HALIFAX
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Item 7.1.2

Transportation Standing Committee
July 5, 2012

TO: Chair and Members of Transportation Standing Committee

SUBMITTED BY: Peter Stickings, Acting Director, Planning & Infrastructure

DATE: June 8, 2012

SUBJECT: Macdonald Bridge Sidewalk Deck Panels

ORIGIN

The Active Transportation Plan, approved in principle by Regional Council in 2006, identifies a network of active transportation routes, some of which will require bridge crossings.

RECOMMENDATION

It is recommended that the Transportation Standing Committee recommend to Halifax Regional Municipality that the report Macdonald Bridge Sidewalk Panels – Active Transportation Applications be approved in principle and that Halifax Harbour Bridges be requested to donate one hundred and twenty sidewalk deck panels and six hundred metres of railing to the Halifax Regional Municipality for re-use in Active Transportation bridges.

BACKGROUND

Several months ago, HRM staff was advised by Halifax Harbour Bridges (HHB) that the existing sidewalk and bikeway panels (approximately 250 in total) on the Macdonald Bridge would be removed as part of the 2014-15 bridge redecking project and replaced with different panels. HHB advised that their intent is to issue a public tender for the salvage of these panels.

In January, 2012, HRM commissioned Hatch Mott MacDonald to conduct an assessment of the feasibility of salvaging these panels for re-use in active transportation bridges.

This initiative was presented to the Active Transportation Advisory Committee for discussion at its meeting of June 21, 2012.

DISCUSSION

The study looked at three typical lengths of active transportation bridges that would be required in the implementation of the Active Transportation Plan. The table below shows some key points in the evaluation:

Bridge Type	Typical Len (m)	Typical Application	Bridges Req'd		Bridge Cost ($ 000's)		Total Panels Req'd
			0-5 yr	5-10 yr	New Materials	Using Panels	
Short	10	Small stream crossing	5	10	$23	$9	60
Medium	24	Medium stream crossing Two-lane road overpass Rail overpass	3	3	$70	$73	60
Long	45	Four-lane highway overpass	1	1	$262	$320	36

The assessment assumes that there is no cost to HRM to acquire the deck panels for use on these bridges, but does assume a cost for the transport and storage of the panels from the time they become surplus to the time they are needed for construction.

The deck panels are an orthotropic design made of galvanized steel and coated with anti-slip material on the surface. They are very thin and light and, as such, need substantial substructure to support longer span lengths. For this reason, the assessment found the panels to be very cost effective in shorter spans but not so in longer spans.

The recommendation to request a donation to HRM of 120 deck panels and 600 metres of railing is based on the panels being used for 15 short-span bridges and 6 medium-span bridges over the next ten years. Although there is little, if any, savings to be gained in using the panels for medium-span bridges, the environmental benefit of reusing materials was a consideration in making the staff recommendation.

BUDGET IMPLICATIONS

There are no immediate budget implications. With approval of the staff recommendation, $45,000 will be included in the 2014/15 Project Budget to cover the cost of transporting the panels and railing from the bridge site and unloading them at an HRM-owned outdoor storage facility. The impact of using the deck panels in any individual active transportation project will be determined through the normal project budgeting process.

If the request for panels to be donated is not accepted by Halifax Harbour Bridges, staff will return with a report on the implications of making a bid for the panels through a tendering process.

FINANCIAL MANAGEMENT POLICIES / BUSINESS PLAN

This report complies with the Municipality's Multi-Year Financial Strategy, the approved Operating, Project and Reserve budgets, policies and procedures regarding withdrawals from the utilization of Project and Operating reserves, as well as any relevant legislation.

COMMUNITY ENGAGEMENT

No community engagement has been undertaken as part of this project.

ENVIRONMENTAL IMPLICATIONS

The reuse of salvaged materials has greater environmental benefit that the alternative of recycling those same materials. The environmental implications of constructing the active transportation bridges will be assessed on a project-by-project basis and will be minimized through the engineering design process.

ALTERNATIVES

The Committee may choose to not recommend this request to Regional Council, or may choose to make a request for fewer or more deck panels.

ATTACHMENTS

Macdonald Bridge Sidewalk Deck Panels: Active Transportation Applications

A copy of this report can be obtained online at http://www.halifax.ca/commcoun/cc.html then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 490-4210, or Fax 490-4208.

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Hatch Mott MacDonald

Macdonald Bridge Sidewalk Deck Panels: Active Transportation Applications

Final Report

June 2012

Halifax Regional Municipality

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Issue and Revision Record

Rev	Date	Originator	Checker	Approver	Description
0	05/17/12	L. Flowers	M. MacDonald	L. Flowers	Draft Report
1	06/12/12	E. Harrison	L. Flowers	M. MacDonald	Final Report
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3					

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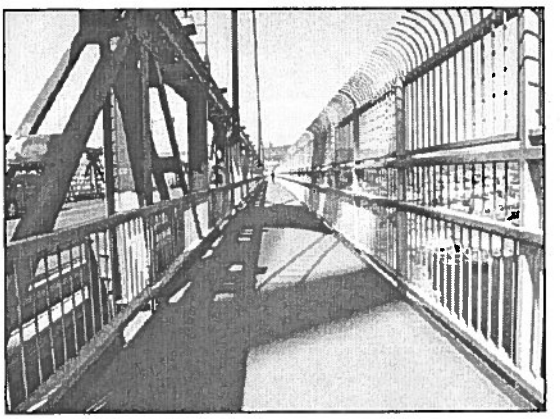
1.0 INTRODUCTION AND PURPOSE

Hatch Mott MacDonald (HMM) was requested to provide Halifax Regional Municipality (HRM) with a report assessing the viability of using existing Macdonald Bridge sidewalk deck sections for generic Active Transportation (AT) applications. The following report outlines how they could be used, how much could HRM conceivably require in the ten year horizon, and in what context would their application be most appropriate.

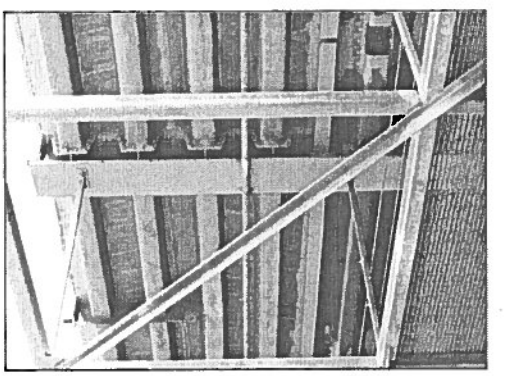


We understand that Halifax Harbour Bridges will undertake the Macdonald bridge redecking in 2014, and that existing sections of the bikeway and pedestrian walkway will be removed and not reinstalled on the new structure.

HRM wishes to understand the potential these sidewalk deck sections may have in new AT bridge structures. This assignment is not intended to produce a design for a particular AT bridge, but to broadly assess the potential for using these existing sections for a range of applications, and to ultimately provide a comparison between constructing a bridge using the salvaged deck sections and using normal AT bridge building methods.

1.1 Available Materials

Decking Material – the decking material is what currently forms the cycling and pedestrian paths crossing the span of the Macdonald Bridge on either side. Decking panels are comprised of a steel orthotropic design, supported by steel outriggers. Each orthotropic panel is 5.08m long by 2.61m wide but there are variations in the lengths depending on the panel location in the span. The steel is galvanized, and there is an anti slip coating on the panel surface. It is estimated that the cantilevered pedestrian and cycling paths are comprised of approximately 250 of such panels[1].



Deck panels as seen from below.

Railings – Railings are constructed of Hollow Structural Sections (HSS) and round stock. The railings are bolted to the bridge structure at the post locations which are spaced at 2.5m. It is estimated that there is approximately 1.4 km of railing currently attached to the sidewalk structure.

[1] This includes only panels on the suspended span, and excludes those panels that are skewed.

2.0 ANALYSIS

There have recently been a number of Active Transportation Bridges constructed in the Halifax Regional Municipality using a variety of construction methods and materials, spanning various distances, and to cross different mediums (i.e. roads, streams). This section examines the proposed new AT bridges in the five and ten year horizons, and suggests a means from which the sidewalk decking material could be repurposed to meet these needs.

2.1 Scenario Discussion

The following table was provided to HMM by HRM Staff in March of 2012, summarizing the number of deck panels required to span a variety of natural and manmade features including stream crossings, roadways, rail corridors, and highways.

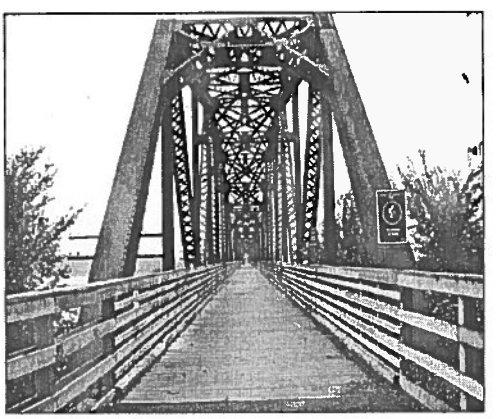
Approx. Span Length	Typical Applications	No. of Bridges 0-5 years	No. of Bridges 5-10 years
10.0 m	Small stream crossing	5	10
24.0 m	Medium stream crossing Two-lane roadway overpass Rail overpass	3	3
45.0 m	Large stream crossing Divided highway overpass	1	1

Table 1: Typical Bridge Span Lengths

Of note, the desirable deck width required by HRM for the new AT bridges is 4.5m with a minimum acceptable deck width of 3m.

2.2 Assumptions

The remainder of this report relies on the following assumptions:

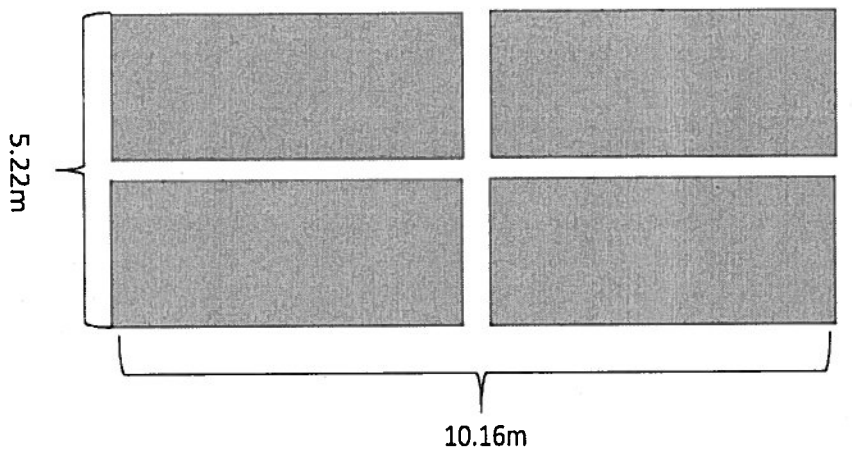


- Sidewalk decking panels will be removed without damaging their integrity.
- Sidewalk decking panels will be removed in 5m sections.
- Railings will be removed and cut to desired length.
- AT bridges will utilize the panel sections in their entirety (i.e. panels will not be cut).
- Bridges will be clear span.
- Cost estimates will not include transportation of material to site, cost of abutments, or cost of storage.
- Beyond the salvaged decking and railing material, all other material will be purchased new.

2.3 Possible Alignments

There are two possible alignments of decking material that will meet the applications listed above. The figure below shows how two applications of decking material that will achieve the 9.6m bridge span requested by HRM in the table above. Both alignments use four decking panels and meet the required minimum width.

Alignment A:



Alignment B:

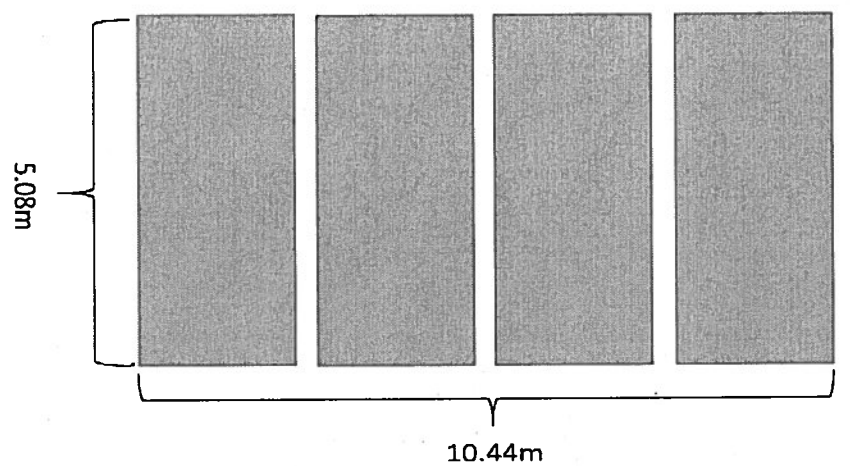


Figure 1: Alignment A(above) and Alignment B (below)

Using these same alignments, any of the three spans can be achieved with approximately the same number of panels and length of railing for Alignment A or Alignment B each.

Each of the two alignments is discussed in more detail in the following pages.

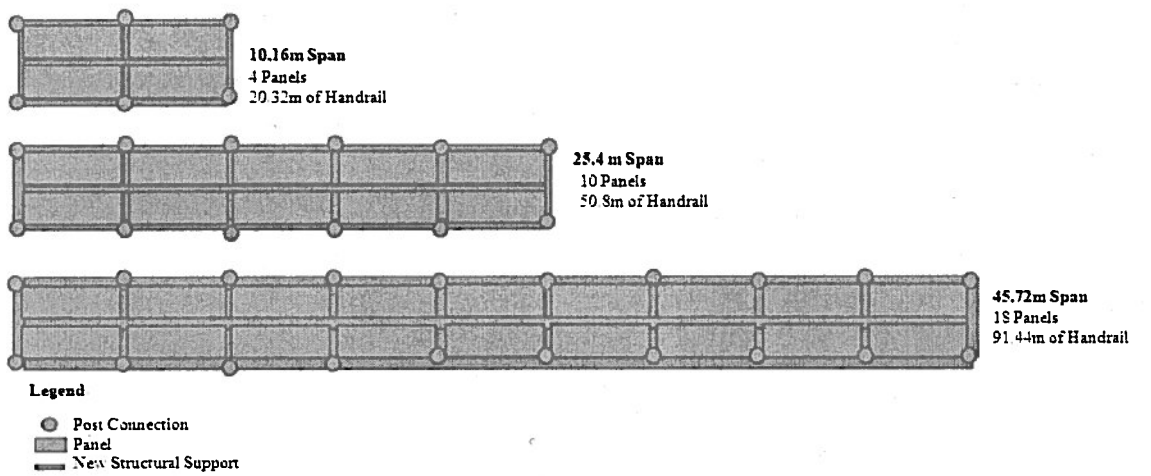
2.3.1 Alignment A

This alignment is similar to what is seen today on the Macdonald Bridge, however, in order to meet the minimum width as per HRM standards, two panels will need to be bolted together, side by side if repurposed as a new AT bridge. The following table builds on Table 1 above and identifies the number of required panels for a bridge of each of the specified spans should Alignment A be selected. Figure 2 extrapolates on the alignment shown in Figure 1.

Span Length[2] (m)	Panels Req'd (Span)	Panels Req'd (Width)	No. of Bridges 0-5 years	No. of Bridges 5-10 years	Total Panels Req'd/ Bridge	Panel Length (m)	Length of Railing Req'd/Bridge (m)	Required Railing (All Bridges) (m)	Required Panels (All Bridges)
10.16	2	2	5	10	4	5.08	20.32	304.8	60
25.4	5	2	3	3	10	5.08	50.8	304.8	60
45.72	9	2	1	1	18	5.08	91.44	182.88	36
							Total:	792.48	156

Table 2: Panel Requirements 5 and 10 Year Horizons – Alignment A

Figure 2: Required Material by Bridge Length – Alignment A



Analysis indicated that although this alignment allows for the re-use of existing handrail connections, it would require a significant amount of additional structural support and new material. New structural support would be required in the longitudinal and transverse directions in order to properly support the sidewalk deck panels.

[2] Spans have been amended in order to reflect the lengths that the panels would form, assuming no alterations are made to the panels themselves

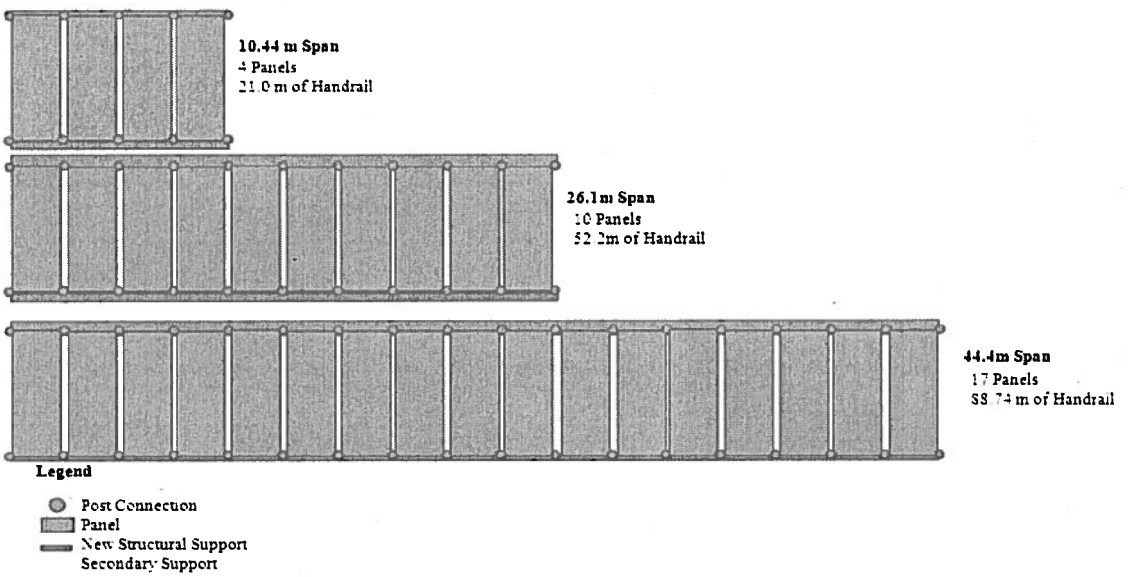
2.3.2 Alignment B

Unlike in Alignment A, in Alignment B it will not be necessary to bolt two panels side-by-side to achieve the minimum width required by HRM. The following table builds on Table 1 above and identifies the number of required panels for a bridge of each of the specified spans should this alignment be chosen.

Span Length[3] (m)	Panels Req'd (Span)	Panels Req'd (Width)	No. of Bridges 0-5 years	No. of Bridges 5-10 years	Total Panels Req'd/ Bridge	Panel Width (m)	Length of Railing Req'd/Bridge (m)	Required Railing (All Bridges) (m)	Required Panels (All Bridges)
10.44	4	1	5	10	4	2.61	20.88	313.2	60
26.1	10	1	3	3	10	2.61	52.2	313.2	60
44.4	17	1	1	1	17	2.61	88.74	177.48	34
							Total:	803.88	154

Table 3: Material Requirements 5 and 10 Year Horizons – Alignment B

Figure 3: Required Material by Bridge Length – Alignment B



In this alignment, the sidewalk deck panel kick plate would need to be removed in order to ensure a flat travelling surface. Similar to Alignment A, new structural support will be required, though for Alignment B it will largely be located in the longitudinal direction of the structure with interim secondary support to pick up the free edge of each sidewalk panel.

[3] Spans have been amended in order to reflect the lengths that the panels would form, assuming no alterations are made to the panels themselves

Of the two alignments, Alignment B requires significantly less new structural support, and for the longest span, requires one less panel than Alignment A. It does, however, still require some secondary support to carry the free edge of the panels. Despite the additional work required to remove the kick plate running running lengthwise along the panels, Alignment B is the preferred alignment. The proposed AT Bridge cross section, using Alignment B, is shown in Figure 4.

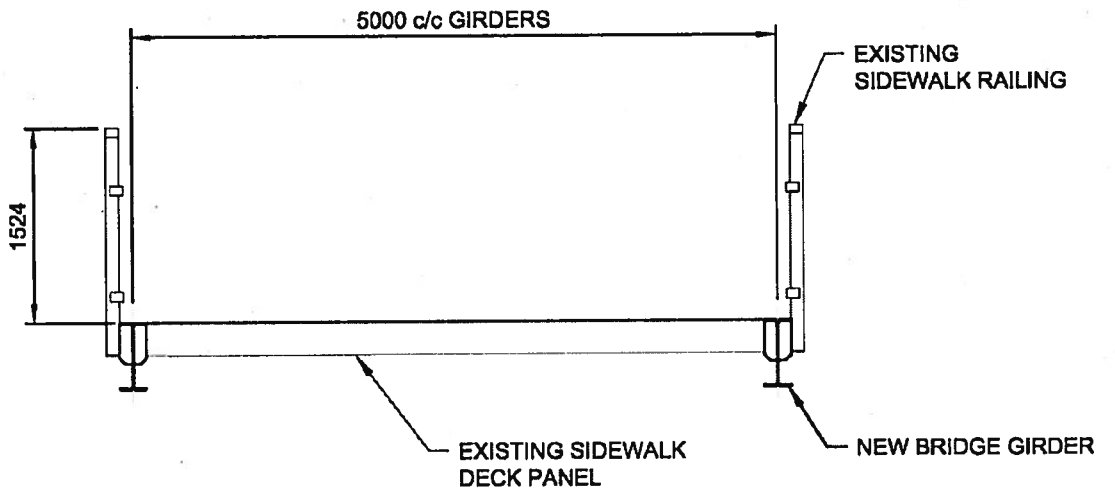


Figure 4: Proposed Bridge Section

2.3.3 Required Railing and Panel Modifications for Alignment B

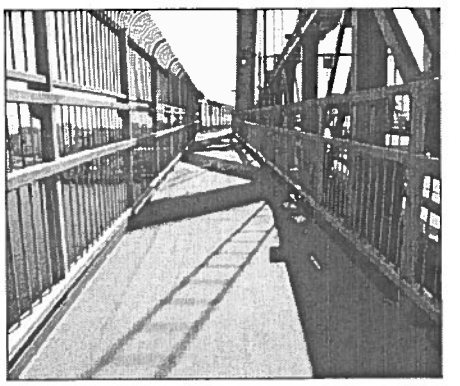
Once removed from the bridge, it is recommended that the top, curved section of the railing be removed to the mid-rail in order to ensure ease of use in as many applications as possible, and to ensure that those using the AT bridges do not feel "closed in" by the high railings. It is assumed that the railing removal process will involve the removal of rail from the midrail up using a torch, grinding smooth the remaining rail, and coating it with a cold galvanizing paint system.

Panel modifications will be minimal, limited to removing the steel kick plate which currently runs along the outside of each panel. As the orientation of the panel will be rotated, these kick plates must be removed to ensure a smooth traveling surface for cyclists and pedestrians. Once removed, this should be painted with a cold galvanizing paint system as well.

3.0 COST ANALYSIS

The following section itemizes costs associated with the transportation of salvaged materials and the construction of an AT bridge using the salvaged materials. Of note, this assumes that neither the decking nor railings were paid for by HRM, but were received at no cost. It also assumes that Alignment B was selected, and that all 23 proposed bridges will be constructed.

3.1 Transportation



The cost of transportation of the decking and railing material to a storage site within HRM was estimated assuming that material for all 23 bridges would need to be moved.

Using a tridem axle truck, it is estimated that 13 truck loads are required to carry approximately 154 panels (at 1710kg/panel), an additional two truckloads will be required to handle approximately 803m of railings (at 63kg/m)[4].

It is estimated that a total of fifteen truck loads would cost in the range of $40,000 - $45,000 to haul the material from one end of the Macdonald Bridge to a storage location in HRM and unload the panels at the site.

3.2 Bridge Construction

Several Active Transportation bridges of varying sizes have been constructed in recent years. Their size and purpose vary from a short span structure over a drainage course, to a large, dedicated pedestrian structure over a multilane highway.

The following table provides the itemized costs of varying elements of the Highway 111 pedestrian bridge from railings to footings.

	Highway 111 Pedestrian Bridge
Span	45m
Cross Section	3m
Deck	$262,000
Railings	$51,000
Abutments	$222,000
Footing	*Included in abutments*
Retaining Walls	*Included in abutments*
Water Control	N/A

Table 4: Cost Breakdown of Recent Highway 111 Pedestrian Bridge

[4] As per Schedule A of the Weights and Dimensions of Vehicles Regulations made under Section 191 of the *Motor Vehicle Act*.

The Highway 111 pedestrian bridge was used as a point of comparison for the longest proposed span of 43.5m.

The Highway 111 Pedestrian Bridge is a steel girder structure with a concrete deck. The deck and steel girders act together as a "composite" section. This allows savings in the amount of steel required for the girders. For the AT bridge comparison, the steel orthotropic sidewalk panels will not contribute to the capacity of the structure and will only act as a dead weight. Therefore a larger girder size will be required for an equivalent span.

The following table compares several elements of the proposed bridge structure to that of the Highway 111 pedestrian bridge.

	Highway 111 Pedestrian Bridge	AT Bridge using Panels (Alignment B) Estimated Cost
Span	45m	44.4m
Cross Section	3m	5m
Deck (including superstructure)	$262,000	$320,000
Railings	$51,000	$10,000[5]

Table 5: Cost Comparison (45 m span)

Due to the cost of the new superstructure required to carry the sidewalk deck panels, the costs to utilize the sidewalk panels are higher than other types of conventional bridge structures.

To provide an idea of the pricing of a superstructure for the shorter bridge spans of 9.6m and 24.0m, budget pricing was obtained from a local supplier, Atlantic Industries Limited (AIL). The type of structures supplied by AIL are a Hollow Structural Section (HSS) truss.

The prefabricated truss bridge quotes assumed the following:

- 9m and 22m span, 5m wide (equivalent to the sidewalk panel dimension)
- 1.2m high railings.
- Pressure treated lumber decking.
- Weathered steel.
- Footings would be in place.
- Includes delivery, but not installation.

[5] Estimated installation costs

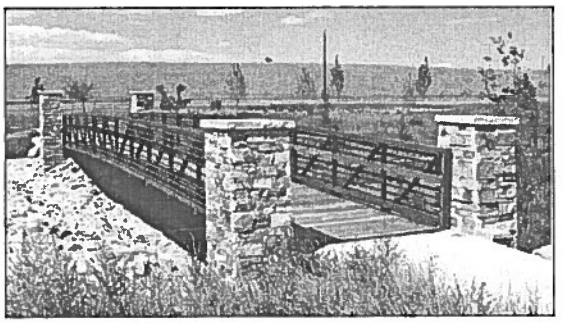
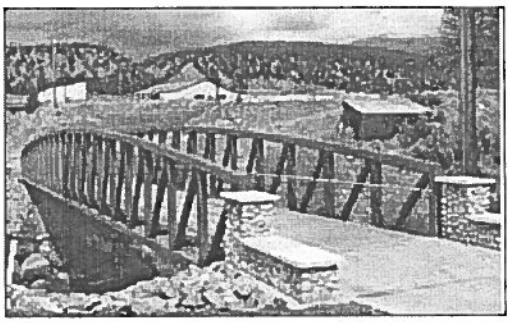



Figure 5: Examples of AIL's Prefabricated Bridges

The AIL quotes were used to compare with the costs of the proposed AT bridges using the salvaged sidewalk deck panel material, as seen in Table 6 below:

	9.0m Span, Prefabricated Bridge	10.44m Span, using Deck Material	22.0m Span, Prefabricated Bridge	26.1m Span, using Deck Material
Span	9m	10.44m	22m	26.1m
Cross Section	5m	5m	5m	5m
Cost	$23,000 +/-	$9,000[6]	$70,000 +/-	$73,000[6]

Table 6: Cost Comparison (9.6m and 24.0m spans)

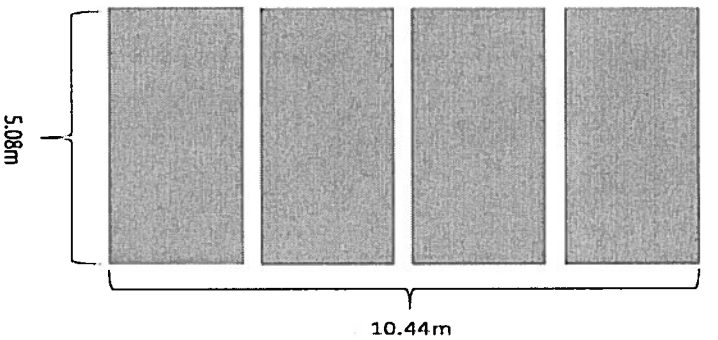
When compared to the longer spans, the shorter span bridges represent the most cost-effective application of the decking and railing material: the cost is significantly lower using the repurposed material at the ~ 9.6m span, and comparable to prefabricated bridges at the ~24.0m span.

[6] Estimated costs assume sidewalk deck materials were acquired by HRM at no cost

4.0 CONCLUSION

The Macdonald Bridge will be undergoing a redecking project in 2014 which offers an opportunity for HRM to acquire the existing pedestrian sidewalk deck panels and railings. If repurposed, this material could be used to improve active transportation connections throughout the Municipality. Assuming that the material is received by HRM at no cost, both the deck panels and the railing could be put to good use as AT bridges over any number of mediums. The findings of the preceding report are as follows:

- Of the two panel alignments examined, the alignment in which the panels run perpendicular to the span of the bridge was decided to be the most cost effective, requiring less new structural material. This differs from the existing alignment of the panels on the Macdonald Bridge.



- It is critical that as few modifications as possible are made to the decking panels in order to maintain the integrity of the steel. The only modification required is to remove the kick plate running along the long side of the exterior of each panel.
- Though it may not be cost-effective to use the material for long span structures, there is the possibility to realize savings when using the material to span shorter distances (approximately 9.6m and 22.0m).
- HRM should consider acquiring as many meters of railing as possible, as this could be used in any number of applications, beyond those identified in this report.
- There is the potential to use the sidewalk deck panels and railing to replace deteriorated decking material on existing structures, however, a structural assessment of the capacity of the existing structure to accept this new decking material must be undertaken by a registered professional engineer on a case by case basis.