Final Design Details

1.0 Final Design

The final design solution for our project, identified in Section 4, includes a structural design plan, an architectural design plan, and a lateral bracing design. These three components will be integrated as one structure and will serve the city of Flagstaff Urban Trail users as a structurally sound, aesthetic, and reliable part of the urban trail. The primary components of the final design are described in detail in Section 5.1 - 5.3.

1.1 Final Structural Design

The final structural design selected for this project was a simply supported beam bridge. This design was developed through hand calculations, which were coded into an excel design spreadsheet. The structural design member sizes are shown atop Page 13 in Table 4.

Table 1: Design Sizing of Each Structural Member

Member Attributes	B (in)	H (in)	I (in4)	S (in3)	A (ft2)	Y (in)
Plank	*11.25*	*1.5*	*3.164*	*4.219*	*0.117*	*0.750*
Joist	*1.5*	*7.25*	*47.635*	*13.141*	*0.076*	*3.625*
Beam	*1.5*	*11.25*	*177.979*	*31.641*	*0.117*	*5.625*
Girder	*14*	*48*	*129024*	*5376*	*4.667*	*24*

1.1.1 Final Structural Design Calculations

The Structural Design components was mainly calculated using Microsoft Excel Software. The overall length and width of the bridge were fixed values as they needed to conform to the existing footings. The rest of the dimensions were determined by meeting requirements such as bending stresses and deflections. Once those criteria were met, it was vital that the final dimensions were sizes that were available from the manufacturer chosen. The final dimensions can be seen in Table 4 above while the design spreadsheet can be seen in Appendix A.

1.2 Final Architectural Design

The final architectural design is an open concept that utilized raw pole bamboo as primary arches, and a piece of raw bamboo as a handrail. The use of arches and curvature contrasts the linearity of the structural design, comprised primarily of laminated bamboo.

1.2.1 Architectural Design Analysis

The raw bamboo and decking of the bridge were the two primary features the team focused on implementing into the bridge. The dual arch design was chosen by our client due to its airy feel and openness of the design. The decking of the bridge is the greatest exposed surface area and most susceptible to rain and snow. Due to these concerns the team went with a steel grating planks that better resist outdoor elements. This grating runs perpendicular to the joists they sit on. A spacer will be installed between the joists and grating to reduce the degradation of the joists. The beam and joist hanger connections being implemented are bare when they arrive. Therefore zinc coating and epoxy paint will be added for corrosion resistance. These details for are to increase the longevity of the bridge.

1.3 Final Lateral Bracing Design

The final lateral bracing design was developed in using RISA software by modeling the final structural floor plan as a truss with diagonal cross bracing for lateral support. The model output from this software can be seen in Appendix B. The maximum load found within the members of the lateral bracing support system was found using this model, described further in Section 5.3.1.

1.3.1 Lateral Bracing Design Calculations and Output

The lateral bracing system was design to a 40 pounds per square foot evenly distributed lateral load. This lateral load was multiplied by the depth of the girder design (4'), yielding a 160 pounds per foot distributed load across the length of the 70.3' bridge span. Once the model was run using RISA software, the calculated axial force within each member of the lateral bracing system was given. The model showed that the largest axial force, 0.783 kips, was seen in Member 20 and Member 21, shown in Table 5 below. These members are found to be near the midpoint of the span of the bridge. The design sizing of these members governed the rest of the other members, providing a uniform design size for each member within the lateral bracing system.

Table 2: Design Deflections vs. Deflection Limits

1	M20	max	.783
		min	.783
1	M21	max	.783
		min	.783