Structure Proposals for Clear Lake

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Introduction

The Clear Lake Conservancy is in Clear Lake, Indiana, population 340 (2017). Located nearly fifteen minutes south of the Indiana-Michigan state line, and thirty minutes west of the Indiana-Ohio state line. Figure 1 gives a view of the location of the project. The executive director of the Clear Lake Conservancy has requested the services of MNBC Engineering to complete the design of a pedestrian bridge or boardwalk to connect the hiking trails on the property of the conservancy. According to the client, this structure has been requested by the citizens of Clear Lake. Completing the trail will create a scenic path for citizens to enjoy a peaceful walk around the beautiful nature that the township is located in. MNBC Engineering has completed an analysis of the existing conditions at the project site; and designed for a pedestrian bridge, as well as a boardwalk connecting the hiking trails. The client is receiving both proposals for a bridge and a boardwalk.

Figure 1: Image of Clear Lake displaying project location

Surveying

The entire project site was surveyed using a GPS total station. The project site is defined from the existing trails and from the water level to the property lines. The GPS was connected to a rod that was placed throughout the project site, where we wanted to retrieve data. In conclusion, the contour map helped us see where the water surface elevation could rise.

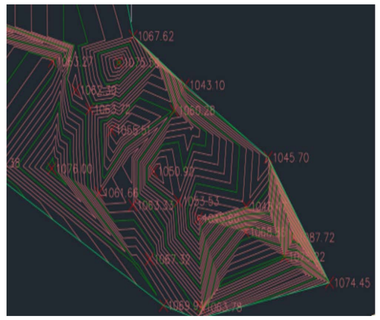

Figure 2:Contour map of the project site with elevations

Geotechnical

Two soil borings and a dynamic cone penetrometer test were completed at each foot of the subsurface.
The map of the region, along with specified locations of each soil boring, can be found in Figure 3.

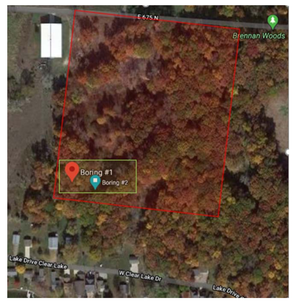

Figure 3: Boring Locations and Project Region

The nominal net bearing capacity of the soil was 6,000 pounds per square foot.

The dimensions of the foundations for the bridge are 4 feet deep with a diameter of 12 inches. The dimensions of the foundation for the boardwalk are 3 feet deep with a diameter of 10 inches. The dimensions were selected based on the calculations of the nominal and allowable capacity of the soil in compression and tension.

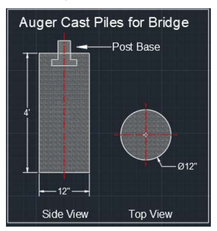

Figure 4: Detailed Sketch of Bridge Foundation

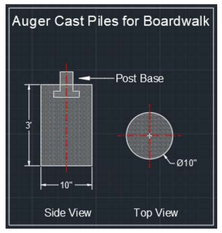

Figure 5: Detailed Sketch of Boardwalk Foundation

Hydraulics

Structure height is essential to consider when designing a structure over water. The structure should be placed high enough to avoid potential flooding. Determining a height for the structure is based on the utility of the structure. Since this structure is used for foot traffic only, it is acceptable to design based on a design storm of 2-yr 24-hrs. By using rainfall data provided by the National Oceanic and Atmospheric Administration (NOAA), the rainfall depth is 2.57 inches for a 2-yr 24-hrs. Based on hydraulics, it is recommended that the structure is positioned at least 3 inches above the current water surface profile.

Bridge Design

The material type was determined by finding the least expensive wood species that can be found at a local hardware store. From visiting Menards and Lowe's, we found that Southern Yellow Pine Grade #2 is the least expensive and thus became the material for our design. The wood must also be pressure treated because the structure is going to be outside and exposed to insects.
The deflection, vibration, truss member strength, floor beam strength, and deck board strength all fall within their acceptable range. Each dimension was determined by using the smallest dimensions that would fit within that members acceptable strength. Therefore, the dimensions of the truss, floor beam, and deck boards are adequate for the design. The truss openings are also a major safety hazard. The openings are susceptible for small children to fall through. To prevent this, we have provided a railing system. The railing system consists of 2" by 2" pressure treated balusters to be applied vertically across the span of the truss. Each rail will be placed 3 ¾-inches apart to properly pass an 4-inch sphere safety test.

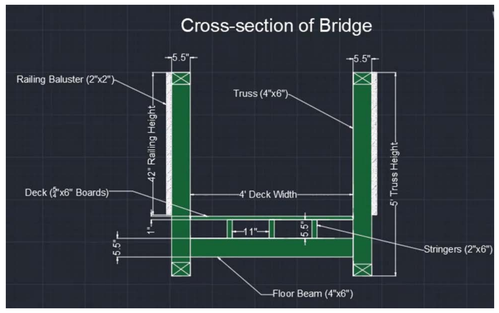

Figure 6: Shows the Cross-section of the bridge, including the trusses, floor beams, and decking (in green hatching)

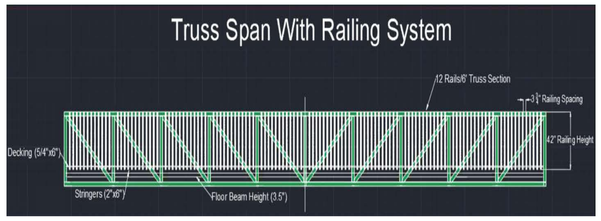

Figure 7: Shows the span of the truss with the designed railing system

Boardwalk Design

The Yellow Southern Pine shall be graded number two and pressure treated for longer-lasting durability in the area it will be located. . The design has been sketched in an eight-foot span. The total length of the boardwalk has been estimated to be 48 feet. That would mean there are six eight-foot spans. That was done by taking the profile at station 1+00 high ridge measuring the distance at which it would be needed to cross to complete the path. The boardwalk will run alongside the wetland, right outside the edge of the water, and through the low point. It will allow for the trail to be completed by the client and allow access for pedestrians to cross by the wetland safely.

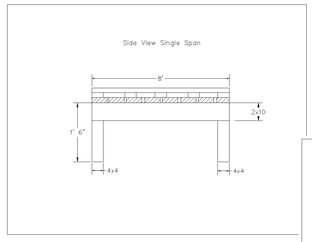

Figure 8: Side View of Single Span of Boardwalk

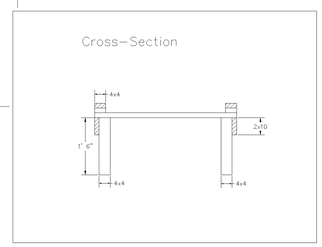

Figure 9: Cross-Section of Boardwalk

Conclusion

This project is a fantastic opportunity to complete the trail and enhance popularity for this conservancy. The project offers a safe and effective way to complete this trail by scoping more than one design. The boardwalk and bridge designs are proposals that would work for connected the trails. The primary considerations would be the physical layout of the structures. The boardwalk has a span of 48 feet and a width of 6 feet. This will require 6 boardwalk sections. While the bridge has a length of 60 feet and a width of 4 feet. Another factor to consider is the cost difference. The boardwalk is cheaper in materials with a total cost of roughly $1,140. While the bridge has a total cost of roughly $1,770. Both structures are using Southern Yellow Pinewood to create a natural-looking structure in your conservancy.