 104 to inform which alternative to move forward to design and construction. We have accounted for a Schedule 'B' MCEA as part of our cost estimates. We note that the ultimate decision on schedule should be reviewed as part of the MCEA process.

We have not completed a cultural heritage evaluation of Structure 104; however, we believe there is a strong possibility that the structure has heritage value due to its age, superstructure types, location and views. As part of a MCEA, a Cultural Heritage Evaluation Report will be required to determine whether the structure has any heritage significance.

4.5 Cost Estimates

Table 3 includes a breakdown of the pre-design cost estimate for each alternative listed above. The prices listed below are presented in 2018 dollars and exclude HST, but include engineering at approximately 15% of construction costs and a 25% contingency. A breakdown of each cost can be found attached to this report.

Table 3: Summary of Cost Estimates for Alternatives

Description	Estimated Capital Costs (2018 Dollars)	Estimated Remaining Life Upon Completion of Work
Alternative 1: Rehabilitation	$2,100,000	15-25 years
Alternative 2: Replacement	$2,600,000	75 years
Alternative 3: Removal	$1,100,000	Not Applicable

We note that the estimated cost for rehabilitation listed above is higher than previous estimates provided to the City in our letter dated April 13, 2018. The increase in the cost estimate for rehabilitation can be attributed to the advanced deterioration discovered in numerous elements of the superstructure, which were identified a result of the enhanced OSIM inspection. In comparison to the previous rehabilitation estimate, the following works have been revised or added to the scope of work recommended for rehabilitation:

- Replacement of all bearings;
- Concrete patch repairs to abutment walls, wingwalls and piers;
- Reinforcing or replacement of numerous steel members on the underside of the structure; and,
- Non-construction costs including a MCEA, engineering design and construction administration.

Please note that no design work has been completed that may influence costs of items such as environmental considerations, transportation requirements, geotechnical conditions, regulatory authority requirements, as well as any ancillary work beyond the limits of the bridge.

5. SUMMARY AND RECOMMENDATIONS

GMBP supervised an arm's length inspection of the Brant's Crossing Bridge (Structure 104). This inspection involved ropes access to inspect the superstructure and above-water substructure elements, as well as an underwater investigation to inspect the exposed footings of the abutments and piers. The results of this inspection determined that Structure 104 is in fair to poor condition, and in need of rehabilitative work in order to re-open for pedestrian use.

To re-open the bridge, we recommend that the City consider Alternative 1 or Alternative 2, described above. Given the significant capital cost required to rehabilitate and maintain Structure 104, we recommend the City consider a MCEA to determine the long-term plan for the structure. A load limit evaluation should be included as part of the MCEA to properly assess the scope of work required for rehabilitation.

Further to the recommendations provided above, we strongly suggest that the City ensures the following maintenance procedures are implemented or continued:

- Avoid use of de-icing chemicals, using sand as an alternative
- Regularly cut back and maintain vegetation around the abutments and deck of the structure
- Regularly clean structure of accumulated debris

We thank you for engaging in the services of GM BluePlan Engineering Limited, and trust that this report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

Per: 

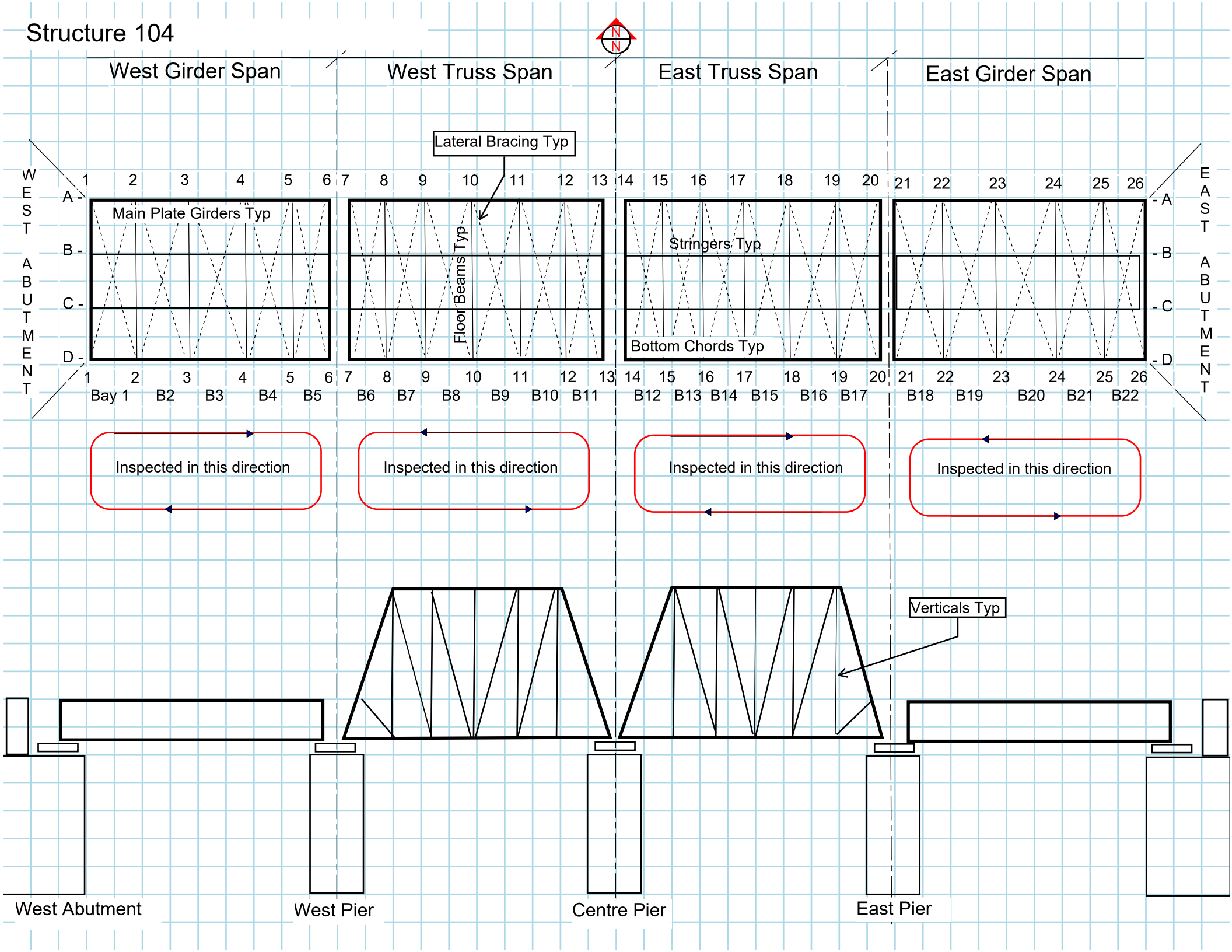
Adam Galezowski, P.Eng.

Per: 

Jack Turner, P.Eng.

APPENDIX A:
Structure 104 Sketch - Naming Convention

Structure 104



APPENDIX B:
Glossary of Technical Terms

GLOSSARY OF TECHNICAL TERMS

Concrete Deficiencies

Delamination: A discontinuity of the surface concrete which is substantially separated but not completely detached from concrete below or above it

Spalling: A continuation of the delamination process whereby the actions of external loads, pressures exerted by the corrosion of reinforcement or by the formation of ice in the delaminated area results in the breaking off of the delaminated concrete

Steel Deficiencies

Corrosion: The deterioration of steel by chemical or electro-chemical reaction resulting from exposure to air, moisture, de-icing salts, industrial fumes and other chemicals and contaminants in the environment in which it is placed, also referred to as rust

Material loss: A continuation of corrosion, material loss refers to the percentage of cross sectional area that has corroded away

General Deficiencies

Scour: The removal of material from the stream bed or bank due to the erosive action of moving water in the stream.

Undermining: The loss in support at the base of a foundation as a result of scour.

APPENDIX C:
Inspection Photos

Photograph G1: North elevation

Photograph G2: East Abutment

Photograph G3: East abutment

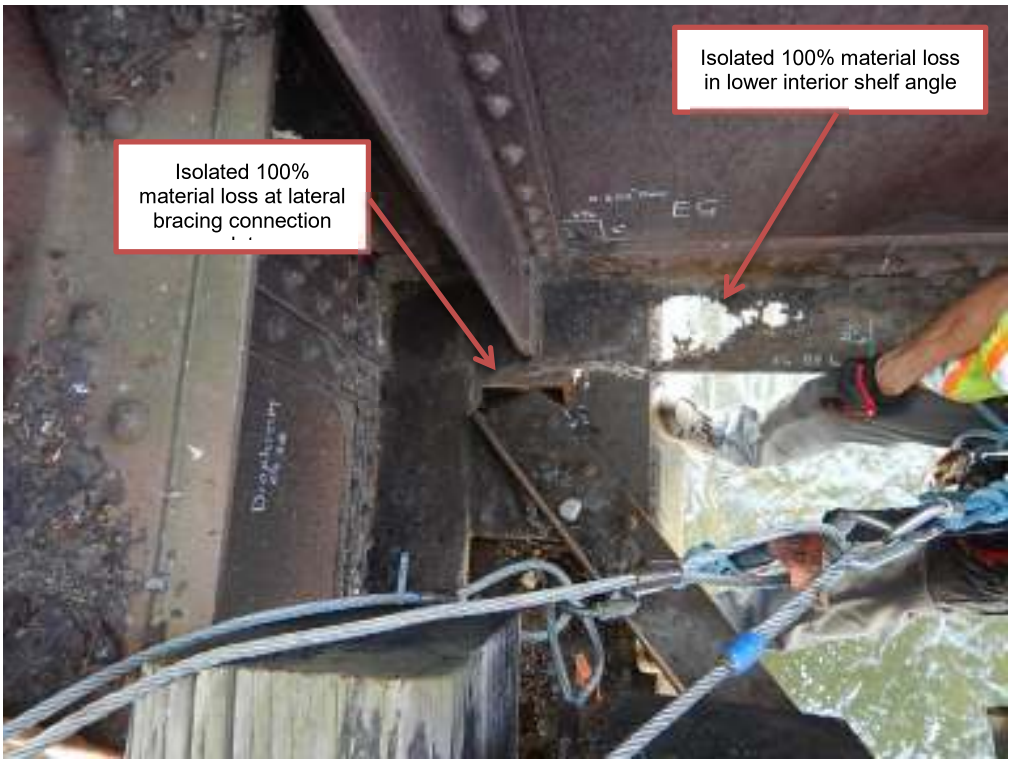
Photograph G4: East abutment, north bearing anchor bolt

Photograph G5: West abutment, south bearing

Photograph G6: West abutment, north bearing anchor bolt

Photograph G7: West span, north girder

Photograph G8: East span, north girder interior



Photograph G9: East span, south girder at east abutment

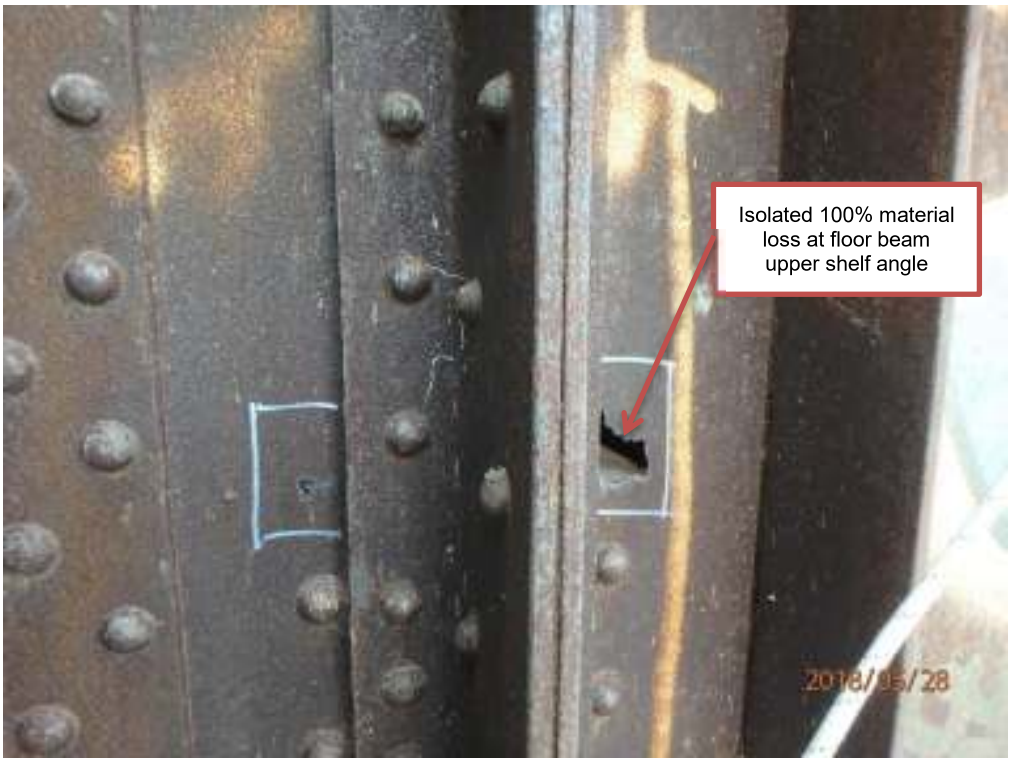
Photograph G10: East span, north girder exterior

Photograph G11: West span, south stringer

Photograph G12: West span, north stringer

Photograph G13: East span, underside

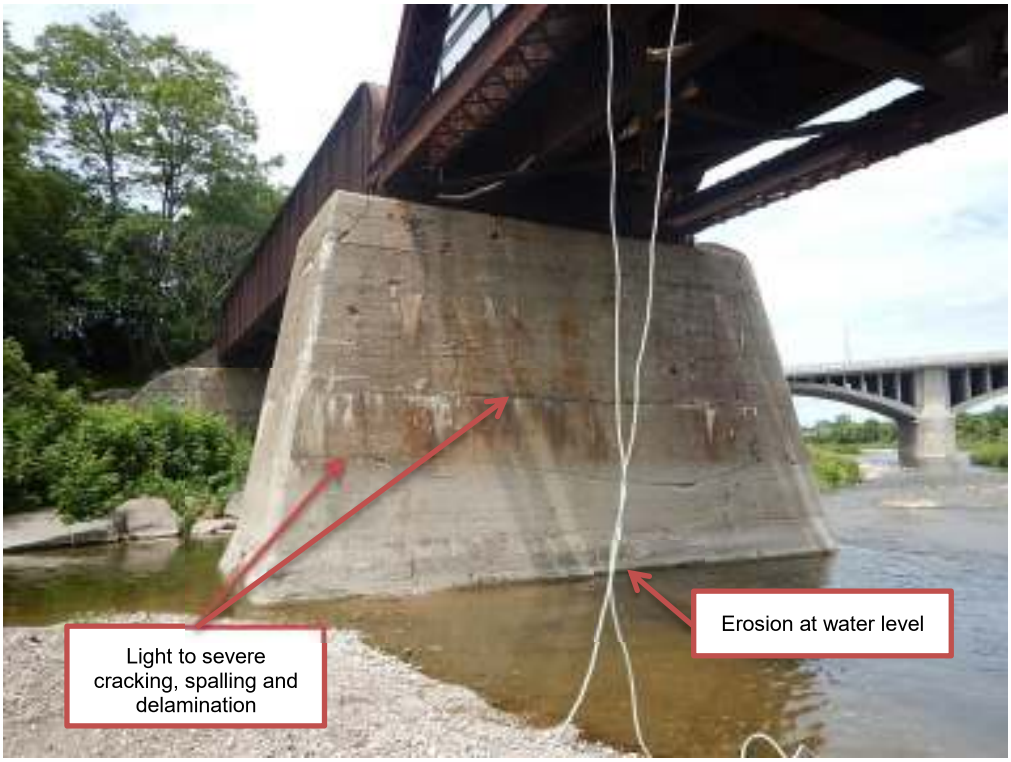
Photograph G14: East span, typical lateral bracing connection plate



Photograph G15: East span, girder web at top of floor beam

Photograph G16: West span underside

Photograph T1: Truss bridge span, south elevation



Photograph T2: West pier

Photograph T3: East pier, north roller bearing

Photograph T4: West pier, north roller bearing

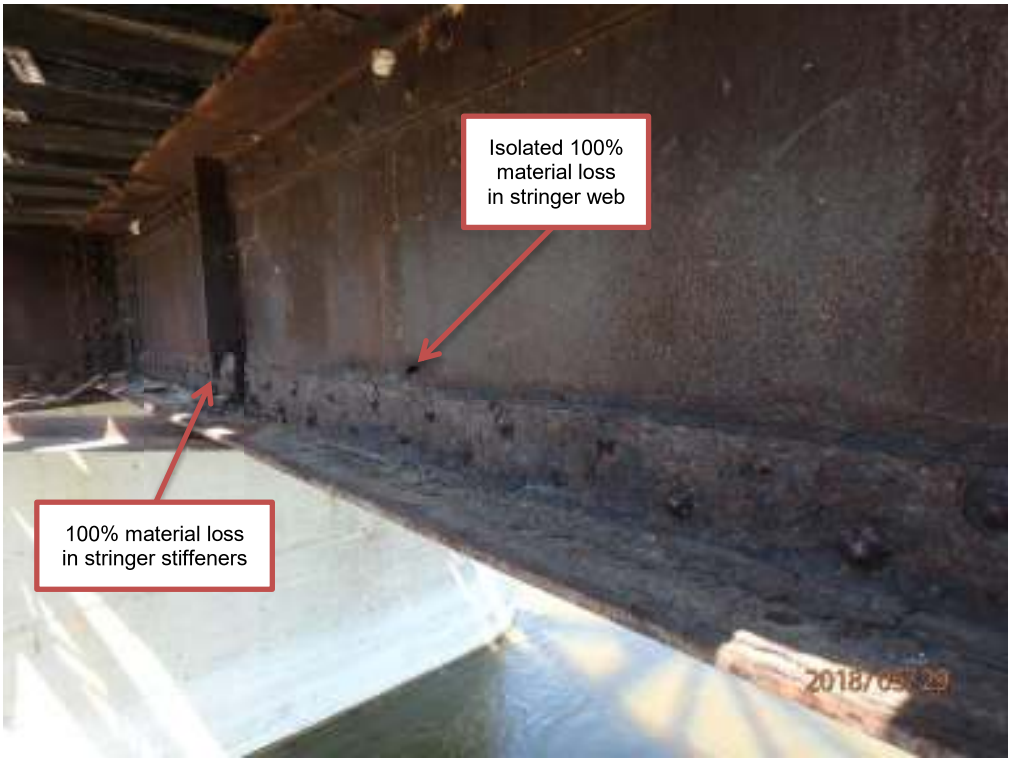
Photograph T5: East truss, bottom chord at lateral brace connection

Photograph T6: Centre pier, southeast bearing

Photograph T7: West truss, north bottom chord (typical material loss)

Photograph T8: Typical vertical connection at bottom chord

Photograph T9: West truss, bottom chord



Photograph T10: East truss, south stringer

Photograph T11: East truss (Floor beam #10)

Photograph T12: East truss, underside

Photograph T13: East truss, lateral bracing

Photograph T14: West truss, lateral bracing

APPENDIX D:
Cost Estimates

STRUCTURE 104 COST ESTIMATE - REHABILITATION					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**GENERAL**				
A.1	Mobilization, Demobilization and Miscellaneous Project Costs	100%	L.S.	$ 40,000.00	$ 40,000.00
A.2	Supply and Install Temporary Working Platform	100%	L.S.	$ 300,000.00	$ 300,000.00
A.3	Environmental Protection	100%	L.S.	$ 15,000.00	$ 15,000.00
TOTAL SECTION A					**$ 355,000.00**
B	**GIRDER SPAN REHABILITATION**				
B.1	Temporary Bridge Jacking	100%	L.S.	$ 150,000.00	$ 150,000.00
B.2	Form, Supply and Install Concrete for Bearing Seat	100%	L.S.	$ 20,000.00	$ 20,000.00
B.3	Remove and Replace Existing Girder Bearings	8	each	$ 4,000.00	$ 32,000.00
B.4	Cast In Place Concrete Patch in Abutment Walls and Wingwalls	100%	L.S.	$ 35,000.00	$ 35,000.00
B.5	Reinforce Girder Webs	13.5	m	$ 2,000.00	$ 27,000.00
B.6	Reinforce Stringer Webs	45	m	$ 2,000.00	$ 90,000.00
B.7	Reinforce Girder Lower Shelf Angles	9	m	$ 1,000.00	$ 9,000.00
B.8	Reinforce Stringer Lower Shelf Angles	4.5	m	$ 1,000.00	$ 4,500.00
B.9	Supply and Install New Girder Stiffeners	35	each	$ 500.00	$ 17,500.00
B.10	Supply and Install New Stringer Stiffeners	80	each	$ 500.00	$ 40,000.00
B.11	Supply and Install New Lateral Braces Including Connection Plates	20	each	$ 2,000.00	$ 40,000.00
TOTAL SECTION B					**$ 465,000.00**
C	**TRUSS SPAN REHABILITATION**				
C.1	Temporary Bridge Jacking	100%	L.S.	$ 200,000.00	$ 200,000.00
C.2	Form, Supply and Install Concrete for Bearing Seat	100%	L.S.	$ 20,000.00	$ 20,000.00
C.3	Remove and Replace Existing Truss Bearings	8	each	$ 4,000.00	$ 32,000.00
C.4	Cofferdams and Dewatering around West Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
C.5	Underpinning of West Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
C.6	Cast In Place Concrete Patch in Piers	100%	L.S.	$ 50,000.00	$ 50,000.00
C.7	Reinforce Bottom Chord Webs	5	each	$ 2,000.00	$ 10,000.00
C.8	Reinforce Bottom Chord Lower Shelf Angle Legs at Lateral Brace Connections	24	each	$ 1,000.00	$ 24,000.00
C.9	Reinforce Bottom Chord Lower Shelf Angle Legs at Bearings	3	each	$ 1,500.00	$ 4,500.00
C.10	Reinforce Floor Beam Lower Shelf Angles	1	each	$ 2,500.00	$ 2,500.00
C.11	Reinforce Intermediate Diaphragms at Lower Connection to Stringer	48	each	$ 500.00	$ 24,000.00
C.12	Reinforce Verticals at Bottom Chord	20	each	$ 500.00	$ 10,000.00
C.13	Supply and Install New Vertical Stiffener Plates on Stringers	80	each	$ 500.00	$ 40,000.00
C.14	Supply and Install New Lateral Braces Including Connection Plates	24	each	$ 2,000.00	$ 48,000.00

STRUCTURE 104 COST ESTIMATE - REHABILITATION					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
TOTAL SECTION C					**$ 505,000.00**
D	**MISCELLANEOUS COSTS**				
D.1	Remove and Dispose of Abandonned Watermain	100%	L.S.	$ 30,000.00	$ 30,000.00
D.2	Site Restoration	100%	L.S.	$ 4,000.00	$ 4,000.00
D.3	Contingency	100%	L.S.	$ 340,000.00	$ 340,000.00
TOTAL SECTION D					**$ 374,000.00**
E	**NON-CONSTRUCTION COSTS**				
E.1	Engineering Design and Construction Administration	100%	L.S.	$ 200,000.00	$ 200,000.00
E.2	Load Limit Analysis	100%	L.S.	$ 100,000.00	$ 100,000.00
E.3	Municipal Class Environmental Assessment	100%	L.S.	$ 100,000.00	$ 100,000.00
TOTAL SECTION E					**$ 400,000.00**
TOTAL REHABILITATION COST					**$ 2,099,000.00**

STRUCTURE 104 COST ESTIMATE - REPLACEMENT					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**CONSTRUCTION COSTS**				
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$150,000.00	$ 150,000.00
A.2	Environmental Protection	100%	L.S.	$20,000.00	$ 20,000.00
A.3	Contractor Layout	100%	L.S.	$10,000.00	$ 10,000.00
A.4	Cofferdams and Dewatering around Piers	100%	L.S.	$40,000.00	$ 40,000.00
A.5	Underpinning of Pier Footings	40	m3	$1,100.00	$ 44,000.00
A.6	Removal of Existing Deck, Railings, Railway Ties and Abandoned Watermain	430	m2	$350.00	$ 150,500.00
A.7	Construction of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$150,000.00	$ 150,000.00
A.8	Removal of Existing Superstructure	100%	L.S.	$300,000.00	$ 300,000.00
A.9	Suspended Platforms at Piers	3	each	$15,000.00	$ 45,000.00
A.10	Cast In Place Concrete Patch in Piers	100%	L.S.	$ 50,000.00	$ 50,000.00
A.11	Platforms at Abutments	2	each	$5,000.00	$ 10,000.00
A.12	Cast In Place Concrete Patch in Abutment Walls and Wingwalls	100%	L.S.	$ 35,000.00	$ 35,000.00
A.13	Modifications to Existing Abutments and Piers	100%	L.S.	$15,000.00	$ 15,000.00
A.14	Design and Supply of new Superstructures for end Spans (23.3m)	100%	L.S.	$260,000.00	$ 260,000.00
A.15	Design and Supply of new Superstructures for middle Spans (37.7m)	100%	L.S.	$360,000.00	$ 360,000.00
A.16	Install new Superstructures	100%	L.S.	$150,000.00	$ 150,000.00
A.17	Removal of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$20,000.00	$ 20,000.00
A.18	Site Restoration	100%	L.S.	$4,000.00	$ 4,000.00
A.19	Contingency at approximately 25%	100%	L.S.	$ 455,000.00	$ 455,000.00
TOTAL SECTION A					**$ 2,268,500.00**
B	**NON-CONSTRUCTION COSTS**				
B.1	Engineering Design and Construction Administration	100%	L.S.	$200,000.00	$ 200,000.00
B.2	Municipal Class Environmental Assessment	100%	L.S.	$100,000.00	$ 100,000.00
B.3	Approvals (est.)	100%	L.S.	$15,000.00	$ 15,000.00
TOTAL SECTION B					**$ 315,000.00**
TOTAL REPLACEMENT COST					**$ 2,583,500.00**

STRUCTURE 104 COST ESTIMATE - SUPERSTRUCTURE REMOVAL					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**CONSTRUCTION COSTS**				
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$50,000.00	$ 50,000.00
A.2	Environmental Protection	100%	L.S.	$10,000.00	$ 10,000.00
A.3	Contractor Layout	100%	L.S.	$2,000.00	$ 2,000.00
A.4	Removal of Existing Deck, Railings, Railway Ties and Abandoned Watermain	430	m2	$350.00	$ 150,500.00
A.5	Construction of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$150,000.00	$ 150,000.00
A.6	Removal of Existing Superstructure	100%	L.S.	$300,000.00	$ 300,000.00
A.7	Removal of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$20,000.00	$ 20,000.00
A.8	Site Restoration	100%	L.S.	$4,000.00	$ 4,000.00
A.9	Contingency at approximately 25%	100%	L.S.	$ 170,000.00	$ 170,000.00
TOTAL SECTION A					**$ 856,500.00**
B	**NON-CONSTRUCTION COSTS**				
B.1	Engineering Design and Construction Administration	100%	L.S.	$100,000.00	$ 100,000.00
B.2	Municipal Class Environmental Assessment	100%	L.S.	$100,000.00	$ 100,000.00
B.3	Approvals (est.)	100%	L.S.	$15,000.00	$ 15,000.00
TOTAL SECTION B					**$ 215,000.00**
TOTAL SUPERSTRUCTURE REMOVAL COST					**$ 1,071,500.00**

BluePlan ENGINEERING

2021 Structural Evaluation Report

Appendix III

Summary of Load Factors used In Evaluation

BRANT'S CROSSING BRIDGE (STRUCTURE 104) STRUCTURAL EVALUATION REPORT

Summary of Loads Factors for Evaluation

Element	Dead Load Category	System Behaviour	Element Behaviour	Inspection Level	Reliability Index, β	Dead Load Factor, αD	*Live Load Factor, αL
Wood Deck	D2	3	3	3	2.50	1.10	1.35
Stringer	D1	3	3	3	2.50	1.05	1.35
Floor Beam	D1	2	3	3	2.75	1.06	1.42
Plate Girder	D1	1	3	3	3.00	1.07	1.49
Top Chord	D1	1	1	3	3.75	1.10	1.70
Bottom Chord	D1	1	1	3	3.75	1.10	1.70
Vertical	D1	2	1	3	3.50	1.09	1.63
Diagonal	D1	2	1	3	3.50	1.09	1.63

** Live Load Factors for Maintenance vehicle*

Prepared By:

City of Brantford

TH&B Crossing Bridge (Structure 143)
Structural Evaluation Report

GMBP File: 119104
May 2021

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

APPENDICES

TH&B CROSSING BRIDGE (STRUCTURE 143) STRUCTURAL EVALUATION REPORT

CITY OF BRANTFORD

GMBP FILE: 119104

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the City of Brantford (City) to complete a load limit evaluation of the TH&B Railway River Crossing (Structure 143), located north of the Veterans Memorial Parkway bridge and spanning the Grand River in the City of Brantford. As a part of this assignment, the existing structure was inspected within an arm's reach and analyzed for the purposes of determining the current load limit and to identify and assess the various rehabilitation and replacement options as part of the Municipal Class Environmental Assessment (MCEA) process.

2. BACKGROUND INFORMATION

2.1 Existing Structure

Structure 143 is a four-span bridge that was originally designed to convey railway traffic and was constructed in 1893. It has since been converted to a pedestrian bridge to carry pedestrian traffic and an electrical utility across the Grand River. The superstructure consists of four through plate girder spans. A rehabilitation project occurred in approximately 2006 that converted Structure 143 to a pedestrian bridge, as well as repaired several elements on the bridge. Design drawings for the rehabilitation project were provided by the City and are included in **Appendix I**.

2.2 2018 Structural Inspection

Following an ice jam event in the Grand River on February 21, 2018, the structure was subject to a detailed structural inspection in accordance with the Ontario Structure Inspection Manual (OSIM). All elements of the bridge were safely accessed within an arm's reach by Acuren using ropes tied to the structure. The ropes access inspection occurred over a period of 2 days from June 4, 2018, to June 5, 2018. During the inspection, element geometry, orientation, and defects were measured and recorded, and the overall condition of each element was determined following the OSIM guidelines.

The complete Enhanced OSIM Summary Report for Structure 143 is provided in **Appendix II**.

Within the Enhanced OSIM Summary Report, both major and minor deficiencies were noted. Major deficiencies are considered to be critical and should be addressed in the next 1-5 years to maintain the structural integrity of the bridge. Minor deficiencies are not classified as urgent and can be addressed at a later time; however, consideration should be given to addressing all deficiencies under one project.

Major deficiencies are included in **Table 4** at the end of this report.

3. NOMENCLATURE

Steel members in each span of Structure 143 generally consist of built-up steel sections. Refer to **Figure 1** below for the standard terminology used for these built-up sections. Refer to **Figure 2** for standard terminology used for the structural elements in the bridge. Note that Figure 2 is provided for glossary of terms only; it is not representative of the actual dimensions of Structure 143. Refer to **Figure 3** for a cross section of the pedestrian platform installed in approximately 2006.

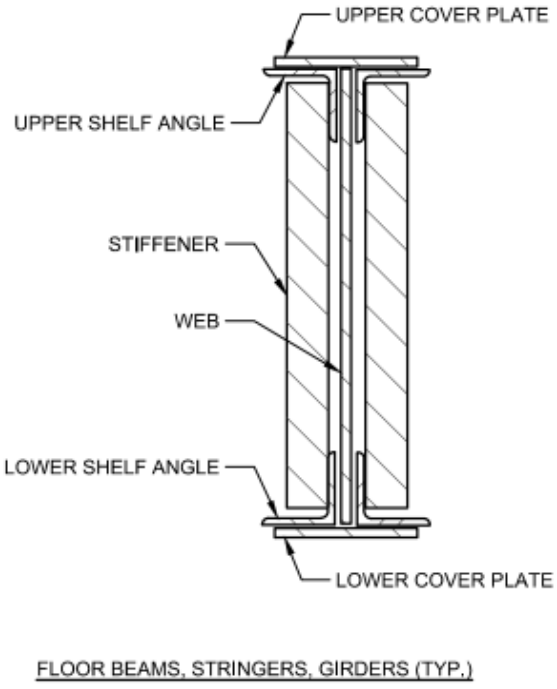


Figure 1: Cross Sections of Typical Built-Up Sections

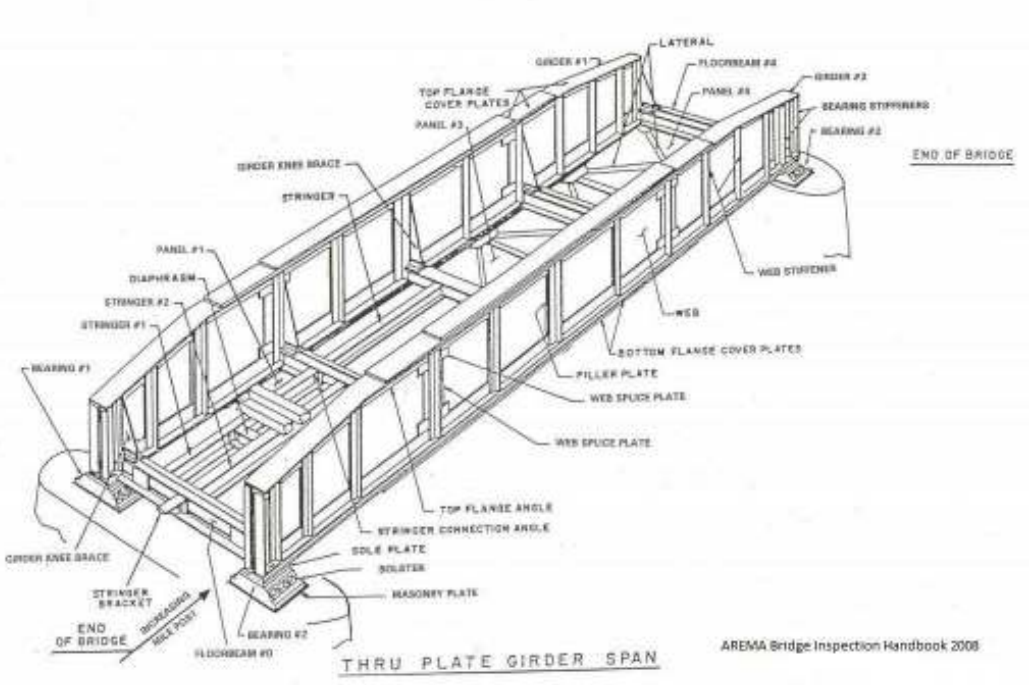


Figure 2: Typical Elements of Through Plate Girder Bridge

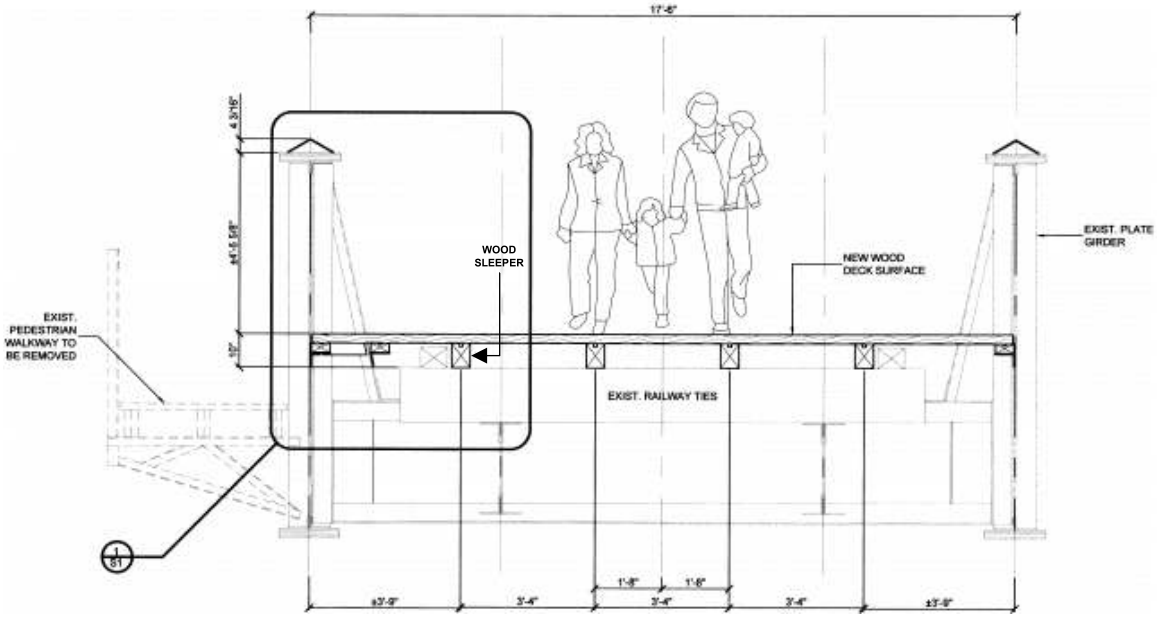


Figure 3: Existing Pedestrian Platform (Wiebe Engineering Group Inc., 2006)

4. METHODOLOGY

The structural evaluation was made in accordance with Section 14 of the CSA-S6-19 Canadian Highway Bridge Design Code (CHBDC). Provided below is a detailed description of the methodology used for this evaluation. It should be noted that our evaluation refers to the capacity of superstructure elements only. Section 14 of the CHBDC does not refer to the evaluation of the substructure. Based on the defects noted during the site visit completed by GMBP, we do not believe that the substructure elements are a limiting factor in the capacity of the evaluated structure.

4.1 Existing Conditions

The historical drawings do not provide details regarding the structural steel sections used to construct Structure 143. Therefore, the structural steel sections for load rating individual elements were derived based on dimensions taken during the Enhanced OSIM inspection. All recorded element dimensions were taken using tape measure and Vernier caliper.

Structural steel strength was determined in accordance with Table 14.1 in Section 14 of the CHBDC, using construction year dating before 1901. Based on the table, the existing steel was evaluated using a yield and tensile strength of 180 MPa and 360 MPa respectively.

Wood deck strength was determined in accordance with Section 9 of the CHBDC using Red Pine, as specified on the 2006 rehabilitation drawings.

4.2 Evaluation Procedure

4.2.1 Dead Loads

Dead loads, such as the self-weight of all bridge components, were calculated in accordance with the CHBDC Table 3.4 and Clause 14.8 “Permanent Loads”. The weights of materials used for the evaluation of each structure (where applicable) are summarized in **Table 1**.

Table 1: Summary of Dead Loads for Evaluations

Material	Weight
Steel	77.0 kN/m^3
Timber (Rail Ties)	9.5 kN/m^3
Wood Planks (Deck)	6.0 kN/m^3

Dead loads are apportioned into three categories: D1 (factory produced products, cast-in-place concrete – excluding decks), D2 (cast-in-place concrete decks, wood, field-measured asphalt, non-structural components), and D3 (asphalt, where the thickness is assumed to be 90 mm). In general, where the geometry could not be verified by field measurement the dead load was considered to be categorized as a D3 dead load.

Dead loads, such as the self-weight of all bridge components, were calculated in accordance with CSA S6-19 Table 3.4 and Clause 14.8 “Permanent Loads”. The weights of materials used for the evaluation of the structure are summarized in Table 3.

The dead loads include self weight of all steel elements, 305x203mm (12”x8”) rail ties spaced at 254mm (10”), 76x152mm (3”x6”) wood deck and supporting 6”x8” wood sleepers.

4.2.2 Live Loads

Two distinct live loads were considered for the load rating evaluation. First, a 4.0 kPa pedestrian load specified in Clause 3.8.12 of the CHBDC was applied to the pedestrian platform. The second live load considered was the maintenance vehicle load specified in Clause 3.8.12 with a gross weight of 80 kN (approximately 18,000 lbs). As per Clause 3.8.11, the maintenance vehicle and pedestrian load were not considered to act simultaneously.

The Live Load Capacity Factor, F, for Ultimate Limit State was calculated to determine the residual strength in the structural elements that is available to resist applied live loads once all permanent loads (i.e., dead loads) have been accounted for by the member's strength. As per Clause 14.17.2 of the CHBDC, F factors greater than or equal to 1, do not require a load posting, meaning the evaluated bridge is capable of supporting loads used to derive the F factors. The overall bridge posting is determined based on the smallest value of F derived for each individual bridge element.

4.2.3 Load Factors

Reliability Indices were used to determine the appropriate load factors for dead and live loads. These indices were dependent upon the element being analyzed, and its system behaviour, element behaviour and inspection level as outlined below:

- System behaviour, classified as one of the following:
  - (S1) Element failure will lead to total collapse
  - (S2) Element failure will likely not lead to total collapse
  - (S3) Element failure will lead to local failure only
- Element behaviour, classified as one of the following:
  - (E1) Element is subject to a sudden loss of capacity with little or no warning
  - (E2) Element is subject to a sudden loss of capacity with little or no warning but will retain post-failure capacity
  - (E3) Element is subject to gradual failure with warning of probably failure
- Inspection level, classified as one of the following:
  - (INSP1) Element is not accessible for inspection
  - (INSP2) Element is accessible for inspection to the satisfaction of the evaluator
  - (INSP3) Element is accessible for inspection and inspection is directed by the evaluator

Once the system behaviour, element behaviour and inspection level have been determined for the failure mode of each element being evaluated, a Reliability Index can be used to determine the appropriate dead and live load factors. It should be noted that a single element may have different load factors depending on the mode of failure being analyzed (i.e., a concrete beam analyzed for shear may have different load factors for analysis than the same beam analyzed for bending). For the purpose of this evaluation, pedestrian live load factors were assigned based on Table 3.1 in Section 3 of the CHBDC ($\alpha L = 1.7$). The target reliability index, a measure of the level of safety of a component(s), used during the evaluation of various elements, and respective live and dead load factors are summarized in the table in **Appendix III**.

In addition to the live load factor αL, no Dynamic Load Allowance (DLA) was considered for maintenance vehicle loading. According to Clause 3.8.4.5.1 of the CHBDC, maintenance vehicle load of 80 kN includes an allowance for dynamic effect.

5. LOAD LIMIT EVALUATION

Both hand calculations and finite element model analysis were completed to determine the member-by-member shear forces and bending moments as per the CHBDC. The finite element model analysis was completed using 2D model in S-Frame Version 11 software.

Resistance of steel structural components and the wood deck was determined using Section 9 and 10 of the CHBDC, respectively. To account for an overall light to medium corrosion, an average 15% steel thickness reduction was applied to all steel members. An additional 5% reduction in steel thickness was used to account for potential future steel corrosion that may take place before the next bridge evaluation. As a result, the resistance of steel members was based on 80% of the steel thickness measured in the field. Additionally, some steel members were measured to have less that 80% of the steel thickness remaining. For these steel members with additional section loss, a resistance associated to the remaining section of the member was individually applied. To account for the isolated severe cracking and splintering noted in the wood deck, an average resistance adjustment factor of 0.8 was applied to wood elements.

See **Table 2** below for the summary of F factors for individual elements:

Table 2: Load Posting Summary

Element	Pedestrian Live Load Capacity Factor, F	Maintenance Vehicle Live Load Capacity Factor, F	Load Posting
Wood Deck	> 1.0	0.05	**Required
Stringer	> 1.0	> 1.0	Not Required
Floor Beam	> 1.0	> 1.0	Not Required
Plate Girder	> 1.0	> 1.0	Not Required

*** Load Posting required only for maintenance vehicle (No load rating required for pedestrian loading)*

Upon completion of the structural analysis, it was determined that all structural elements have a Load Capacity Factor, F larger than 1.0 for the pedestrian load. Therefore, no load limit is required in reference to pedestrian loading.

It was determined that all structural elements, with the exception of the existing wood deck, have a Load Capacity Factor, F, larger than 1.0 for the CHBDC 80 kN maintenance vehicle.

Note, the above findings align with the 2006 rehabilitation drawings involving deck replacement. Based on the drawings, the deck was designed for pedestrian load of 4.0 kPa and a maximum 2.8 kN (approximately 285 kg) maintenance vehicle axle load.

6. CONCLUSION AND RECOMMENDATIONS

Based on the load rating and deficiencies stated in this report, the existing bridge does not require a load posting, provided it is only subject to pedestrian or maintenance vehicle loading with a maximum axle loading of 2.8kN (285kg). If the bridge was to be used by a maintenance vehicle with a maximum gross weight in excess of that stated above, or the CHBDC maintenance vehicle of 80 kN (approximately 8,155 kg) as specified in Clause 3.8.11 of the CHBDC, we recommend that the existing wood deck be modified or fully replaced.

The existing deck could be modified by placing additional sleepers spaced at 600mm and replacing the existing 76x152mm (3”x6”) planks with 38x140 (2”x6”) planks nailed together. The additional dead load caused by thicker wood planks will change the steel element load capacity factors F; however, the revised F factors will still remain greater than 1.0, meaning no load posting would be required.

Please note that the inspection completed was at a single point in time. To our knowledge, this is the first Enhanced OSIM completed on this structure. Therefore, there is no reference benchmark to help assess the rate of deterioration of steel elements. The recommended work implementation timeframes and extension of service life may vary depending on the actual rate of deterioration. Please note that the use of salt to maintain this structure in the winter months is expected to result in accelerated deterioration of the structure. It is therefore recommended that winter maintenance of this structure avoid the use of salt.

In accordance with the 2018 Ontario Structure Inspection Manual (OSIM), with structures greater than 30 years old with critical components in poor condition, it is recommended that an Enhanced OSIM inspection be completed every 6 years in order to monitor member deterioration, until such time that a major rehabilitation is completed to address the poor condition members. The last Enhanced inspection was completed in spring of 2018. Prior to detailed design of major rehabilitation work, it is recommended that an additional Enhanced OSIM take place to confirm the scope of the major rehabilitation work.

In addition to modifying the existing deck to increase the load limit, there are several other deficiencies identified in the 2018 Enhanced OSIM that could be addressed as part of a capital project. A summary of the recommended rehabilitation work, based on the desired service life for Structure 143, is provided in **Table 3** and **Table 4** below. Refer to Appendix A of the 2018 Enhanced OSIM Summary Report included in **Appendix II** of this report for a diagram describing node locations referenced in the table below.

Table 3: Option 1 – Minimum Rehabilitation Works Required for a 10 to 15 Year Service Life

Item	Rehabilitation Work	Location
1.0	Modify or replace existing wood deck*[1]	• All four spans
2.0	Install anchor bolts / guide plates at elastomeric bearings	• East abutment
3.0	Install nuts and washers on bearing anchors	• South bearing in east pier in span no. 1 • South bearing in east pier in span no. 2 • South bearing in west pier in span no. 3
4.0	Repair lateral brace and connection plate	• Node A32

*[1] *Rehabilitation work required if bridge is to be used by maintenance vehicle specified in Clause 3.8.11 of the CHBDC*

Table 4: Option 2 – Rehabilitation Works Required for a 15 to 30 Year Service Life

Item	Rehabilitation Work	Location
1.0	Modify or replace existing wood deck*[1]	• All four spans
2.0	Concrete repair work	• West abutment and wingwalls • West piers
3.0	Repointing of stone blocks	• East abutment and wingwalls
4.0	Install anchor bolts / guide plates at elastomeric bearings	• East abutment
5.0	Install nuts and washers on bearing anchors	• South bearing in east pier in span no. 1 • South bearing in east pier in span no. 2 • South bearing in west pier in span no. 3
6.0	Repair steel crack	• South column in east pier
7.0	Repair lateral brace and connection plate	• Node A32

*[1] *Rehabilitation work required if bridge is to be used by maintenance vehicle specified in Clause 3.8.11 of the CHBDC*

Further to the recommendations provided above, we strongly suggest that the City ensures the following maintenance procedures are implemented or continued:

- Avoid use of de-icing chemicals, using sand as an alternative
- Regularly cut back and maintain vegetation around the abutments and deck of the structure
- Regularly clean structure of accumulated debris

7. LIMITATIONS

The following limitations are applicable to this load limit evaluation report:

- This report is intended exclusively for the Client(s) named in the report. The material in it reflects our best judgment in light of the information reviewed by GM BluePlan Engineering Limited at the time of preparation. Unless otherwise agreed in writing by GM BluePlan Engineering Limited, this report shall not be used to imply warranty as to the fitness of the property for a particular purpose. This report is not a certification of compliance with past or present regulations. No portion of this report may be used as a separate entity, it is written to be read in its entirety.
- Only the specific information identified has been reviewed. GM BluePlan Engineering Limited is not obligated to identify mistakes or insufficiencies in the information obtained from the various sources or to verify the accuracy of the information. GM BluePlan Engineering Limited may use such specific information obtained in performing its services and is entitled to rely upon the accuracy and completeness thereof.
- This assessment does not wholly eliminate uncertainty regarding the potential for existing or future losses in connection with a property. No physical or destructive testing has been performed unless specifically recorded. Conditions existing, but not recorded, were not apparent given the level of study undertaken. We can perform further investigation on items of concern, if so required.

8. BIBLIOGRAPHY

1. The Canadian Highway Bridge Design Code, CSA S6-19 (CHBDC)

2. Bakht, B. and Jaeger, L.G (1988). Document SRR-88-04 “Bridge Testing – A Surprise Every Time.” The Research and Development Branch, Ministry of Transportation of Ontario

We thank you for engaging in the services of GM BluePlan Engineering Limited, and trust that this report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

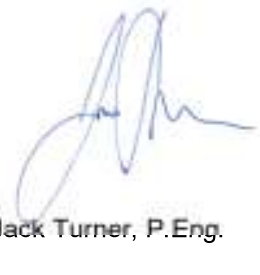
Your truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

Adam Galezowski, P.Eng.

Per:



Jack Turner, P.Eng.

BluePlan ENGINEERING

2021 Structural Evaluation Report

Appendix I

Historical Drawings

CONVERSION OF FORMER CN BRIDGE OVER GRAND RIVER TO PEDESTRIAN WALKWAY

DRAWING LIST:

SP1	SITE PLAN
S1	PEDESTRIAN WALKWAY DETAILS
S2	ABUTMENT APPROACH DETAILS
S3	ABUTMENT APPROACH DETAILS
S4	ABUTMENT REPAIR DETAILS
S5	RETAINING WALL DETAILS
CS1	CONSTRUCTION SPECIFICATIONS

KEY PLAN

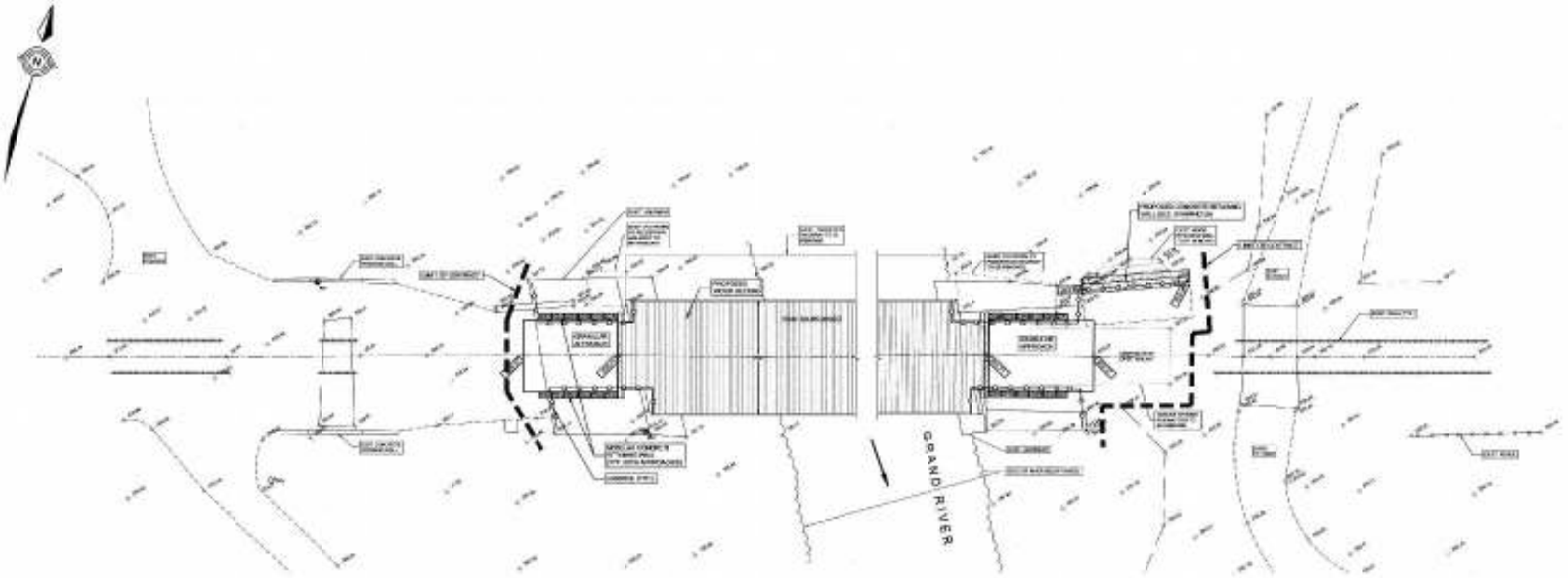
THE CORPORATION OF THE CITY OF BRANTFORD

CITY OF BRANTFORD

PROJECT No. 2006.201

Wiebe Engineering Group Inc.
CONSULTING ENGINEERS & PROJECT MANAGERS

WIEBE ENGINEERING GROUP INC. PROJECT No.: BR04077



PLAN @ WEST ABUTMENT

PLAN @ EAST ABUTMENT

LEGEND

BENCHMARKS

NO.	DESCRIPTION	DATE	CHKD
3	ISSUED FOR TENDER	05/29/2005	OPC
4	ISSUED FOR REVIEW	07/11/2005	OPC
5	ISSUED FOR REVIEW	09/19/2005	OPC
6	ISSUED FOR GRCA AND MTR APPROVAL	09/12/2005	OPC
7	ISSUED FOR GRCA REVIEW	01/09/2006	OPC

BRANTFORD

Wiebe Engineering Group Inc.

DESIGNED BY: EPE
DRAWN BY: TMT
CHECKED BY: OPC
APPROVED BY: OPC

PROJECT

CONVERSION OF FORMER CN BRIDGE OT PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

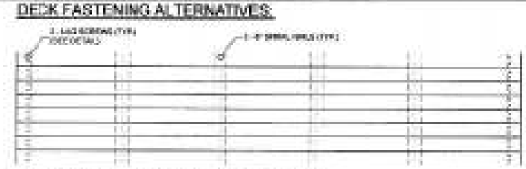
CONVERSION OF THE CITY OF BRANTFORD
PROJECT No. 2004.29

DRAWING TITLE

SITE PLAN

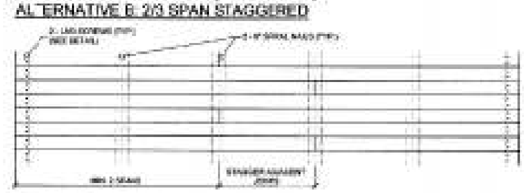
SCALE	1:100	DRAWING No.	SP1
DATE	APRIL 2005		
FILE No.	BR04077	REV. No.	0

DECK FASTENING ALTERNATIVES

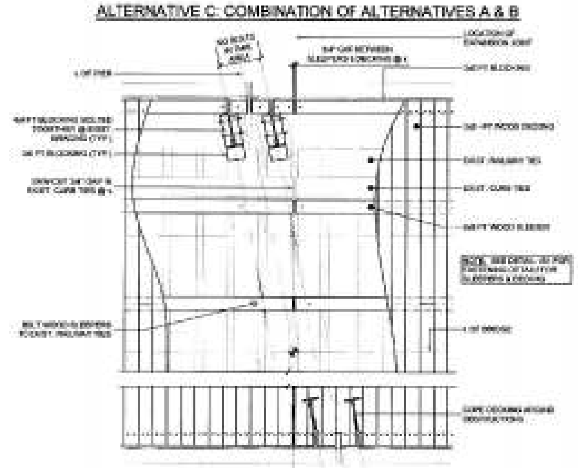


ALTERNATIVE A: FULL LENGTH DECKING

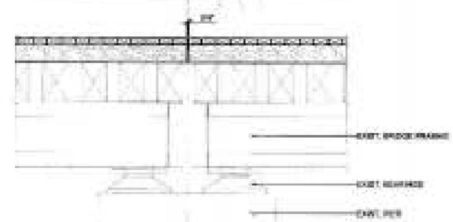
ALTERNATIVE B: 2/3 SPAN STAGGERED



ALTERNATIVE C: COMBINATION OF ALTERNATIVES A & B

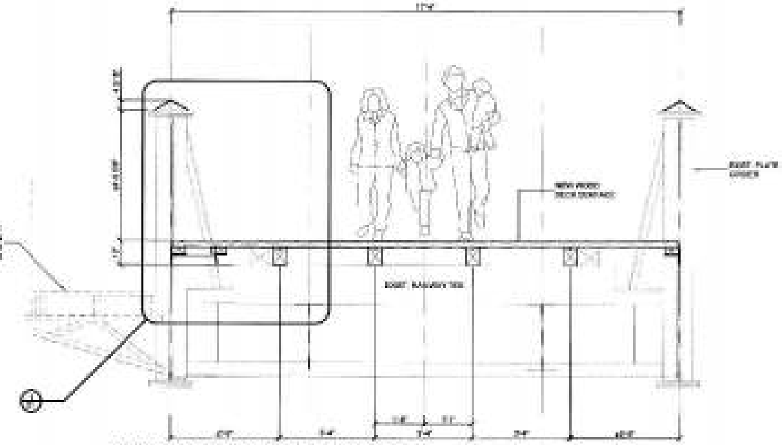


EXPANSION JOINT DETAIL @ PIER

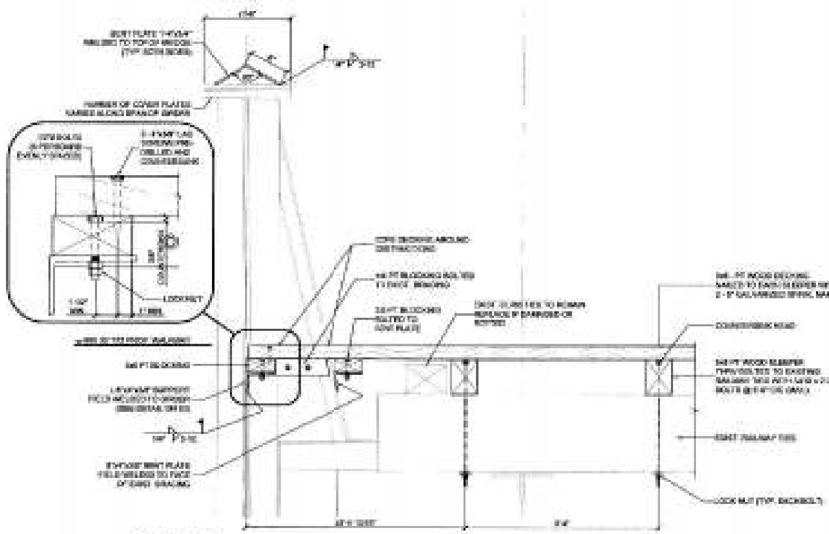


BRIDGE ELEVATION

TYPICAL DECK SECTION LOOKING EAST



DETAIL 1



KEY PLAN

No.	DESCRIPTION	DATE	CHKD
5	ISSUED FOR TENDER	[illegible]	SPC
4	ISSUED FOR REVIEW	[illegible]	SPC
3	ISSUED FOR REVIEW	[illegible]	SPC
2	ISSUED FOR CITY GRCA AND MNR APPROVAL	[illegible]	SPC
1	ISSUED FOR GRCA REVIEW	[illegible]	SPC

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.

DESIGNED BY: SPC | CHECKED BY: SPC
DRAWN BY: TMP | APPROVED BY: SPC

PROJECT

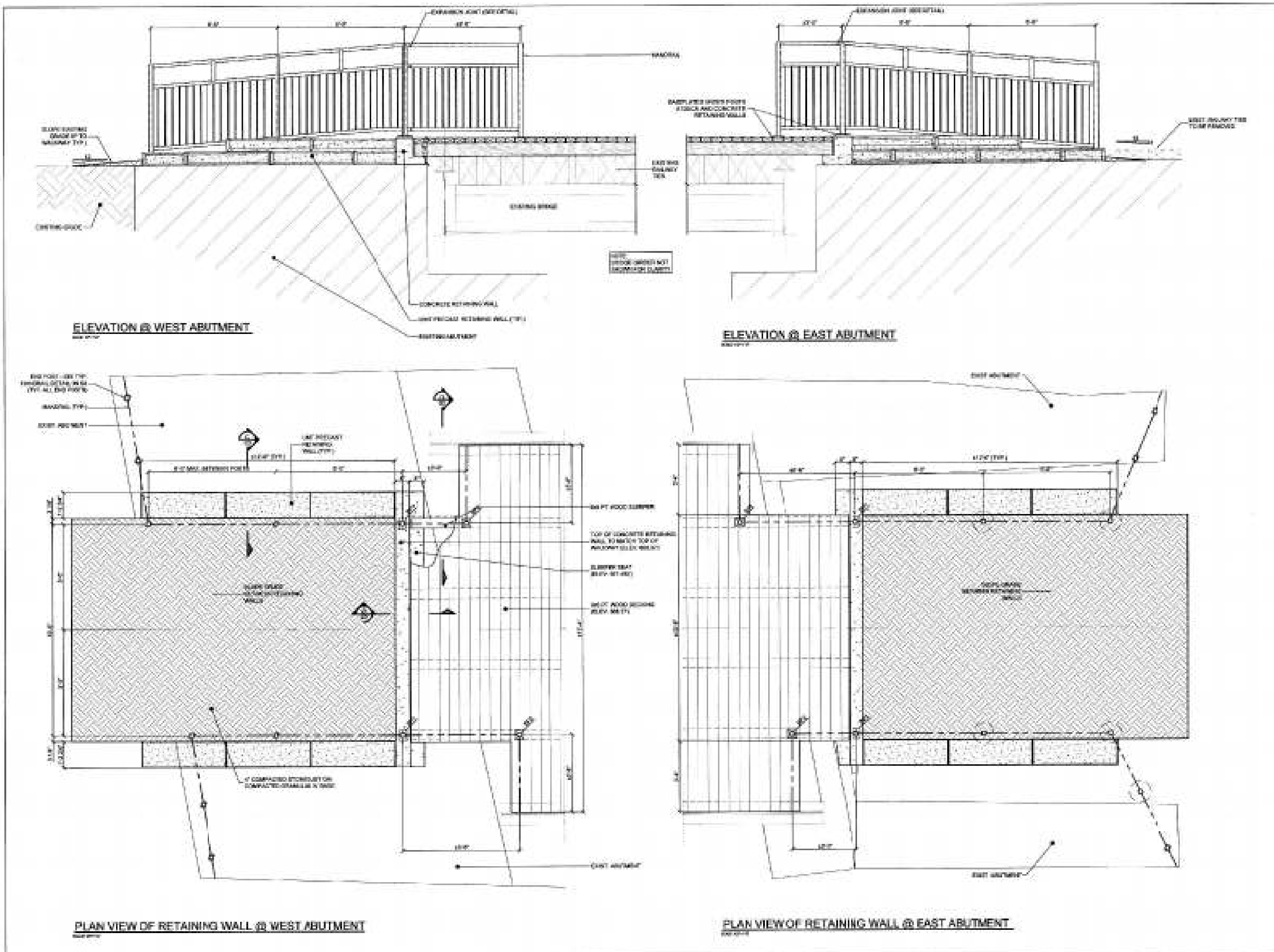
CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

DRAWING TITLE

PEDESTRIAN WALKWAY DETAILS

SCALE: AS SHOWN
DATE: APRIL 2006
FILE No.: BR04077
DRAWING No.: S1



No.	Description	Date	Drwn
5	ISSUED FOR TENDER		DPC
4	ISSUED FOR REVIEW		DPC
3	ISSUED FOR REVIEW		DPC
2	ISSUED FOR GRCA AND MNR APPROVAL		DPC
1	ISSUED FOR GRCA REVIEW		DPC

BRANTFORD

Wiebe Engineering Group Inc.

Engineered by: DPC — Checked by: DPC
Drawn by: TMP — Approved by: DPC

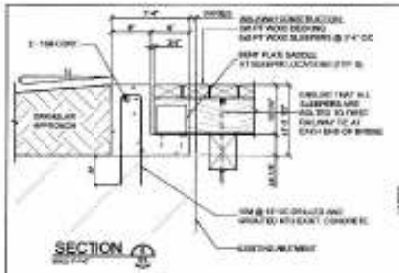
PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

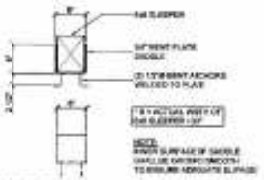
BRANTFORD, ONTARIO

ABUTMENT APPROACH DETAILS

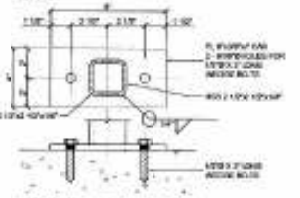
Scale: AS SHOWN
Date: APRIL 2006
File No.: BR04077
Drawing No.: S2



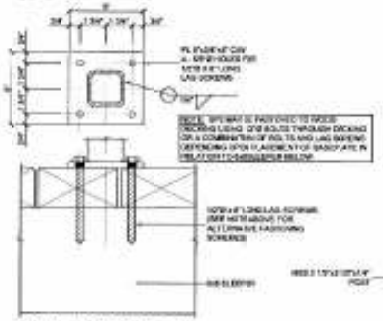
SECTION



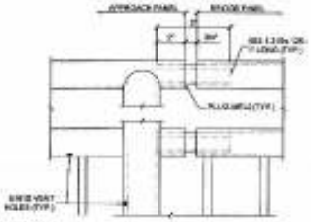
SADDLE DETAIL



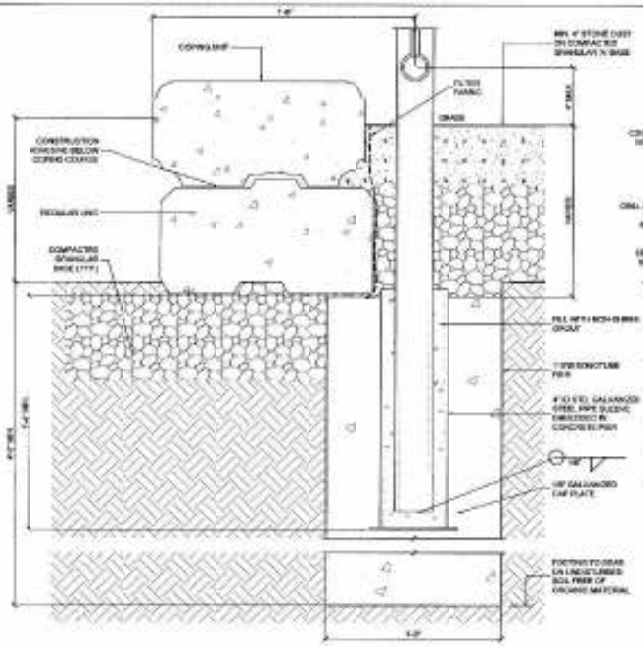
BASEPLATE BP1 DETAIL



BASEPLATE BP2 DETAIL

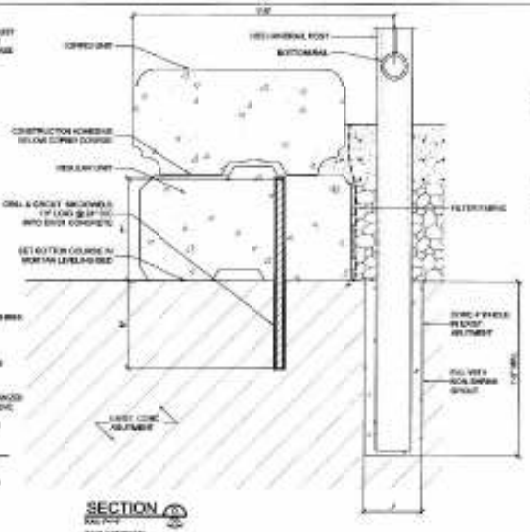


TYP. JOINT DETAIL



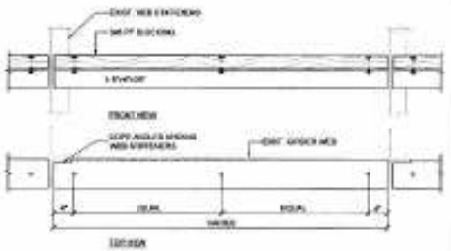
SECTION

(FOR SOIL OR GRANULAR MATERIAL)

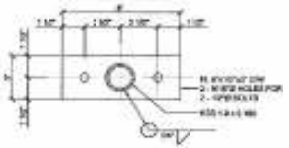


SECTION

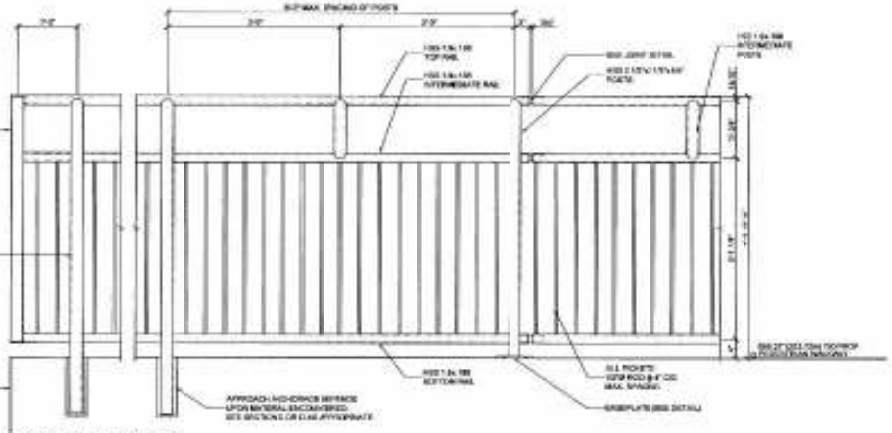
(FOR CONCRETE)



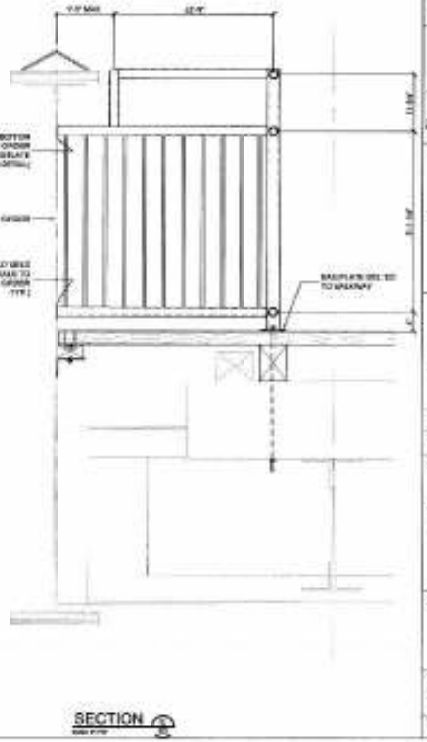
SHELF ANGLE FASTENING DETAILS



BASEPLATE BP3 DETAIL



TYP. HANDRAIL DETAIL



SECTION

6	ISSUED FOR TENDER	05/10/2005	DPC
4	ISSUED FOR REVIEW	07/11/2005	DPC
3	ISSUED FOR REVIEW	05/10/2005	DPC
2	ISSUED FOR GRCA AND MNR APPROVAL	05/10/2005	DPC
1	ISSUED FOR GRCA REVIEW	05/09/2005	DPC
No.	DESCRIPTION	DATE	CHKD

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.

CONSULTING ENGINEERS & PROJECT MANAGERS

DESIGNED BY: DPC | CHECKED BY: DPC

DRAWN BY: TMF | APPROVED BY: DPC

PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

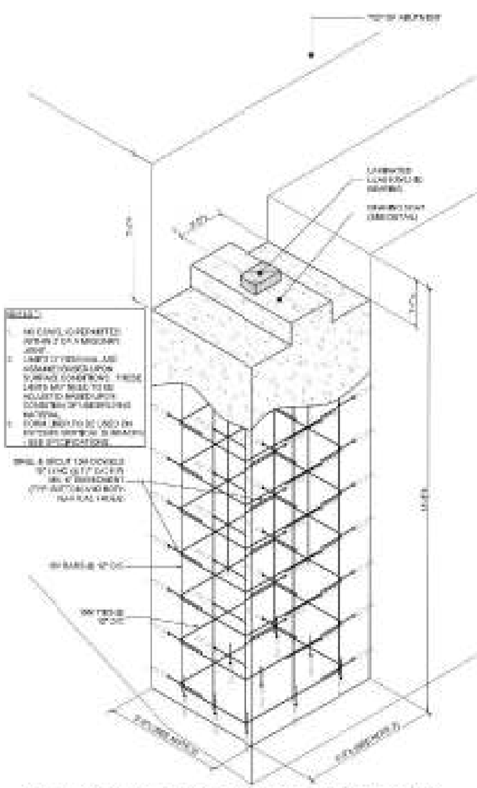
BRANTFORD, ONTARIO

CONVERSION OF THE CITY OF BRANTFORD PROJECT No. 2004-20

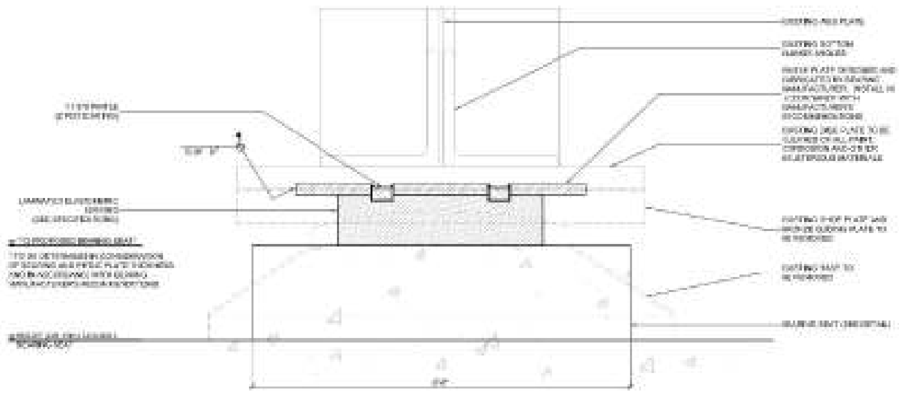
DRAWING TITLE

ABUTMENT APPROACH DETAILS

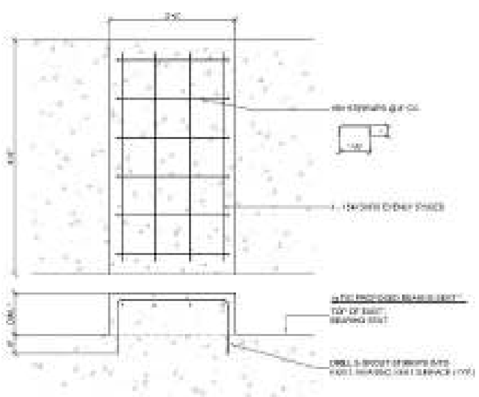
SCALE	AS SHOWN	DRAWING No.	S3
DATE	APRIL 2005		
FILE No.	BR04077	REV. No.	6



NORTH CORNER OF EAST ABUTMENT - REPAIR DETAILS



SECTION



BEARING SEAT DETAIL

NORTH CORNER OF EAST ABUTMENT

EXIST. BEARING

SOUTH CORNER OF EAST ABUTMENT

BRANTFORD

Wiebe Engineering Group Inc.

CONVERSION OF FORNER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

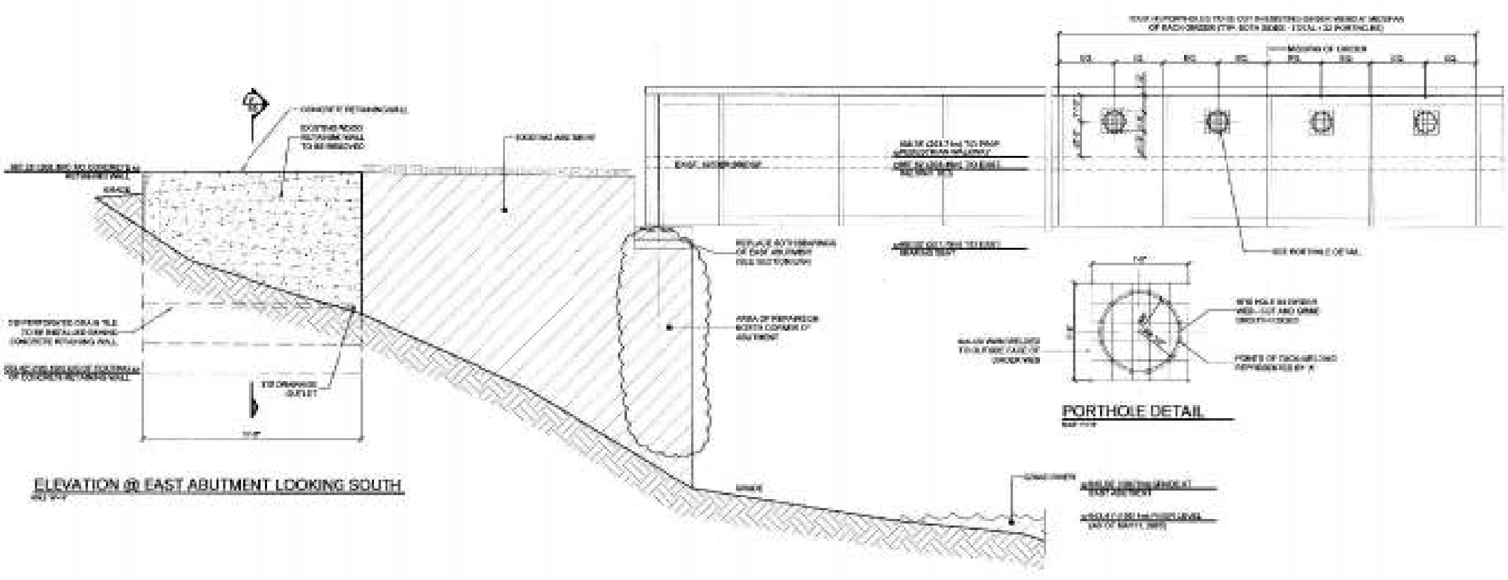
ABUTMENT REPAIR DETAILS

AS SHOWN

APRIL 2005

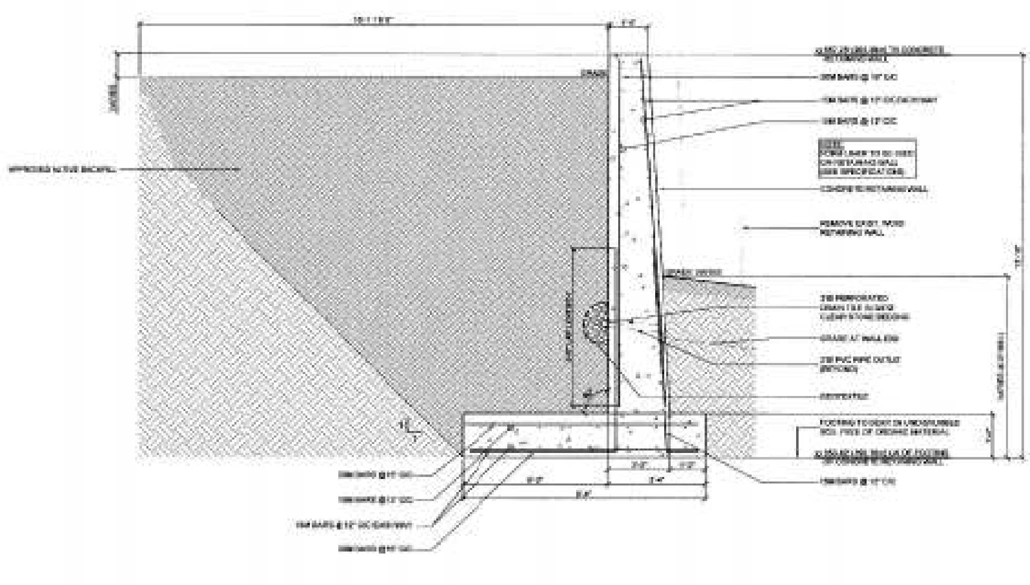
S4

BR04077



ELEVATION @ EAST ABUTMENT LOOKING SOUTH

PORTHOLE DETAIL



SECTION

NO.	DESCRIPTION	DATE	CHKD
5	ISSUED FOR TENDER	[illegible]	DPC
4	ISSUED FOR REVIEW	[illegible]	DPC
3	ISSUED FOR REVIEW	[illegible]	DPC
2	ISSUED FOR CCGA AND MNR APPROVAL	[illegible]	DPC
1	ISSUED FOR GRCA REVIEW	[illegible]	DPC

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.

CONSULTING ENGINEERS & PROJECT MANAGERS

DESIGNED BY: DPC | CHECKED BY: DPC
DRAWN BY: TMB | APPROVED BY: DPC

PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

DRAWING TITLE

RETAINING WALL DETAILS

SCALE: AS SHOWN
DATE: APRIL 2005
FILE NO.: BR04077
DRAWING NO.: S5

GENERAL NOTES

1. Contractors shall visit the site prior to bid to ascertain conditions which may adversely affect the work as set forth herein.
2. The Engineer shall not be responsible for the methods, techniques and sequence of construction to perform the work. The supervision of the work is the sole responsibility of the Contractor.
3. The Contractor shall be responsible for complying with all safety precautions and regulations during the work. The Engineer will not observe or oversee construction to enforce precautions and regulations.
4. Drawings and all general and special notes of construction. Where conditions are not specifically shown, similar details of construction shall be used, subject to approval by the Engineer.
5. The Contractor shall verify all dimensions prior to construction and shall report any discrepancies, errors or omissions to the Engineer before proceeding with construction.
6. Unless otherwise noted, refer to all notes and details shall be the most critical.
7. Shop drawings and other items shall be submitted to the Engineer for review prior to fabrication. All shop drawings shall be reviewed by the Contractor before submittal. The Engineer's review is to be for conformance with the design concept and general compliance with the relevant contract documents. The Engineer's review does not relieve the Contractor's responsibility to review, check and coordinate their own shop drawings prior to submission. The Contractor must be entirely responsible for errors and omissions associated with the preparation of shop drawings as they pertain to maximum sizes, details, dimensions, etc.
8. Submission of shop drawings and/or other documentation for approval is required for the following components:
   a. Concrete mix designs
   b. Form liner pattern
   c. Non-forming plastic
   d. Steel (up and down pattern engineer's seal required)
   e. Railings
   f. Welding and stitching (steel engineer's seal required)
9. It is the Contractor's responsibility to maintain all parts of the existing bridge in a safe condition during the progress of construction and to protect the existing bridge from damage. Any damage to the existing structure caused by the Contractor's operations shall be repaired at the Contractor's expense.
10. Information and / or the preparation of these drawings was largely derived from or in areas of the original bridge drawings. Copies of the original bridge drawings can be made available to the Contractor should he desire.
11. Shoring, grading and site preparation work may be required to allow for proper adequate storage/laying areas and/or access routes between the work site and public thoroughfares. Additional equipment and materials required but unspecified for work and necessary to maintain a safety and construction site with due work shall be included in the contractor's bid price.
12. Prior to mobilization of the work, it is the contractor's responsibility to make all areas impacted by the contractor's operations fully accessible to others. The contractor is to maintain the specifications for landscaping found in Section 3 of Scotland Industries Code applicable standards.

APPENDIX A

1. This structure has been designed as a Schedule B project under the Ontario Bridge Code and the Canadian Highway Bridge Design Code. The Contractor is advised that all Schedule B requirements have been satisfied.
2. The Contractor is hereby advised that the following regulatory agencies have been contacted for their requirements on this project:
   a. Grand River Conservation Authority - a fill/flood permission has been obtained (see below)
   b. DEPARTMENT OF FISHERIES & Oceans - no comments are performed in GRCA's review.
   c. Ministry of Natural Resources - no permits required.
   d. Transport Canada - no permit required.
3. The Grand River Conservation Authority has provided verification of conditional approval of this project. The specific requirements stated in their letter dated July 14, 2007, issued as of Permit No. 3470 is subject to meeting the following conditions:
   a. That all in-water construction, including bar removal, take place in the dry, using cofferdams, during the period between March 31 and June 30 in any given year.
   b. That the Contractor will be responsible for ensuring that all erosion and sediment control measures are properly installed and maintained to prevent sediment from entering the watercourse during construction and that all disturbed areas are stabilized immediately following construction.
   c. That the Contractor will be responsible for ensuring that all construction activities are carried out in accordance with the Fisheries Act and that no deleterious substances enter the watercourse during construction.
   d. That the Contractor shall notify the Grand River Conservation Authority at least 48 hours prior to the commencement of any construction activities.
   e. That all disturbed areas are topsoiled and seeded with a suitable seed mixture.
   f. That the Contractor shall obtain a Permit to Take Water from the Ministry of the Environment, if required.
   g. That the Contractor shall obtain a Work Permit from the Grand River Conservation Authority, if required.
4. The Contractor shall observe the aforementioned and any restrictive wording and shall complete the following reporting documentation:
   a. A registered construction schedule
   b. A registry of submitting plan submitting
      - proposed heavy equipment
      - access routes for the various work areas (particularly for on-river work)
      - details of site access work
      - temporary work dewatering measures
      - proposed refueling areas
      - removed materials and equipment storage areas, and
      - proposed sedimentation controls.

DESIGN CRITERIA

1. All construction shall conform to CAN/CSA-S6-00 and applicable reference standards. Unless otherwise noted, all concrete work and steelwork shall conform to the applicable section of Ontario Reg 854/06.
2. Allowed loading has been designed for the following loads:
   a. Dead load due to material and weight
   b. Live/density distributed load of 5 kPa per sq.m.
   c. A light maintenance vehicle with a maximum axle load of 5000 kg (11 kN)
3. Design load for the decking has not been designed to accommodate the maintenance vehicle load included in CAN/CSA-S6-00. In accordance with 3.8.3.1 in CAN/CSA-S6-06, the vehicle width has been considered to be 1.7 m (11 kN).
4. Loading design criteria are as follows:
   a. Dead load per bearing
      - DL1 113 kip (507 kN)
      - DL2 80.1 kip (361 kN)
   b. Total live load bearing
      - LL1 448 kips (2 kNs)
      - LL2 180.4 kip (801 kN)
   c. Lateral force magnitude
   d. Rotation magnitude
   e. Longitudinal movement
      - Expansion from neutral temp: 1.47" (37 mm)
      - Contraction from neutral temp: 1.47" (37 mm)
      - Total longitudinal movement: 1.18" (30 mm)
5. This structure has been designed with such maintenance factors in accordance with generally accepted principles of structural engineering. The fundamental nature of these factors is to compensate for uncertainties in the design. Neglecting any violation of assumptions during construction, it is reasonable that these factors be used to distribute load carrying capacity of the structure more uniformly than real loads may dictate load and that the building will perform better than design load without failures. While there are at times factors relative some excess capacity beyond design load, such excess capacity cannot be adequately predicted and should not be relied upon.

LOADING AND SHORING

1. Before proceeding with any work, the Contractor shall prepare for himself/herself a shoring and other conditions. It shall be the Contractor's responsibility to provide all necessary shoring, and other temporary supports as parts of the existing structure in a safe condition during the process of removal and construction and to protect from damage those portions of the existing structure which are to remain.
2. Footing and Piling, to CSA S269.1-1975 (R2003).
3. Design of jacking and shoring measures shall be the responsibility of the Contractor. Details shall be illustrated on engineer sealed drawings and shall be submitted for approval prior to any construction.
4. Jacking forces shall not exceed upon the following:
   a. Dead load of 1.0 kips (527 kN)
   b. Thermal/shrinkage due to the Contractor's equipment and operations.
   c. Appropriate safety factors as provided by the applicable codes.
5. Upon completion, jacks shall be removed and all jacking equipment suitable removed. In order to ensure bearing functionality, any detailed inspection schedules to monitor periods of maintenance or construction operations. Visually, such inspection shall take place during an extended period (for several hours) of moderate temperatures (approximately 10°C).
6. Any modifications to the bridge superstructure or substructure to accommodate jacking must be restored to their original state. In the event that such modifications do not satisfy to the satisfaction of the Engineer, then replacement may be ordered at the discretion of the Engineer.

FABRICATION

1. Limits of camber/deflection on the drawings are approximate and may be revised at the Engineer's discretion based upon actual material conditions encountered.
2. Unless otherwise indicated, all items noted to be permanently removed or demolished shall become the Contractor's property and be removed from the site for reuse or disposal at an approved waste disposal facility. The fences (ASTM) ribbon that the existing openings at the east abutment are an exception to this. These plates should be carefully removed by the Contractor and provided to the City's representative.
3. Particular care must be taken during construction to prevent materials from falling into the watercourse. The requirements of the Grand River Conservation Authority must be strictly observed in this regard.

STEEL

1. Unless otherwise noted, all steel materials must be in accordance with the following CSA specifications:

MATERIAL	STANDARD	MIN. STRENGTH
W-Shapes (Rolled Sections)	CAN/CSA-G40.21, Grade 350W	350 MPa
Plates, Flanges, Bolsters	CAN/CSA-G40.21	350 MPa
Other rolled shapes/angles	CAN/CSA-G40.21	300 MPa
Connection bolts	ASTM A325	830 MPa
Anchor bolts/threaded rods	ASTM A36	400 MPa

2. Unless otherwise noted all bolts shall be smeared using type bolts and shall be tightened in accordance with CSA S16.1 and CAN/CSA-S6.
3. Holes shall be drilled or drilled to the finish diameter, except that punched holes are allowed in material up to 16 mm (5/8") in thickness. All drilled holes shall be provided with smooth edges. Burning of holes and hand cutting of the utility is not permitted.
4. Welding shall conform to CSA-W59. Electrodes shall be selected in accordance with: (1) 10.21 of CAN/CSA-S6 as appropriate for the base material being joined. All welding shall be performed by operators certified to Division 1 or Division 2.1 of CSA W47.1.
5. Fabrication of field splices shall be performed in accordance with: 10.24.3.2.3 of CAN/CSA-S6.
6. Unless otherwise noted, all steel components (including fasteners) shall be hot dip galvanized in accordance with CAN/CSA-G164-M.
7. Protective coatings damaged during the shipping, erection and field welding processes shall be repaired in the field to match factory applied coating.
8. All steel that will be assembled by the contractor on ground and then put in place by crane, in particular, all handrails and guards shall be free of all excess edges and burrs.

WELDING

1. Steel welded shall conform to CAN/CSA-G40 and the following specification:
   a. Carbon content
      - Grade: Rail Plate
      - Copper: Welded
   b. All other forms
      - Grade: Any from Table 6.1.1.1 of CAN/CSA-G40.20
      - Grade: No. 2 or better
2. All welded shall be carried out in accordance with the CAN/CSA-W59 Series. For manufacturing and any other work completed in a specific shop fabrication contract, the preparation shall meet the one of the following:
   a. Unassembled edges prepared (CWB)
   b. Automatic welding and shall be prepared (AWA)
   c. Semi-automatic welding and shall be prepared (AWSA-1)
   d. Semi-manual welding and shall be prepared (SMA)
3. Where possible, weld components shall be such as these as cuts, all scaffolding, weld, weldings, mig grooves, chipped fixing, flame and other cuts shall be made and/or machined as per manufacturer specification. Except where it is not possible, components shall be shall be cut to length or be field.
4. All cuts, perforations and other that have been required to machine wood shall be fortified/made with new applications of a brush-applied copper naphthenate based preservative.
5. Generally, the welding of the existing railway box or the bridge has been determined to be possible for support of the new deck structure. However, a detailed examination of each the box not been performed. Prior to contact the Engineer should any weaknesses be discovered.
6. Except for rivets or bolts, all members and materials fastened shall be made permanently in accordance with CAN/CSA-G164-M. Rods and quotes shall be fully galvanized in accordance with CAN/CSA-G40.21. Galvanized rods shall be as shown in article 10 CAN/CSA-S6. The completed diameter of the rod shall be galvanizing, then finished after components and connections shall be cleaned by an approved process mechanical.
7. Stainless steel: be avoided under field threads are now in contact with wood.
8. Double nuts shall be provided to prevent the loosening of bolted connections, as indicated on the drawings. As a minimum, this consideration shall apply to all bolted connections where one or more of the components being joined is wood.

CONCRETE

1. Concrete material and construction shall conform to the requirements of CAN/CSA-A23.1. Exposed faces to cold weather must satisfy conditions, as necessary, based upon weather CAN/BCA of the Table of Construction.
2. All concrete shall conform to the following specifications:
   a. Min. 28 day strength: 1,000 psi (6.9 MPa)
   b. Air entrainment: 6% +/- 1.5%
   c. Max. water cement ratio: 0.5
3. All anchors grout shall be non-shrinkage grout with a minimum 28 day compressive strength of 3,000 psi (20 MPa).
4. All reinforcing steel shall conform to CAN/CSA-G30.18, Grade 400W. All welding of reinforcing steel shall be in accordance with the standard AWS.
5. Concrete cover and reinforcing shall conform to the following:
   a. Vertical surfaces of structural components: 50 mm (2.00 mm)
   b. Top surfaces of structural components: 40 mm (1.60 mm)
   c. Footing, abutment and retaining walls exposed to earth and/or water: 75 mm (3.00 mm)
   d. Footings completed and permanently exposed to earth: 100 mm (4.00 mm)
6. Bar supports and tying wire shall be provided to all reinforcing steel to ensure proper concrete cover. Bar supports shall be plastic tipped or stainless steel.
7. All reinforcing steel shall be set and held in position in courting of concrete. Do not field bend bars partially embedded in hardened concrete unless specifically authorized or approved by the Engineer.
8. Construction joints (if any) for reinforcing and/or structure is to be formed in a textured surface by use of a form liner. Pattern to be selected by the City.
9. All edges of permanently exposed concrete surfaces shall be chamfered 10 (3/4in.) unless otherwise noted.
10. Formwork shall remain in place until concrete has obtained at least 28N of its 28 day compressive strength. The Contractor shall provide all shoring and surveying, as necessary.

REFINISHING WALL

1. Retaining and facing shall be foundation consisting of reinforced concrete as indicated on the plans. A baseline of waterproofing is likely loading pressure of 2 kN/sq.m (unless) or greater. Not all the bonding envelope shall be evaluated by a qualified geotechnical engineer prior to placing concrete. And if the Engineer should finds soil conditions be inferior to the required bearing capacity.
2. Where sub-excavation and placement of engineered fill is required to replace non-bearing soils this work shall be performed under the direction of a qualified geotechnical engineer.
3. Retaining wall shall be backfilled with clean, compact, select material compacted in layers to 95% standard proctor dry density.

5	ISSUED FOR TENDER	08/22/2008	DPC
4	ISSUED FOR REVIEW	07/11/2008	DPC
3	ISSUED FOR REVIEW	06/04/2008	DPC
2	REVISED FOR GRCA AND MNR COMMENTS	06/01/2008	DPC
1	ISSUED FOR GRCA REVIEW	04/28/2008	DPC
No.	DESCRIPTION	DATE	INITIALS

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.
CONSULTING ENGINEERS & PROJECT MANAGERS
58 DALHOUSIE STREET, BRANTFORD, TEL: (519) 759-4561
600 KENT WEST STREET, WELLAND, TEL: (905) 735-4422
www.wiebeengineering.com

ISSUED BY: DPC	CHECKED BY: DPC
DRAWN BY: TBE	APPROVED BY: DPC

PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

CONVERSION OF THE CITY OF BRANTFORD PROJECT NO. 0508-0408

DRAWING TITLE

CONSTRUCTION SPECIFICATIONS

SCALE	AS SHOWN	DRAWING No.
DATE	APRIL 2008	CS1
FILE No.	BR04077	REV No. 5

BluePlan ENGINEERING

2021 Structural Evaluation Report

Appendix II

2018 Enhanced OSIM Summary Report

Prepared By:

City of Brantford

TH&B Railway River Crossing (Structure 143) Enhanced OSIM Summary Report

GMBP File: 118074

December 2018

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER |LONDON | HAMILTON | GTA
650 WOODLAWN RD. W., BLOCK C, UNIT 2, GUELPH ON N1K 1B8 P: 519-824-8150
WWW.GMBLUEPLAN.CA

TABLE OF CONTENTS

APPENDICES

TH&B RAILWAY RIVER CROSSING (STRUCTURE 143) ENHANCED OSIM SUMMARY REPORT

CITY OF BRANTFORD

DECEMBER 2018

GMBP FILE: 118074

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the City of Brantford (City) to complete an Enhanced OSIM inspection and summary report of the TH&B Railway River Crossing (Structure 143), located north of Veterans Memorial Parkway and spanning the Grand River in the City of Brantford. The City requested this inspection in response to flooding and ice jamming events in February of 2018 in order to obtain a more detailed understanding of the condition of the bridge and to estimate costs for rehabilitation or replacement options.

The following is a summary description of the structure based on the results of our Enhanced OSIM inspection. The recommended capital works for rehabilitation and superstructure replacement are summarized below, complete with cost estimates attached. Capital costs have been estimated based on our recent experience in similar bridge construction projects, including recent tender prices received by GMBP, and discussions with suppliers and contractors. The capital cost estimates are presented in 2018 dollar values and do not include HST; however, cost estimates do include associated costs such as engineering design and contingencies. The estimated costs contained in this report should be considered as preliminary, as no pre-design work has been completed that may influence costs of items such as environmental considerations, transportation requirements, geotechnical conditions, regulatory authority requirements, as well as any ancillary work beyond the limits of the bridge.

It should also be noted that projects involving railway bridges converted to pedestrian bridges are quite unique and can often be difficult to accurately estimate.

1.1 Background

Structure 143 is a four-span bridge that was originally designed to convey railway traffic and was constructed prior to 1901. It has since been converted to a pedestrian bridge to carry pedestrian traffic and an electrical utility crossing across the Grand River. The superstructure consists of four through plate girder spans. A rehabilitation project occurred in approximately 2005 that converted Structure 143 to a pedestrian bridge, as well as repaired several elements on the bridge. Design drawings for the rehabilitation project were provided by the City and are included in **Appendix A**.

An ice jam event in the Grand River on February 21, 2018, prompted a preliminary visual inspection that was completed by GMBP. Based on the findings of the preliminary visual inspection, it was recommended that an arm's length inspection be completed in the form of an Enhanced OSIM inspection to properly assess the condition of Structure 143. To safely assess all elements of the bridge within an arm's reach, Acuren Group Inc. (Acuren) was retained to perform a ropes access inspection of all elements beyond an arm's reach, which included the underside of the structure. The ropes access inspection occurred over a period of 2 days from June 4, 2018, to June 5, 2018. All inspections were completed under the supervision of Adam Galezowski, P.Eng., of GMBP. A copy of the Acuren report is provided in **Appendix B**.

1.2 Nomenclature

For the purpose of this report, all bridge elements have followed a naming convention to inform their location. A sketch of Structure 143 that has adopted this naming convention has been included in **Appendix C**. For definitions of some of the technical terms used in this report refer to **Appendix D**. Steel members in each span generally consist of built-up sections. Refer to **Figure 1** below for the standard terminology used for these built-up sections.

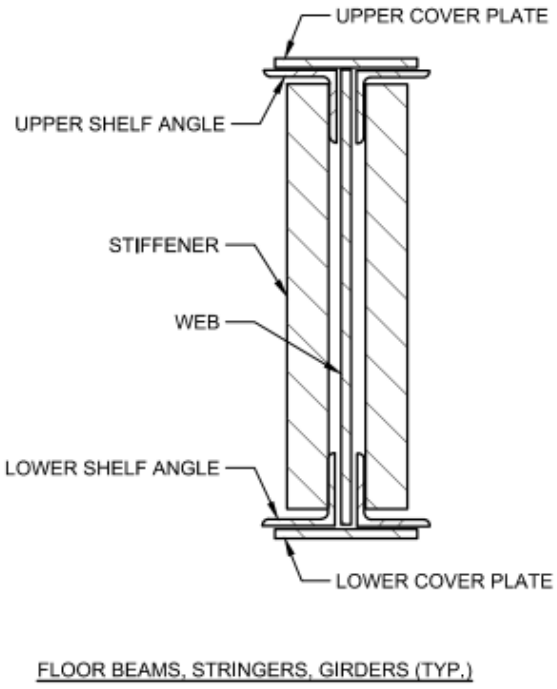


Figure 1: Cross Sections of Typical Built-Up Sections in Structure 143

2. INSPECTION SUMMARY

Table 1 includes a summary of observations from the 2018 Enhanced OSIM inspection. The observations have been summarized based on inspection reports provided by Acuren, as well as our inspector's observations and have been categorized as being major or minor depending on our opinion of their structural significance. Major deficiencies are considered to be critical and should be addressed in the next 1-5 years to maintain the structural integrity of the bridge. Minor deficiencies are not classified as urgent and can be addressed at a later time; however, consideration should be given to addressing all deficiencies under one project. Refer to **Appendix E** for photos referenced in **Table 1**.

Table 1: Summary of Deficiencies

Structure Element	Observations	Photo Ref#
East Abutment/ Wingwalls	Minor Deficiencies	
	• Narrow to medium cracks in stone	-
	• Light to severe loss of mortar in joints	4
West Abutment/ Wingwalls	Major Deficiencies	
	• Light to severe spalling and delamination with narrow to wide cracks throughout west abutment and ballast wall.	2
Steel Piers	Major Deficiencies	
	• Wide crack on west face of south column of east pier (visible in previous biennial inspections).	10
	Minor Deficiencies	
	• The east pier has isolated severe permanent deformations on the north face of the north column (visible in previous biennial inspections).	9
	• The centre pier has isolated severe permanent deformations and cracking on the north face of the north column (visible in previous biennial inspections).	8
Concrete Pier	Major Deficiencies	
	• Light to severe delamination and spalling throughout.	6, 7
Abutment and Pier Bearings	Major Deficiencies	
	• Elastomeric bearings on the east abutment appear to have been installed without anchor bolts (confirmed with 2005 drawings).	5
	• Anchor bolts on bearings are missing nuts and washers at locations D9, D24 and D25.	13
	Minor Deficiencies	
	• The bearing at location A17 appears to have shifted 20mm south. In the absence of previous monitoring data, the movement of the bearing was determined based on the measured displacement between plates.	11
	• Medium corrosion with up to 10% material loss isolated at the base of anchor bolts on bearings at locations A16, A17, D17, A24 and A25.	12
	• Bearings on the west abutment are covered in debris.	-

Structure Element	Observations	Photo Ref#
Girders	Minor Deficiencies • Evidence of a weld repair on the lower shelf angle of the north girder in Bay 28. There is a very minor crack in the weld at location A32. • Overall light to medium corrosion noted throughout with up to 10% material loss.	16 14-16
Stringers	Minor Deficiencies • Overall light to medium corrosion noted throughout with up to 10% material loss.	14
Floor Beams	Minor Deficiencies • Overall light to medium corrosion noted throughout with up to 10% material loss.	14,18
Lateral Bracing	Major Deficiencies • Isolated severe corrosion with 100% material loss in lateral brace at location A32. • Isolated severe corrosion with 100% material loss in lateral brace connection plate at location A32. Minor Deficiencies • Overall light to medium corrosion noted throughout with up to 10% material loss.	18 17 17, 18
Wood Deck	Major Deficiencies • Isolated severe cracking and splintering.	19, 20

3. DEFICIENCIES AND CONCERNS

Overall, Structure 143 is in fair condition. In prior biennial OSIM inspections, severe corrosion in girders, stringers and floor beams was noted, with repairs to these members recommended in 1-5 years. Based on the results of the Enhanced OSIM inspection, we observed that these elements had overall light to medium corrosion and do not require rehabilitation. During the inspection, it was confirmed that the columns of the steel piers are filled with concrete. The deficiencies noted in the steel columns during the enhanced inspection were also noted in previous biennial inspections. Therefore, we do not believe that the deformations in the steel columns warrant urgent repair. The wide crack in the south column of the east pier should continue to be monitored with biennial inspections. Based on its location and that the columns are filled with concrete, visual monitoring may be considered in lieu of a formal crack monitoring program. As the steel columns provide confinement strength to the fill concrete, they should be repaired as part of the next capital project.

A suspected movement of approximately 20mm was noted at the centre pier on Span 2. This was determined by the deflected angle of the anchor bolt of the bearing. This location is inaccessible for typical biennial visual inspections, so we are unable to confirm whether this deflection was caused by the ice jam events in February 2018.

The wood deck appears to be in fair condition, with isolated sections requiring replacement. Based on conversations with City staff, we understand that City maintenance vehicles have broken through the wood deck in the past. We note

that the 2005 rehabilitation project accounted for a pedestrian load of 4.0 kPa and a maximum 2.8 kN maintenance vehicle axle load in the design. Any anticipated loading beyond these values should be confirmed through a structural evaluation.

The repair to the lower shelf angle of the main girders may be indicative of a previous coupon testing investigation, which would typically be required to confirm the suitability of welding for repairs. These areas should be monitored visually as part of the biennial inspections.

We believe the following deficiencies should be addressed as part of a capital project in the next 1-5 years to maintain the structure in working order:

- Concrete patch repairs to the west pier;
- Concrete patch repairs to the west abutment and wingwalls;
- Install missing nuts and washers on bearings;
- Install missing anchor bolts or guide plates at elastomeric bearings on the east abutment;
- Repointing of east abutment and wingwalls;
- Repair crack in south column of east pier;
- Repair lateral brace and connection plate; and,
- Replace wood deck.

To our knowledge, this is the first detailed inspection of Structure 143 since it was converted to a pedestrian bridge in approximately 2005. Therefore, it is difficult to determine the rate of deterioration of the bridge, and its remaining useful service life. Increased frequency of enhanced inspections may be warranted to better understand the performance of the structure. The next enhanced inspection of this structure should be scheduled in the next 3-5 years, or in advance of any rehabilitation work. We estimate that this inspection would cost approximately $30,000+HST.

4. EVALUATION OF ALTERNATIVES

We have evaluated three alternatives for the City's consideration regarding Structure 143: rehabilitation, replacement and removal. The following sections summarize each alternative, with pre-design cost estimates presented at the end of the section. Itemized cost estimates are provided in **Appendix F.**

4.1 Alternative 1: Rehabilitation

In this alternative, all major and minor deficiencies would be addressed. Major cost items would include concrete repairs to the west abutment and west pier and replacement of the wood deck. Our experience with wood bridge decks is that their useful life is typically 10-15 years.

A hydraulic assessment could be considered to determine whether the superstructure should be raised to increase hydraulic capacity. The costs to complete a hydraulic assessment, raise the bridge, potential modifications to the abutment walls and wingwalls, and potential modifications to the approach pathways have not been included in the cost estimate provided in **Appendix F.** We estimate that raising the existing superstructure would greatly increase the complexity and cost of rehabilitation.

Based on our experience, a change in hydraulic capacity of the bridge crossing would necessitate the completion of a Municipal Class Environmental Assessment (MCEA).

4.2 Alternative 2: Replacement

In this alternative, the existing superstructure would be removed and replaced. To complete removals, construction of temporary pads and access roads to staging areas within the Grand River may be required. For the purposes of this report we have considered the replacement structure to be four prefabricated steel truss bridge spans. The truss bridge spans could bear on existing piers and abutments, provided that concrete and steel repairs are completed as required.

A hydraulic assessment should be considered to determine the capacity of the replacement structure and its bearing elevations. One of the benefits of the prefabricated truss system shown in **Figure 2** below is that the underside of the superstructure would be raised by approximately 1.0 m in comparison to the existing structure while maintaining the same deck elevation. Therefore, the bearing elevation would need to increase just to maintain the existing deck elevation. This could be accomplished using similar construction details to those provided in the 2005 rehabilitation of the east abutment. If the hydraulic assessment determines that the deck elevation is to be raised above the current elevations, additional modifications to the abutment walls, wingwalls, and the approach pathways would be required. The costs of these additional modifications have not been included in the pre-engineering cost estimate provided in **Appendix D**.

Based on our experience, a change in hydraulic capacity of the bridge structure would necessitate the completion of a MCEA.

It should be noted that the replacement superstructure types assumed for our estimated capital costs would not represent a sympathetic or replica replacement structure type. Replacement superstructures would be similar to a typical pre-fabricated steel truss structure, similar to the WGP Overhead Trail Bridge (Structure 152) shown below.

Figure 2: Prefabricated steel truss superstructure (Structure 152)

4.3 Alternative 3: Removal/Permanent Closure

In this alternative, the crossing would be closed permanently. The existing superstructure would either remain or be removed. The piers and abutments may also be removed; however, these could possibly be left in place as an indication that a structure once stood there and to mitigate the impacts to the environment from removal activities.

Should the crossing have heritage significance, various options would be considered including, but not limited to, removal of the superstructure for relocation to an adjacent location for a monument or commemorative display at the existing location.

Based on our experience, removal of a bridge would necessitate the completion of a MCEA.

The pre-engineering cost estimate provided in **Appendix F** accounts for the removal of the superstructure; however, it was assumed that the abutments and piers would remain and a commemorative plaque/display would be installed on both sides of the Grand River.

4.4 Other Considerations

If the City wishes to pursue superstructure replacement or wishes to rehabilitate the existing structure and raise the superstructure to provide more hydraulic capacity, the City should consider a MCEA to determine the appropriate means for addressing the condition of Structure 143. Based on our understanding of the MCEA process, without raising the superstructure we estimate that the appropriate schedule of MCEA for rehabilitation would be a Schedule 'A+'. We note that the ultimate decision on schedule should be reviewed as part of the MCEA process.

We have not completed a cultural heritage evaluation of Structure 143; however, we believe there is a strong possibility that the structure has heritage value due to its age, superstructure type, location and views. As part of a MCEA, a Cultural Heritage Evaluation Report will be required to determine whether the structure has any heritage significance.

4.5 Cost Estimate

Table 2 below includes our pre-design cost estimates for the rehabilitation, replacement and removal of Structure 143. The price below is presented in 2018 dollars and exclude HST, but include engineering at approximately 15% of construction costs and a 25% contingency. A breakdown of the cost estimate can be found in **Appendix F**.

Table 2: Pre-Design Rehabilitation Cost Estimate for Structure 143

Description	Estimated Capital Costs (2018 Dollars)	Estimated Remaining Life Upon Completion of Work
Alternative 1: Rehabilitation	$710,000	15-30 years
Alternative 2: Replacement	$2,500,000	75 years
Alternative 3: Removal	$1,100,000	Not Applicable

Please note that no design work has been completed that may influence costs of items such as environmental considerations, transportation requirements, geotechnical conditions, regulatory authority requirements, as well as any ancillary work beyond the limits of the bridge.

5. SUMMARY AND RECOMMENDATIONS

GMBP supervised an arm's length inspection of the TH&B Railway River Crossing (Structure 143). This inspection involved ropes access to inspect the superstructure and above-water substructure elements. The results of this inspection determined that Structure 143 is in fair condition. Rehabilitation in the next 1-5 years or replacement in the next 6-10 years should be considered. An option for removal was also considered for comparison purposes. The next enhanced inspection should be completed in 3-5 years, or in advance of rehabilitation. The crack on the south column of the east pier should be monitored visually through biennial OSIM inspections.

Further to the recommendations provided above, we strongly suggest that the City ensures the following maintenance procedures are followed:

- Avoid use of de-icing chemicals, using sand as an alternative
- Regularly cut back and maintain vegetation around the abutments and deck of the structure
- Regularly clean structure of accumulated debris

We thank you for engaging in the services of GM BluePlan Engineering Limited, and trust that this report provides the information that you require at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact us.

All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

Per:

Adam Galezowski, P.Eng.

Per:

Jack Turner, P.Eng.

APPENDIX A:
Structure 143 Conversion and Repair Drawings

CONVERSION OF FORMER CN BRIDGE OVER GRAND RIVER TO PEDESTRIAN WALKWAY

DRAWING LIST:

SP1	SITE PLAN
S1	PEDESTRIAN WALKWAY DETAILS
S2	ABUTMENT APPROACH DETAILS
S3	ABUTMENT APPROACH DETAILS
S4	ABUTMENT REPAIR DETAILS
S5	RETAINING WALL DETAILS
CS1	CONSTRUCTION SPECIFICATIONS

KEY PLAN

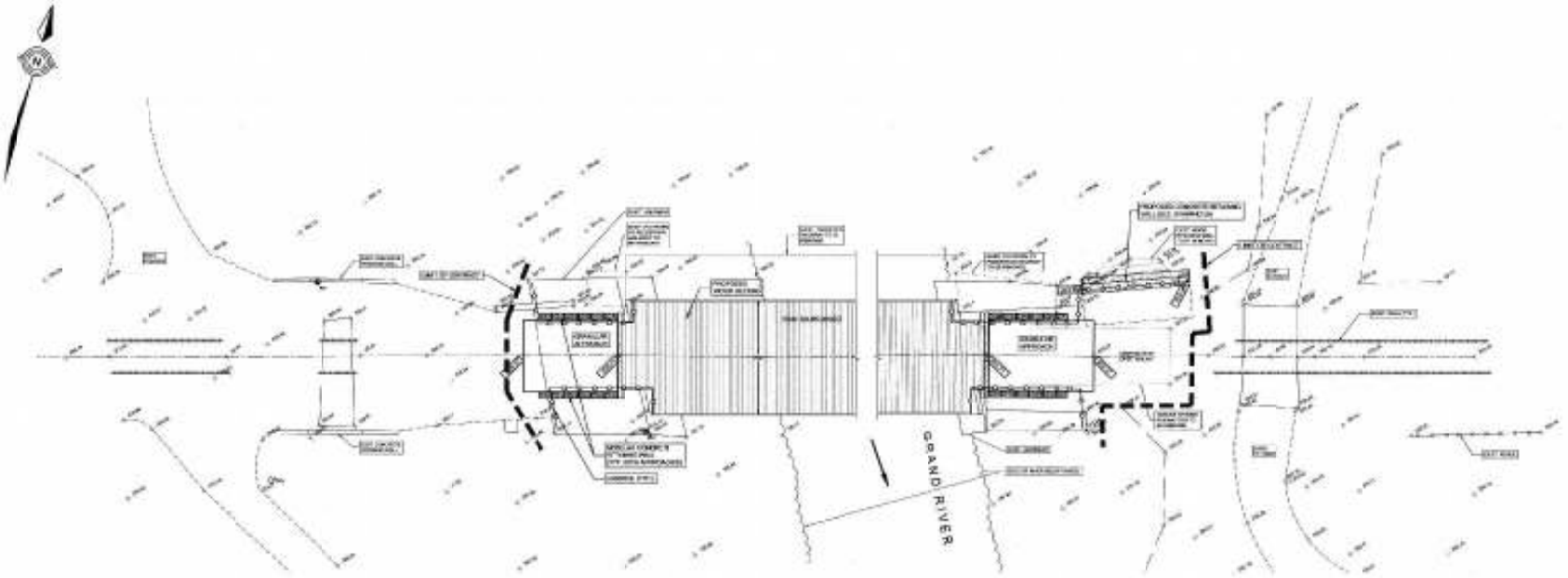
THE CORPORATION OF THE CITY OF BRANTFORD

CITY OF BRANTFORD

PROJECT No. 2006.201

Wiebe Engineering Group Inc.
CONSULTING ENGINEERS & PROJECT MANAGERS

WIEBE ENGINEERING GROUP INC. PROJECT No.: BR04077



PLAN @ WEST ABUTMENT

PLAN @ EAST ABUTMENT

LEGEND

BENCHMARKS

NO.	DESCRIPTION	DATE	CHKD
3	ISSUED FOR TENDER	05/29/2005	OPC
4	ISSUED FOR REVIEW	07/11/2005	OPC
5	ISSUED FOR REVIEW	09/19/2005	OPC
6	ISSUED FOR GRCA AND MTR APPROVAL	09/12/2005	OPC
7	ISSUED FOR GRCA REVIEW	01/09/2006	OPC

BRANTFORD

Wiebe Engineering Group Inc.

DESIGNED BY: EPE
DRAWN BY: TMT
CHECKED BY: OPC
APPROVED BY: OPC

PROJECT

CONVERSION OF FORMER CN BRIDGE OT PEDESTRIAN WALKWAY

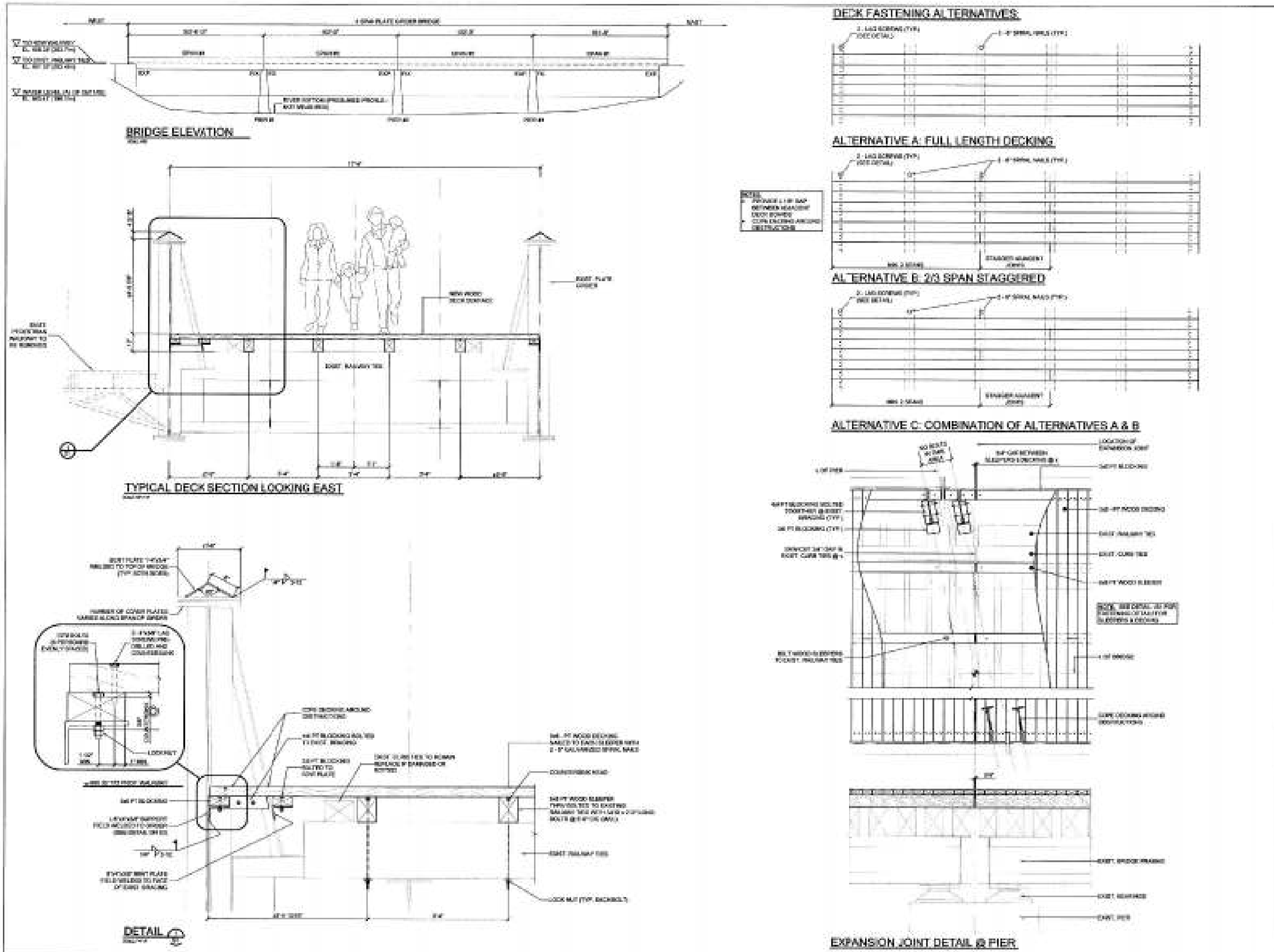
BRANTFORD, ONTARIO

CONVERSION OF THE CITY OF BRANTFORD
PROJECT No. 2004.29

DRAWING TITLE

SITE PLAN

SCALE	1:100	DRAWING No.	SP1
DATE	APRIL 2005		
FILE No.	BR04077	REV. No.	0



BRANTFORD

Wiebe Engineering Group Inc.

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

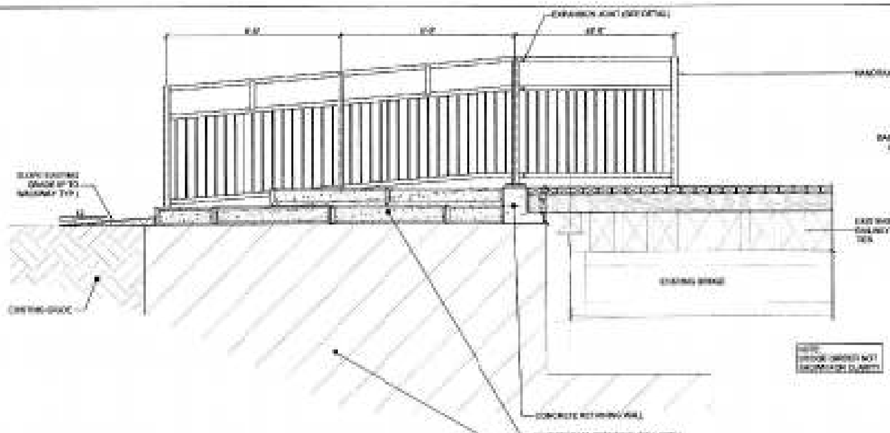
PEDESTRIAN WALKWAY DETAILS

AS SHOWN

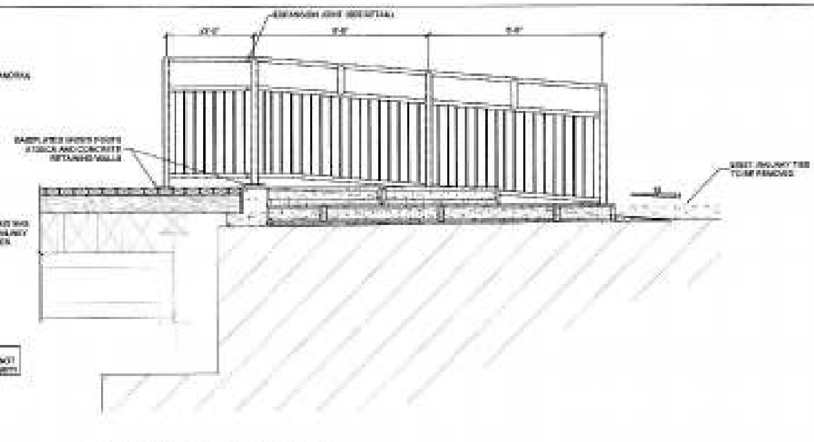
APRIL 2006

S1

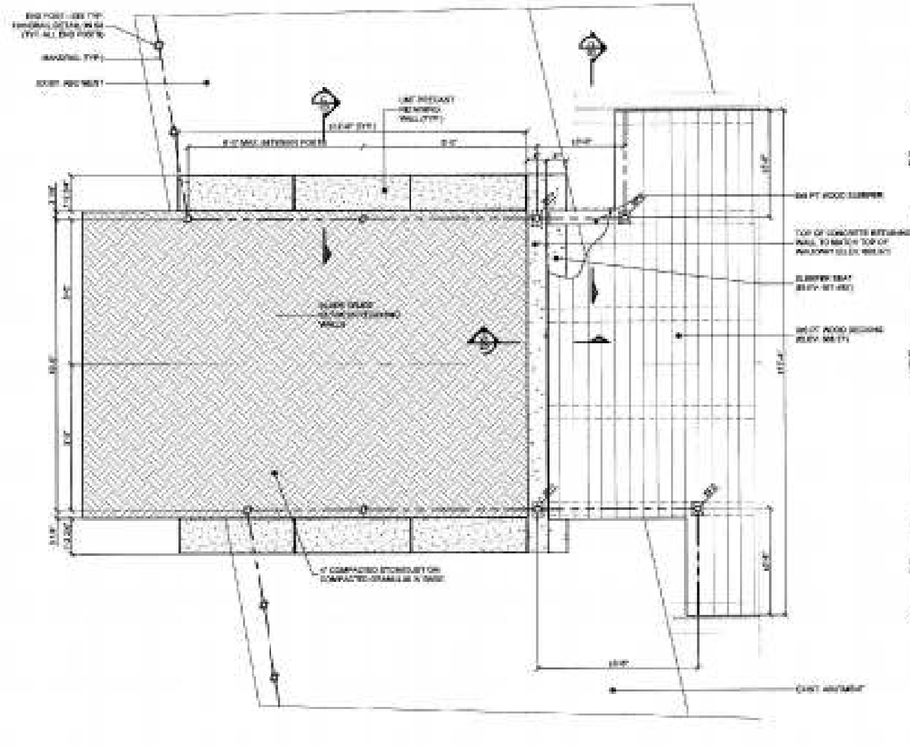
BR04077



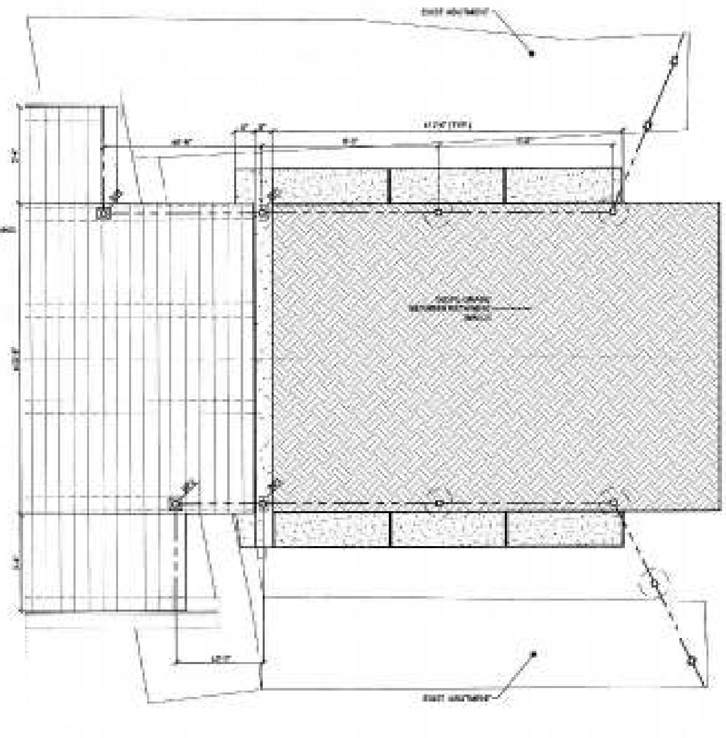
ELEVATION @ WEST ABUTMENT



ELEVATION @ EAST ABUTMENT



PLAN VIEW OF RETAINING WALL @ WEST ABUTMENT



PLAN VIEW OF RETAINING WALL @ EAST ABUTMENT

No.	DESCRIPTION	DATE	DWG
5	ISSUED FOR TENDER	[illegible]	DPC
4	ISSUED FOR REVIEW	[illegible]	DPC
3	ISSUED FOR REVIEW	[illegible]	DPC
2	ISSUED FOR GRCA AND MNR APPROVAL	[illegible]	DPC
1	ISSUED FOR GRCA REVIEW	[illegible]	DPC

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.

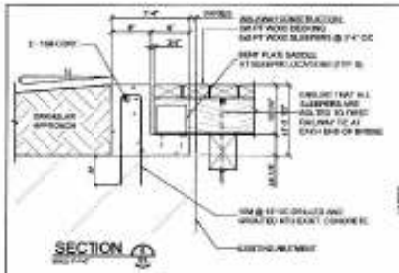
PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

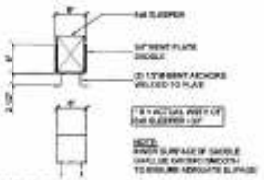
BRANTFORD, ONTARIO

ABUTMENT APPROACH DETAILS

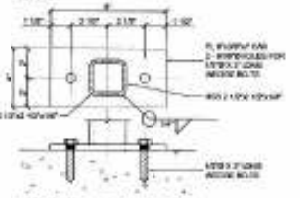
SCALE	AS SHOWN
DATE	APRIL 2006
FILE No.	BR04077
DRAWING No.	S2



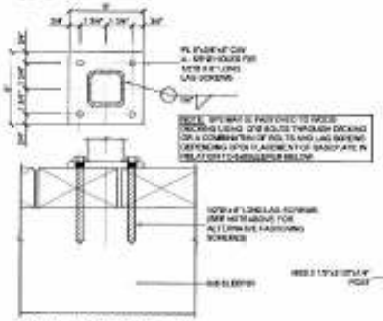
SECTION



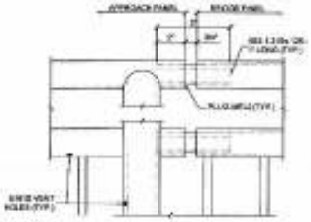
SADDLE DETAIL



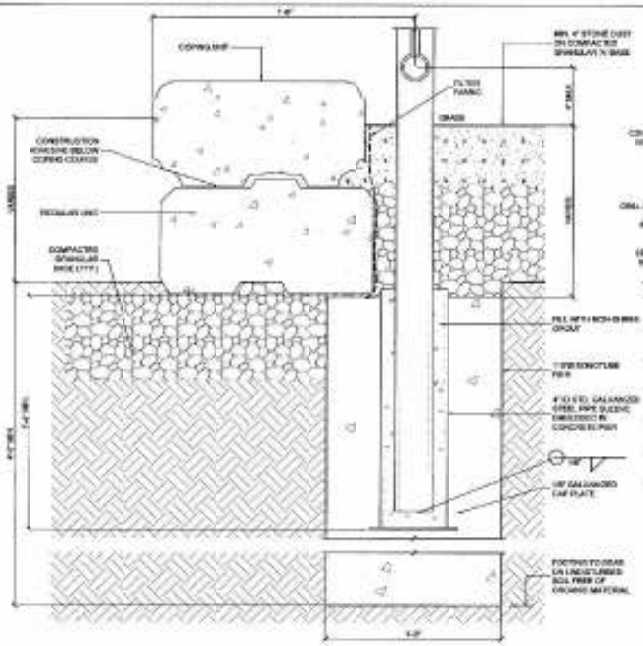
BASEPLATE BP1 DETAIL



BASEPLATE BP2 DETAIL

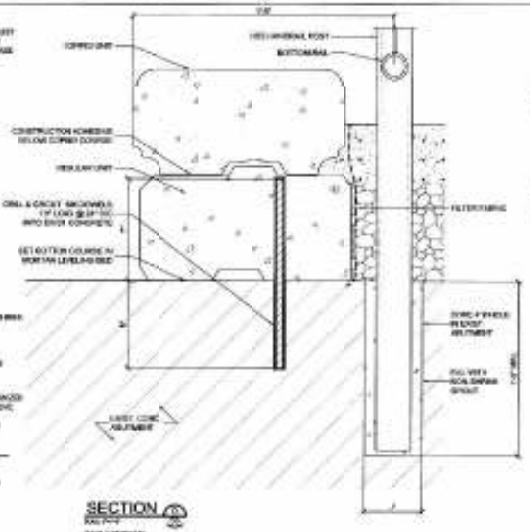


TYP. JOINT DETAIL



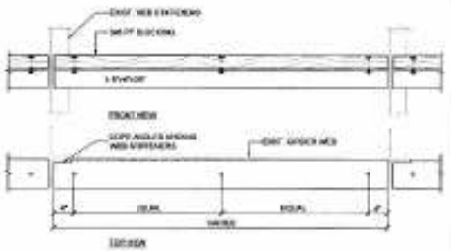
SECTION

(FOR SOIL OR GRANULAR MATERIAL)

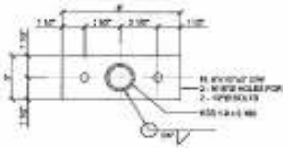


SECTION

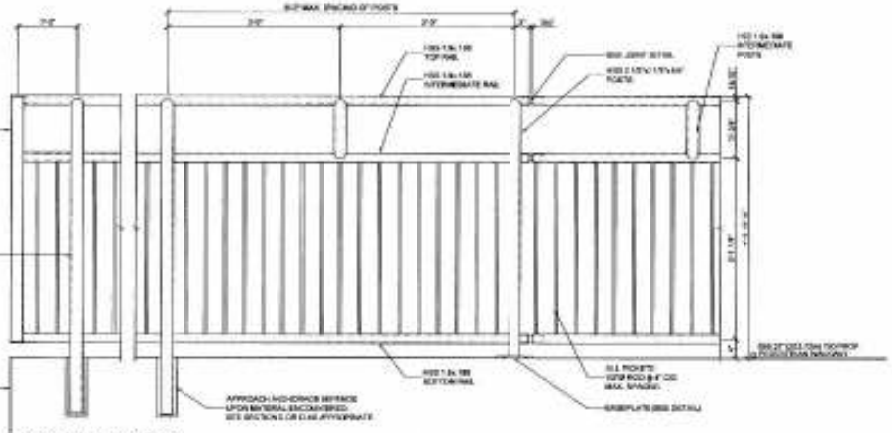
(FOR CONCRETE)



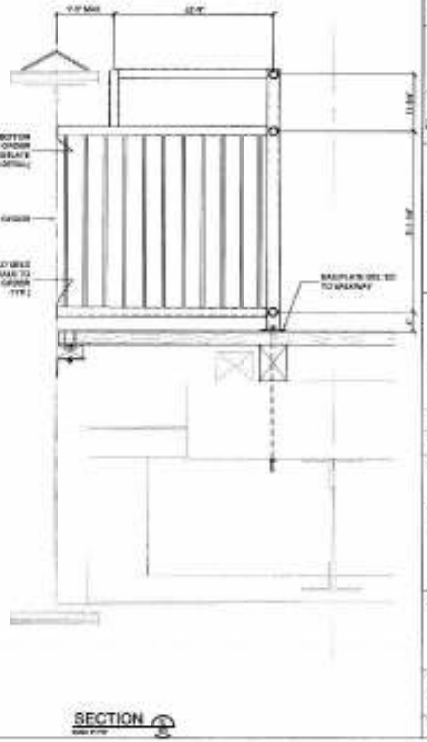
SHELF ANGLE FASTENING DETAILS



BASEPLATE BP3 DETAIL



TYP. HANDRAIL DETAIL



SECTION

6	ISSUED FOR TENDER	05/10/2005	DPC
4	ISSUED FOR REVIEW	07/11/2005	DPC
3	ISSUED FOR REVIEW	05/10/2005	DPC
2	ISSUED FOR GRCA AND MNR APPROVAL	05/10/2005	DPC
1	ISSUED FOR GRCA REVIEW	05/09/2005	DPC
No.	DESCRIPTION	DATE	CHKD

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.

CONSULTING ENGINEERS & PROJECT MANAGERS

DESIGNED BY: DPC | CHECKED BY: DPC

DRAWN BY: TMF | APPROVED BY: DPC

PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

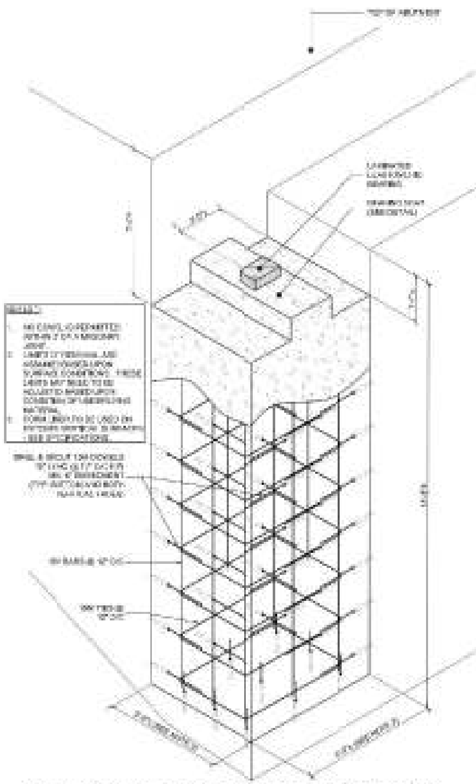
BRANTFORD, ONTARIO

CONVERSION OF THE CITY OF BRANTFORD PROJECT No. 2004-20

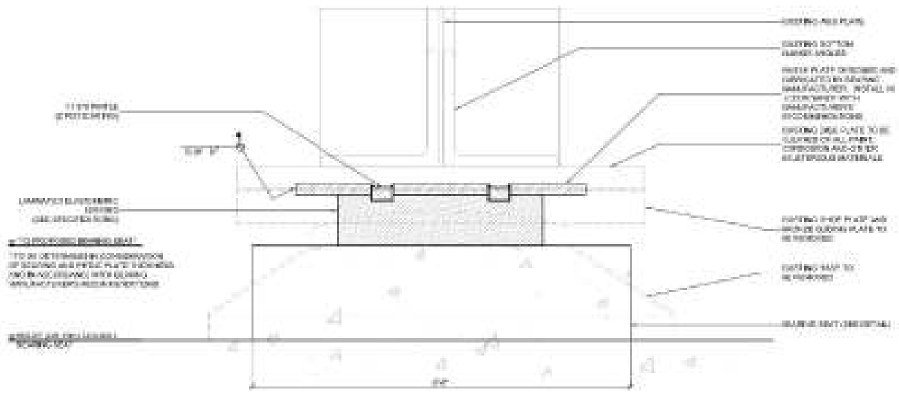
DRAWING TITLE

ABUTMENT APPROACH DETAILS

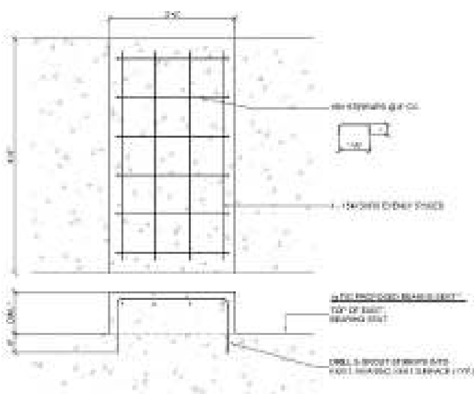
SCALE	AS SHOWN	DRAWING No.	S3
DATE	APRIL 2005		
FILE No.	BR04077	REV. No.	6



NORTH CORNER OF EAST ABUTMENT - REPAIR DETAILS



SECTION



BEARING SEAT DETAIL

NORTH CORNER OF EAST ABUTMENT

EXIST. BEARING

SOUTH CORNER OF EAST ABUTMENT

BRANTFORD

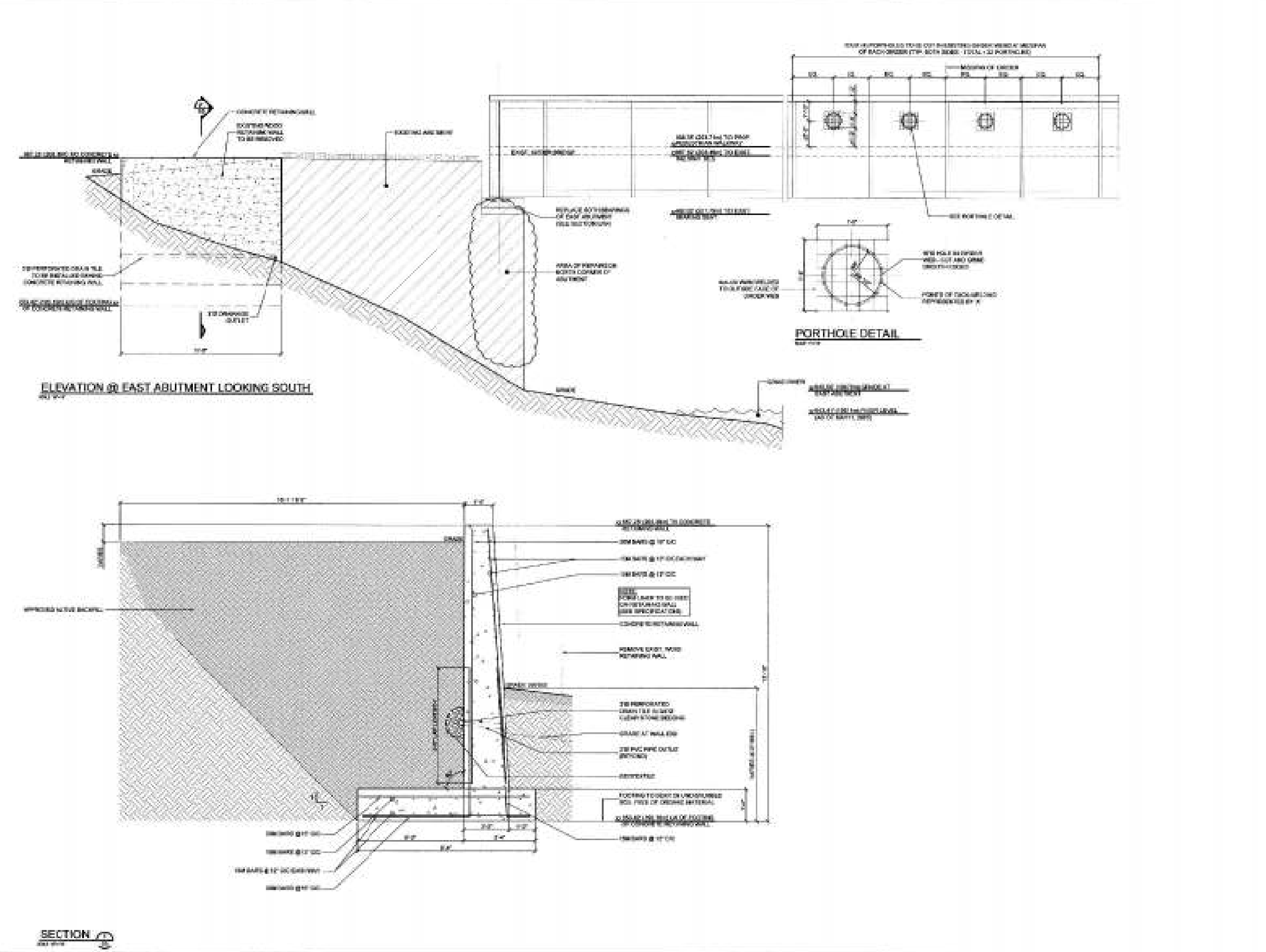
Wiebe Engineering Group Inc.

CONVERSION OF FORNER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

ABUTMENT REPAIR DETAILS

AS SHOWN	S4
APRIL 2005	
BR04077	



No.	Description	Date	Chk
5	ISSUED FOR TENDER		DPC
4	ISSUED FOR REVIEW		DPC
3	ISSUED FOR REVIEW		DPC
2	ISSUED FOR CDGA AND MNR APPROVAL		DPC
1	ISSUED FOR GROUP REVIEW		DPC

BRANTFORD

Wiebe Engineering Group Inc.

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

RETAINING WALL DETAILS

SCALE: AS SHOWN
DATE: APRIL 2005
DRAWING No. S5
FILE No. BR04077

GENERAL NOTES

1. Contractors shall visit the site prior to bid to ascertain conditions which may adversely affect the work as set forth herein.
2. The Engineer shall not be responsible for the methods, techniques and sequence of construction to perform the work. The supervision of the work is the sole responsibility of the Contractor.
3. The Contractor shall be responsible for complying with all safety precautions and regulations during the work. The Engineer will not observe or oversee construction to enforce precautions and regulations.
4. Drawings and all general and special notes of construction. Where conditions are not specifically shown, similar details of construction shall be used, subject to approval by the Engineer.
5. The Contractor shall verify all dimensions prior to construction and shall report any discrepancies, errors or omissions to the Engineer before proceeding with construction.
6. Unless otherwise noted, refer to all notes and details shall be the most critical.
7. Shop drawings and other items shall be submitted to the Engineer for review prior to fabrication. All shop drawings shall be reviewed by the Contractor before submittal. The Engineer's review is to be for conformance with the design concept and general compliance with the relevant contract documents. The Engineer's review does not relieve the Contractor's responsibility to review, check and coordinate their own shop drawings prior to submission. The Contractor must be entirely responsible for errors and omissions associated with the preparation of shop drawings as they pertain to maximum sizes, details, dimensions, etc.
8. Submission of shop drawings and/or other documentation for approval is required for the following components:
   a. Concrete mix designs
   b. Form liner pattern
   c. Non-forming plastic
   d. Steel (up and down pattern engineer's seal required)
   e. Railings
   f. Welding and stitching (steel engineer's seal required)
9. It is the Contractor's responsibility to maintain all parts of the existing bridge in a safe condition during the progress of construction and to protect the existing bridge from damage. Any damage to the existing structure caused by the Contractor's operations shall be repaired at the Contractor's expense.
10. Information and / or the preparation of these drawings was largely derived from or in areas of the original bridge drawings. Copies of the original bridge drawings can be made available to the Contractor should he desire.
11. Shoring, grading and site preparation work may be required to allow for proper adequate storage/laying areas and/or access routes between the work site and public thoroughfares. Additional equipment and materials required but unspecified for work and necessary to maintain a safety and construction site with due work shall be included in the contractor's bid price.
12. Prior to mobilization of the work, it is the contractor's responsibility to make all areas impacted by the contractor's operations fully accessible to others. The contractor is to maintain the specifications for landscaping found in Section 3 of Scotland Industries Code applicable standards.

APPENDIX A

1. This structure has been designed as a Schedule B project under the Ontario Bridge Code and the Canadian Highway Bridge Design Code. The Contractor is advised that all Schedule B requirements have been satisfied.
2. The Contractor is hereby advised that the following regulatory agencies have been contacted for their requirements on this project:
   a. Grand River Conservation Authority - a fill/flood permission has been obtained (see below)
   b. DEPARTMENT OF FISHERIES & Oceans - no comments are performed in GRCA's review.
   c. Ministry of Natural Resources - no permits required.
   d. Transport Canada - no permit required.
3. The Grand River Conservation Authority has provided verification of conditional approval of this project. The specific requirements stated in their letter dated July 14, 2007, issued as of Permit No. 3470 is subject to meeting the following conditions:
   a. That all in-water construction, including bar removal, take place in the dry, using cofferdams, during the period between March 31 and June 30 in any given year.
   b. That the Contractor will be responsible for ensuring that all erosion and sediment control measures are properly installed and maintained to prevent sediment from entering the watercourse during construction and that all disturbed areas are stabilized immediately following construction.
   c. That the Contractor will be responsible for ensuring that all construction activities are carried out in accordance with the Fisheries Act and that no deleterious substances enter the watercourse during construction.
   d. That the Contractor shall notify the Grand River Conservation Authority at least 48 hours prior to the commencement of any construction activities.
   e. That all disturbed areas are topsoiled and seeded with a suitable seed mixture.
   f. That the Contractor shall obtain a Permit to Take Water from the Ministry of the Environment, if required.
   g. That the Contractor shall obtain a Work Permit from the Grand River Conservation Authority, if required.
4. The Contractor shall observe the aforementioned and any restrictive wording and shall complete the following reporting documentation:
   a. A registered construction schedule
   b. A registry of submitting plan submitting
      - proposed heavy equipment
      - access routes for the various work areas (particularly for on-river work)
      - details of site access work
      - temporary work dewatering measures
      - proposed refueling areas
      - removed materials and equipment storage areas, and
      - proposed sedimentation controls.

DESIGN CRITERIA

1. All construction shall conform to CAN/CSA-S6-00 and applicable reference standards. Unless otherwise noted, all concrete work and steelwork shall conform to the applicable section of Ontario Reg 854/06.
2. Allowed loading has been designed for the following loads:
   a. Dead load due to material and weight
   b. Live/density distributed load of 5 kPa per sq.m.
   c. A light maintenance vehicle with a maximum axle load of 5000 kg (11 kN)
3. Design load for the decking has not been designed to accommodate the maintenance vehicle load included in CAN/CSA-S6-00. In accordance with 3.8.3.1 in CAN/CSA-S6-06, the vehicle width has been considered to be 1.7 m (11 kN).
4. Loading design criteria are as follows:
   a. Dead load per bearing
      - DL1 113 kip (507 kN)
      - DL2 80.1 kip (361 kN)
   b. Total live load bearing
      - LL1 448 kips (2 kNs)
      - LL2 180.4 kip (801 kN)
   c. Lateral force magnitude
   d. Rotation magnitude
   e. Longitudinal movement
      - Expansion from neutral temp: 1.47" (37 mm)
      - Contraction from neutral temp: 1.47" (37 mm)
      - Total longitudinal movement: 1.18" (30 mm)
5. This structure has been designed with such maintenance factors in accordance with generally accepted principles of structural engineering. The fundamental nature of these factors is to compensate for uncertainties in the design. Neglecting any violation of assumptions during construction, it is reasonable that these factors be used to distribute load carrying capacity of the structure more uniformly than real loads may dictate load and that the building will perform better than design load without failures. While there are at times factors relative some excess capacity beyond design load, such excess capacity cannot be adequately predicted and should not be relied upon.

LOADING AND SHORING

1. Before proceeding with any work, the Contractor shall prepare for himself/herself a shoring and other conditions. It shall be the Contractor's responsibility to provide all necessary shoring, and other temporary supports as parts of the existing structure in a safe condition during the process of removal and construction and to protect from damage those portions of the existing structure which are to remain.
2. Footing and Piling, to CSA S269.1-1975 (R2003).
3. Design of jacking and shoring measures shall be the responsibility of the Contractor. Details shall be illustrated on engineer sealed drawings and shall be submitted for approval prior to any construction.
4. Jacking forces shall not exceed upon the following:
   a. Dead load of 1.0 kips (527 kN)
   b. Thermal/shrinkage due to the Contractor's equipment and operations.
   c. Appropriate safety factors as provided by the applicable codes.
5. Upon completion, jacks shall be removed and all jacking equipment suitable removed. In order to ensure bearing functionality, any detailed inspection schedules to monitor periods of maintenance or construction operations. Visually, such inspection shall take place during an extended period (for several hours) of moderate temperatures (approximately 10°C).
6. Any modifications to the bridge superstructure or substructure to accommodate jacking must be restored to their original state. In the event that such modifications do not satisfy to the satisfaction of the Engineer, then replacement may be ordered at the discretion of the Engineer.

FABRICATION

1. Limits of camber/deflection on the drawings are approximate and may be revised at the Engineer's discretion based upon actual material conditions encountered.
2. Unless otherwise indicated, all items noted to be permanently removed or demolished shall become the Contractor's property and be removed from the site for reuse or disposal at an approved waste disposal facility. The fences (ASTM) ribbon that the existing openings at the east abutment are an exception to this. These plates should be carefully removed by the Contractor and provided to the City's representative.
3. Particular care must be taken during construction to prevent materials from falling into the watercourse. The requirements of the Grand River Conservation Authority must be strictly observed in this regard.

STEEL

1. Unless otherwise noted, all steel materials must be in accordance with the following CSA specifications:

MATERIAL	STANDARD	MIN. STRENGTH
W-Shapes (Rolled Sections)	CAN/CSA-G40.21, Grade 350W	350 MPa
Plates, Flanges, Bolsters	CAN/CSA-G40.21	350 MPa
Other rolled shapes/angles	CAN/CSA-G40.21	300 MPa
Connection bolts	ASTM A325	830 MPa
Anchor bolts/threaded rods	ASTM A36	400 MPa

2. Unless otherwise noted all bolts shall be smeared using type bolts and shall be tightened in accordance with CSA S16.1 and CAN/CSA-S6.
3. Holes shall be drilled or drilled to the finish diameter, except that punched holes are allowed in material up to 16 mm (5/8") in thickness. All drilled holes shall be provided with smooth edges. Burning of holes and hand cutting of the utility is not permitted.
4. Welding shall conform to CSA-W59. Electrodes shall be selected in accordance with: (1) 10.21 of CAN/CSA-S6 as appropriate for the base material being joined. All welding shall be performed by operators certified to Division 1 or Division 2.1 of CSA W47.1.
5. Fabrication of field splices shall be performed in accordance with: 10.24.3.2.3 of CAN/CSA-S6.
6. Unless otherwise noted, all steel components (including fasteners) shall be hot dip galvanized in accordance with CAN/CSA-G164-M.
7. Protective coatings damaged during the shipping, erection and field welding processes shall be repaired in the field to match factory applied coating.
8. All steel that will be assembled by the contractor on ground and then put in place by crane, in particular, all handrails and guards shall be free of all excess edges and burrs.

WELDING

1. Steel welded shall conform to CAN/CSA-G40 and the following specification:
   a. Carbon content
      - Grade: Rail Plate
      - Copper: Welded
   b. All other forms
      - Grade: Any from Table 6.1.1.1 of CAN/CSA-G40.20
      - Grade: No. 2 or better
2. All welded shall be carried out in accordance with the CAN/CSA-W59 Series. For manufacturing and any other work completed in a specific shop fabrication contract, the preparation shall meet the one of the following:
   a. Unassembled edges prepared (CWB)
   b. Automatic welding and shall be prepared (AWA)
   c. Semi-automatic welding and shall be prepared (AWSA-1)
   d. Semi-manual welding and shall be prepared (SMA)
3. Where possible, weld components shall be such as these as cuts, all scaffolding, weld, weldings, mig grooves, chipped fixing, flame and other cuts shall be made and/or machined as per manufacturer specification. Except where it is not possible, components shall be shall be cut to length or be field.
4. All cuts, perforations and other that have been required to machine wood shall be fortified/made with new applications of a brush-applied copper naphthenate based preservative.
5. Generally, the welding of the existing railway box or the bridge has been determined to be possible for support of the new deck structure. However, a detailed examination of each the box not been performed. Prior to contact the Engineer should any weaknesses be discovered.
6. Except for rivets or bolts, all members and materials fastened shall be made permanently in accordance with CAN/CSA-G164-M. Rods and quotes shall be fully galvanized in accordance with CAN/CSA-G40.21. Galvanized rods shall be as shown in article 10 CAN/CSA-S6. The completed diameter of the rod shall be galvanizing, then finished after components and connections shall be cleaned by an approved process mechanical.
7. Stainless steel: be avoided under field threads are now in contact with wood.
8. Double nuts shall be provided to prevent the loosening of bolted connections, as indicated on the drawings. As a minimum, this consideration shall apply to all bolted connections where one or more of the components being joined is wood.

CONCRETE

1. Concrete material and construction shall conform to the requirements of CAN/CSA-A23.1. Exposed faces to cold weather must satisfy conditions, as necessary, based upon weather CAN/BCA of the Table of Construction.
2. All concrete shall conform to the following specifications:
   a. Min. 28 day strength: 1,000 psi (6.9 MPa)
   b. Air entrainment: 6% +/- 1.5%
   c. Max. water cement ratio: 0.5
3. All anchors grout shall be non-shrinkage grout with a minimum 28 day compressive strength of 3,000 psi (20 MPa).
4. All reinforcing steel shall conform to CAN/CSA-G30.18, Grade 400W. All welding of reinforcing steel shall be in accordance with the standard AWS.
5. Concrete cover and reinforcing shall conform to the following:
   a. Vertical surfaces of structural components: 50 mm (2.00 mm)
   b. Top surfaces of structural components: 40 mm (1.60 mm)
   c. Footing, abutment and retaining walls exposed to earth and/or water: 75 mm (3.00 mm)
   d. Footings completed and permanently exposed to earth: 100 mm (4.00 mm)
6. Bar supports and tying wire shall be provided to all reinforcing steel to ensure proper concrete cover. Bar supports shall be plastic tipped or stainless steel.
7. All reinforcing steel shall be set and held in position in courting of concrete. Do not field bend bars partially embedded in hardened concrete unless specifically authorized or approved by the Engineer.
8. Construction joints (if any) for reinforcing and/or structure is to be formed in a textured surface by use of a form liner. Pattern to be selected by the City.
9. All edges of permanently exposed concrete surfaces shall be chamfered 10 (3/4in.) unless otherwise noted.
10. Formwork shall remain in place until concrete has obtained at least 28N of its 28 day compressive strength. The Contractor shall provide all shoring and surveying, as necessary.

REFINISHING WALL

1. Retaining and facing shall be foundation consisting of reinforced concrete as indicated on the plans. A baseline of waterproofing is likely loading pressure of 2 kN/sq.m (unless) or greater. Not all the bonding envelope shall be evaluated by a qualified geotechnical engineer prior to placing concrete. And if the Engineer should finds soil conditions be inferior to the required bearing capacity.
2. Where sub-excavation and placement of engineered fill is required to replace non-bearing soils this work shall be performed under the direction of a qualified geotechnical engineer.
3. Retaining wall shall be backfilled with clean, compact, select material compacted in layers to 95% standard proctor dry density.

5	ISSUED FOR TENDER	08/22/2008	DPC
4	ISSUED FOR REVIEW	07/11/2008	DPC
3	ISSUED FOR REVIEW	06/04/2008	DPC
2	REVISED FOR GRCA AND MNR COMMENTS	06/01/2008	DPC
1	ISSUED FOR GRCA REVIEW	04/28/2008	DPC
No.	DESCRIPTION	DATE	INITIALS

REVISIONS

BRANTFORD

Wiebe Engineering Group Inc.
CONSULTING ENGINEERS & PROJECT MANAGERS
58 DALHOUSIE STREET, BRANTFORD, TEL: (519) 759-4561
600 KENT WEST STREET, WELLAND, TEL: (905) 735-4422
www.wiebeengineering.com

ISSUED BY: DPC	CHECKED BY: DPC
DRAWN BY: TBE	APPROVED BY: DPC

PROJECT

CONVERSION OF FORMER CN BRIDGE TO PEDESTRIAN WALKWAY

BRANTFORD, ONTARIO

CONVERSION OF THE CITY OF BRANTFORD PROJECT NO. 0508-0408

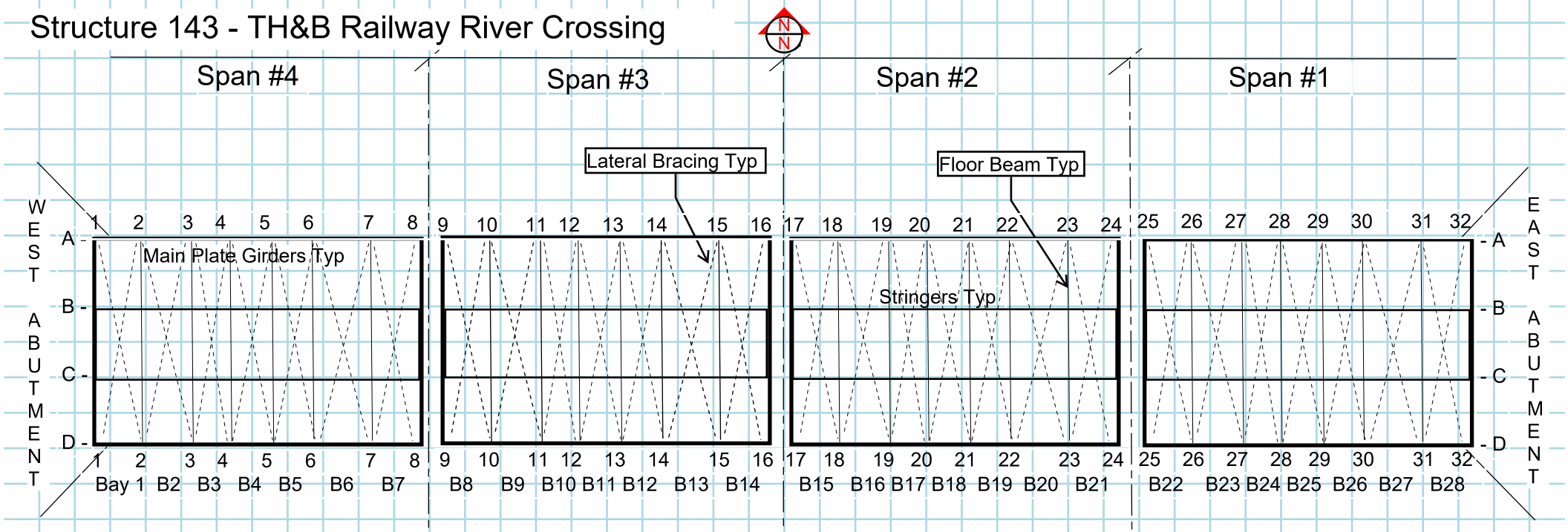
DRAWING TITLE

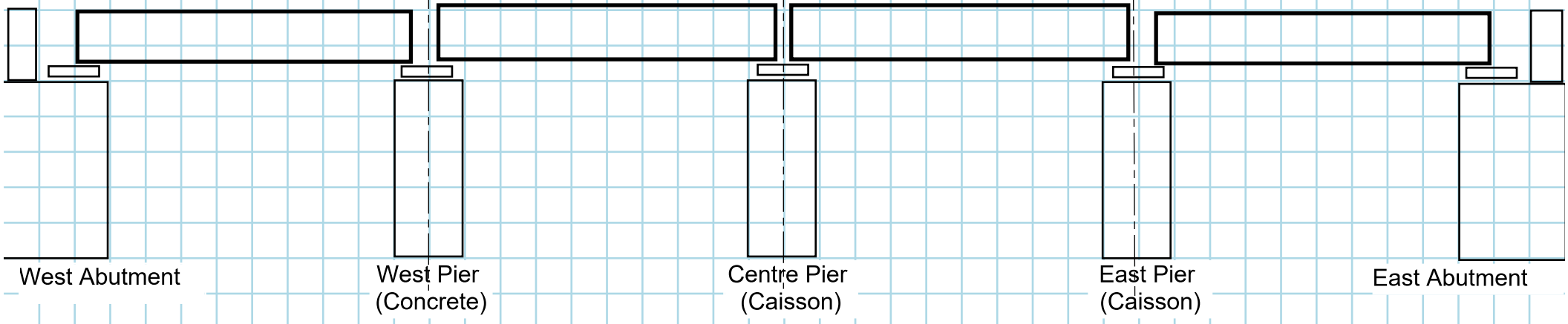
CONSTRUCTION SPECIFICATIONS

SCALE	AS SHOWN	DRAWING No.
DATE	APRIL 2008	CS1
FILE No.	BR04077	REV No. 5

APPENDIX C:
Structure 104 Sketch - Naming Convention

Structure 143 - TH&B Railway River Crossing





APPENDIX D:
Glossary of Technical Terms

GLOSSARY OF TECHNICAL TERMS

Concrete Deficiencies

Delamination: A discontinuity of the surface concrete which is substantially separated but not completely detached from concrete below or above it

Spalling: A continuation of the delamination process whereby the actions of external loads, pressures exerted by the corrosion of reinforcement or by the formation of ice in the delaminated area results in the breaking off of the delaminated concrete

Steel Deficiencies

Corrosion: The deterioration of steel by chemical or electro-chemical reaction resulting from exposure to air, moisture, de-icing salts, industrial fumes and other chemicals and contaminants in the environment in which it is placed, also referred to as rust

Material loss: A continuation of corrosion, material loss refers to the percentage of cross sectional area that has corroded away

General Deficiencies

Scour: The removal of material from the stream bed or bank due to the erosive action of moving water in the stream.

Undermining: The loss in support at the base of a foundation as a result of scour.

APPENDIX D:
Inspection Photos

Photograph 1: South elevation

Photograph 2: West abutment

Photograph 3: East abutment, north corner

Photograph 4: East abutment

Photograph 5: East abutment, south bearing

Photograph 6: West pier

Photograph 7: West pier

Photograph 8: Center pier, north steel column (north face)

Photograph 9: East pier, north steel column (north face)

Photograph 10: East pier, south steel column

Photograph 11: Center pier, Span #2, north bearing

Photograph 12: East pier, anchor bolt at location A25

Photograph 13: West pier, bearing at location D9

Photograph 14: Underside, looking west

Photograph 15: North plate girder, looking west

Photograph 16: North girder at east abutment

Photograph 17: East span, lateral bracing connection plate

Photograph 18: East span, lateral bracing

Photograph 19: Deck top, looking east

Photograph 20: Deck top

APPENDIX F:
Cost Estimates

STRUCTURE 143 COST ESTIMATE - REHABILITATION					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**CONSTRUCTION COSTS**				
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$ 40,000.00	$ 40,000.00
A.2	Environmental Protection	100%	L.S.	$ 10,000.00	$ 10,000.00
A.3	Cofferdams and Dewatering around West Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
A.4	Cast In Place Concrete Repair in West Pier	14	m3	$ 6,000.00	$ 84,000.00
A.5	Cast In Place Concrete Patch in West Abutment Wall, Ballast Wall and Wingwalls	10	m3	$ 5,000.00	$ 50,000.00
A.6	Work Platform at Centre Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
A.7	Repair North Steel Column, Centre Pier	100%	L.S.	$ 5,000.00	$ 5,000.00
A.8	Work Platform at East Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
A.9	Repair North Steel Column, East Pier	100%	L.S.	$ 5,000.00	$ 5,000.00
A.10	Repair South Steel Column, East Pier	100%	L.S.	$ 5,000.00	$ 5,000.00
A.11	Install Missing Nuts and Washers on East Abutment Bearings	3	ea	$ 500.00	$ 1,500.00
A.12	Work Platform at East Abutment	100%	L.S.	$ 10,000.00	$ 10,000.00
A.13	Install Anchor Bolts / Guide Plates at Elastomeric Bearings on East Abutment	2	ea	$ 7,500.00	$ 15,000.00
A.14	Repointing of East Abutment Wall and Wingwalls	100%	L.S.	$ 5,000.00	$ 5,000.00
A.15	Repair Lateral Brace and Connection Plate	100%	L.S.	$ 5,000.00	$ 5,000.00
A.16	Remove and Replace Wood Deck	670	ea	$ 300.00	$ 201,000.00
A.17	Site Restoration	100%	L.S.	$ 5,000.00	$ 5,000.00
A.18	Contingency at approximately 25%	100%	L.S.	$ 90,000.00	$ 125,000.00
TOTAL SECTION A					**$ 626,500.00**
B	**NON-CONSTRUCTION COSTS**				
B.1	Engineering Design and Construction Administration	100%	L.S.	$ 70,000.00	$ 70,000.00
B.2	Approvals (est.)	100%	L.S.	$ 10,000.00	$ 10,000.00
TOTAL SECTION B					**$ 80,000.00**
TOTAL REPLACEMENT COST					**$ 706,500.00**

STRUCTURE 143 COST ESTIMATE - REPLACEMENT					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**CONSTRUCTION COSTS**				
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$ 150,000.00	$ 150,000.00
A.2	Environmental Protection	100%	L.S.	$ 20,000.00	$ 20,000.00
A.3	Contractor Layout	100%	L.S.	$ 10,000.00	$ 10,000.00
A.3	Cofferdams and Dewatering around West Pier	100%	L.S.	$ 20,000.00	$ 20,000.00
A.4	Cast In Place Concrete Repair in West Pier	14	m3	$ 6,000.00	$ 84,000.00
A.5	Cast In Place Concrete Patch in West Abutment Wall, Ballast Wall and Wingwalls	10	m3	$ 5,000.00	$ 50,000.00
A.6	Removal of Existing Deck and Railway Ties	670	m2	$ 250.00	$ 167,500.00
A.7	Construction of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$ 150,000.00	$ 150,000.00
A.8	Removal of Existing Superstructure	100%	L.S.	$ 250,000.00	$ 250,000.00
A.9	Suspended Platforms at Piers	3	each	$ 15,000.00	$ 45,000.00
A.7	Repair North Steel Column, Centre Pier	100%	L.S.	$ 5,000.00	$ 5,000.00
A.9	Repair North Steel Column, East Pier	100%	L.S.	$ 5,000.00	$ 5,000.00
A.10	Repair South Steel Column, East Pier	100%	L.S.	$ 5,000.00	$ 5,000.00
A.11	Platforms at Abutments	2	each	$ 5,000.00	$ 10,000.00
A.14	Repointing of East Abutment Wall and Wingwalls	100%	L.S.	$ 5,000.00	$ 5,000.00
A.13	Modifications to Existing Abutments and Piers	100%	L.S.	$ 50,000.00	$ 50,000.00
A.14	Design and Supply of new Superstructures (approx. 4 x 31.1m)	100%	L.S.	$ 550,000.00	$ 550,000.00
A.16	Install new Superstructures	100%	L.S.	$ 150,000.00	$ 150,000.00
A.17	Removal of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$ 20,000.00	$ 20,000.00
A.18	Site Restoration	100%	L.S.	$ 4,000.00	$ 4,000.00
A.19	Contingency at approximately 25%	100%	L.S.	$ 450,000.00	$ 450,000.00
TOTAL SECTION A					**$ 2,200,500.00**
B	**NON-CONSTRUCTION COSTS**				
B.1	Engineering Design and Construction Administration	100%	L.S.	$200,000.00	$ 200,000.00
B.2	Municipal Class Environmental Assessment	100%	L.S.	$100,000.00	$ 100,000.00
B.3	Approvals (est.)	100%	L.S.	$15,000.00	$ 15,000.00
TOTAL SECTION B					**$ 315,000.00**
TOTAL REPLACEMENT COST					**$ 2,515,500.00**

STRUCTURE 143 COST ESTIMATE - REMOVAL					
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT OF MEASURE	UNIT PRICE	TOTAL AMOUNT
A	**CONSTRUCTION COSTS**				
A.1	Mobilization, Bonding, Insurance, Demobilization	100%	L.S.	$ 50,000.00	$ 50,000.00
A.2	Environmental Protection	100%	L.S.	$ 10,000.00	$ 10,000.00
A.3	Contractor Layout	100%	L.S.	$ 2,000.00	$ 2,000.00
A.4	Removal of Existing Deck and Railway Ties	670	m2	$ 250.00	$ 167,500.00
A.5	Construction of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$ 150,000.00	$ 150,000.00
A.6	Removal of Existing Superstructure	100%	L.S.	$ 250,000.00	$ 250,000.00
A.7	Removal of Temporary Access Paths and Staging Areas in Grand River	100%	L.S.	$ 20,000.00	$ 20,000.00
A.8	Site Restoration	100%	L.S.	$ 4,000.00	$ 4,000.00
A.9	Contingency at approximately 25%	100%	L.S.	$ 160,000.00	$ 160,000.00
TOTAL SECTION A					**$ 813,500.00**
B	**NON-CONSTRUCTION COSTS**				
B.1	Engineering Design and Construction Administration	100%	L.S.	$100,000.00	$ 100,000.00
B.2	Municipal Class Environmental Assessment	100%	L.S.	$100,000.00	$ 100,000.00
B.3	Approvals (est.)	100%	L.S.	$15,000.00	$ 15,000.00
TOTAL SECTION B					**$ 215,000.00**
TOTAL REPLACEMENT COST					**$ 1,028,500.00**

BluePlan ENGINEERING

2021 Structural Evaluation Report

Appendix III

Summary of Load Factors used In Evaluation

TH&B CROSSING BRIDGE (STRUCTURE 143) STRUCTURAL EVALUATION REPORT

Summary of Loads Factors for Evaluation

Element	Dead Load Category	System Behaviour	Element Behaviour	Inspection Level	Reliability Index, β	Dead Load Factor, αD	*Live Load Factor, αL
Wood Deck	D2	3	3	3	2.50	1.10	1.35
Stringer	D1	3	3	3	2.50	1.05	1.35
Floor Beam	D1	2	3	3	2.75	1.06	1.42
Plate Girder	D1	1	3	3	3.00	1.07	1.49

** Live Load Factors for Maintenance vehicle*