Lansing Temporary Bridge Design

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Introduction

With a request from an alumni and an NGO "Lansing Bridge to Recovery", the Department of Civil and Environmental Engineering of the William State Lee College of Engineering at UNC Charlotte has offered a class on temporary bridge design during spring 2025. The purpose of the class is to teach students to learn how to design temporary bridges that can be constructed for the citizens of Ashe County who lost their private stream crossing bridges after Hurricane Helene (September 25-26, 2024). By the end of the semester, 3 bridges were designed and one is now in the process of construction. However, many residents still need bridges to access their homes (Lansing Bridge to Recovery has contracted 285 bridges). Dr. Chen made the decision to write a book on temporary bridges and reoffer the class in the summer. My research is to help generate easy-to-use tables and figures for contractors who may not have the engineering background to perform vigorous engineering designs.

Site Information

Lansing is a small town in Ashe county, North Carolina located in the Mountains. After Hurricane Helene, many businesses, homes, bridges, and many other outdoor structures were destroyed due to the creek's high water levels. It's been nearly a year since the hurricane and people are still recovering from the damage. The tributaries that were flooded during Helene include Big Horse Creek, Small Horse Creek, South Fork New River.

Figure 1: Property at 2330 W Buffalo Road after the Hurricane Helene. The bridge was complete ripped off from the fountain and could not be found.

Main Objectives

To generate design tables, a set of design parameters were established and I conducted parametric studies to determine:

- Safety factors were computed based on the design loading and flexural and shear capacities of W-shape and HP-shaped beams at 20,000 lb. and 80,000 lb.
- Several design tables were generated using available beams in the AISC steel manual.
- A table tabulating specific weights and limiting strength of different soils were established, which is used to determine the admissible force of different foundation types.

Conclusion

The State of North Carolina is managing more than 3,000 private bridge projects. This research for temporary bridge design has and will continue to help Ashe County with its journey to recovery. The temporary bridge design book will help bridge design to be more efficient and less costly. UNC Charlotte students will continue to help design more bridges.

Acknowledgements

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Figures

Figure 2. The completed construction of a temporary bridge at one of the many bridge sites. Our bridge design is similar to this bridge which includes a gravel-laden gravity foundation. The bridge is donated and built by two churches from coastal region.

Figure 3. The side view of the temporary bridge shows the characteristic steel girder bridge with wood decking. The elevated bridge height is to prevent from potential future flooding that may be congested by the bridge height resulting in backwatering upstream watershed.

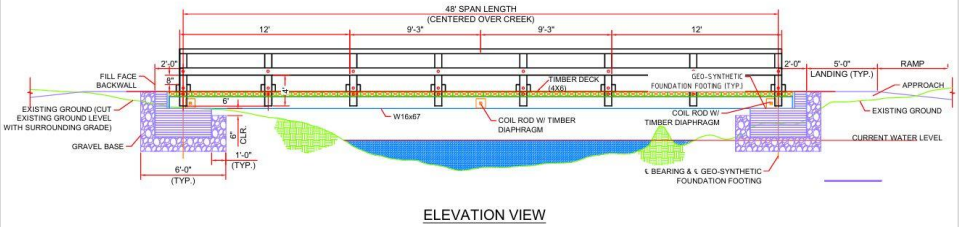

Figure 4. A side view of the temporary bridge design complete with railing, foundation and bridge superstructure. The bridge is designed to carry an ambulance (20,000 lb) traveling at 3 miles per hour.

Bridge Span (ft)	Steel Beam Type	Unit weight (lb/ft)	Self Weight (lb)	Flexural Strength (kip-ft)	Shear Strength (kip)	Flexural Load (kip-ft)	Shear Load (kip)	Safety Factor (F)	Safety Factor (S)
40	HP18 (x135)	135	5400	1170.83	393.75	298.01	31.12	3.3	12.65
40	HP16 (x88)	88	3520	670.83	247.86	286.26	29.95	1.82	8.28
40	HP14 (x73)	73	2920	491.67	206.04	282.51	29.57	1.36	6.97
40	HP12 (x53)	53	2120	308.33	153.99	277.51	29.07	0.83 (Fail)	5.3

Figure 5. Sample of design chart: The first 4 rows in 40 ft span section of the HP Shape 20,000 lb table. Only the lightest steel beam types are listed. A safety factor value with the words "Fail" under means it cannot be used for a temporary bridge with the respective span and beam type.