Walter Bean Grand River Trail Community Connection

BIG BALLER BRIDGES

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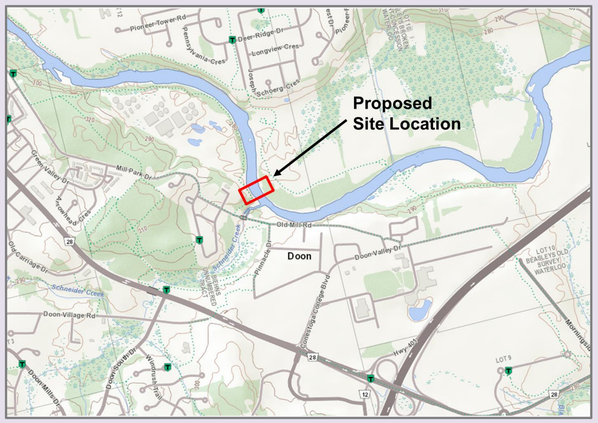
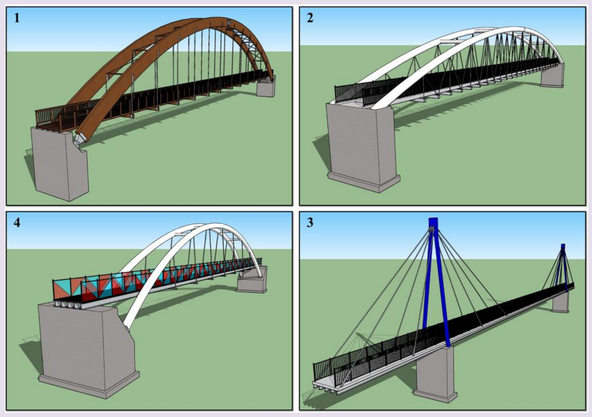
Problem Statement:

The City of Kitchener and the Walter Bean Grand River Community Trails Foundation have identified the need to provide a link across the Grand River to serve as a connection between the Deer Ridge and Doon Communities. The crossing is also needed to improve trail network connectivity between the Walter Bean Grand River Trail and Trans Canada Trail systems. Most importantly, in interest of the notable heritage surrounding the Grand River, the Walter Bean Grand River Community Trails Foundation has emphasized their desire to create a crossing that serves as a focal point for users along the trail network.



Alternative Designs Considered:

The alternatives included a Glulam Arch (1), a Steel Arch (2), a Cable-Stayed Bridge (3), and a Through Arch Bridge (4).



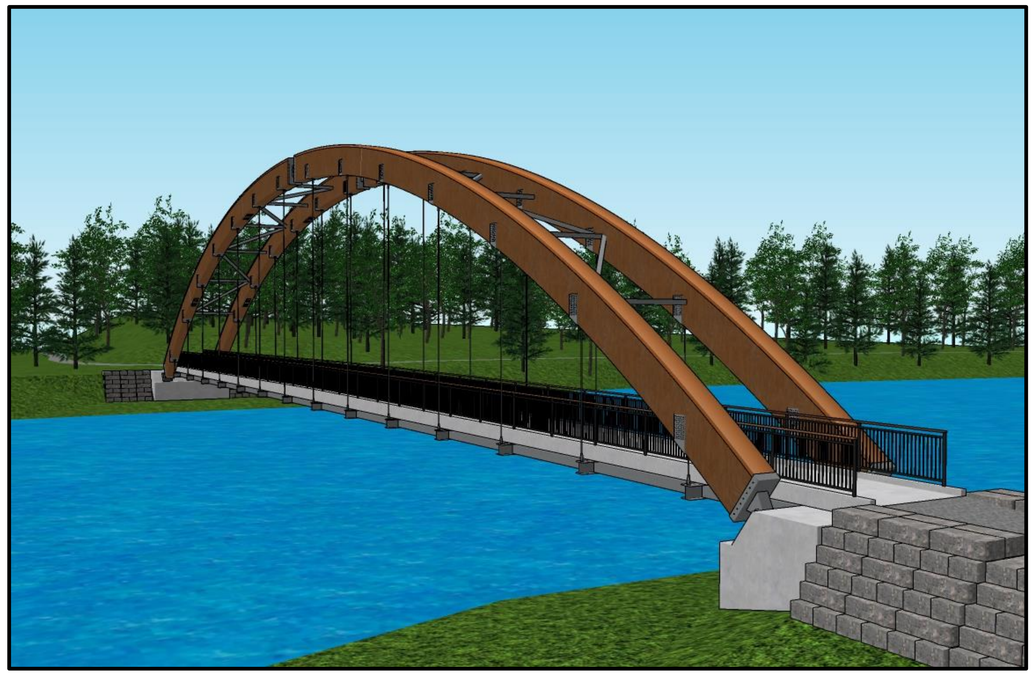
The designs were evaluated using a weighted decision matrix to determine the optimal solution. The evaluation criteria included:

Using a weighted decision matrix, the optimal solution was determined to be Alternative 1 – the Glulam Arch Bridge.

Detailed Design Process:

Load Determination and Factored Load Combos → Design of Superstructure → Lateral Support System for the Superstructure → Design of Key Connections → Serviceability Analysis → Design of Substructure → Results

Structural Design:



Bridge Properties			
Type:	Glued-Laminated Timber (Glulam) Arch Bridge	Cost:	$ 3,814,779.71 CAD (H.S.T. included)
Dimensions:	Clear Span = 70m, Width = 3.0m, Height = 12.3m	Weight:	Superstructure = 1,648kN (167,994kg)

Deck System:

Consists of Aluminum Guardrail, concrete curb, precast concrete deck panels (5 m x 3 m x 0.25 m), transverse steel beams (W360x134), & stainless-steel structural tie bars.

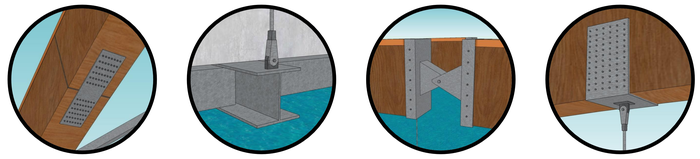
Glulam Arches:

The glulam sections have a depth of 1330 mm and a width of 615 mm. The glulam arch and timber handrail will be subject to direct pedestrian contact, consequently, ammoniacal copper zinc arsenate (ACZA), commonly known as Chemonite, has been selected as the preferred treatment method.

Design Loads:

The loadings analyzed for the proposed structure include live loading due to pedestrians, live loading due to a maintenance vehicle, dead loading due to self-weight, ice accretion, earth pressures, and wind loading on the structure.

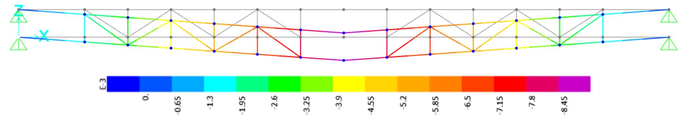
Major Connections:



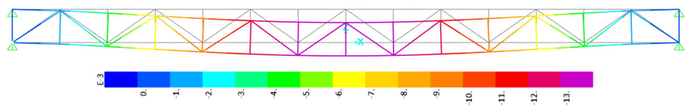
Lateral Support Systems:

The underside of the deck and arch systems were each treated as pin-connected trusses and analyzed in SAP2000 against prescribed wind loads for the City of Kitchener. The figures below show the resulting deflections in metres. The deck system utilizes HSS 305x305x16 as bracing while the arch features HSS 152x152x13 sections.

Deck Lateral Support Analysis

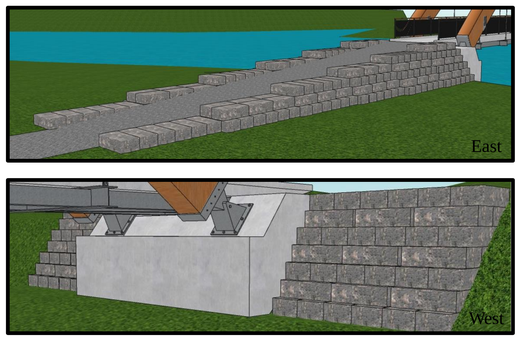


Arch Lateral Support Analysis



Substructure Design:

The substructure consists of concrete abutments and amour stone wingwalls and retaining walls.



Conclusions:

The final pedestrian bridge design features a pre-cast concrete panel deck, steel W-shape transverse beams, steel hangers, glulam arches, steel HSS sections utilized as lateral bracing, concrete abutments and armour stone wingwalls and retaining walls. Overall, the proposed structure utilizes a wide range of construction materials which function together to create an aesthetically pleasing feature bridge.

References:

Ontario Ministry of Agriculture, Food and Rural Affairs. (2019). AgMaps. Retrieved from: https://www.gisapplication.lrc.gov.on.ca/ AIA/index.html?viewer=AIA.AIA&locale=en-US