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Kenbrook Bridge Project

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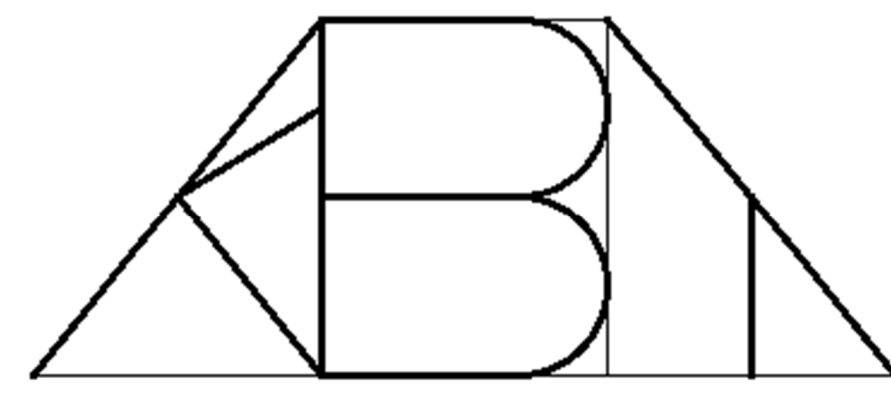
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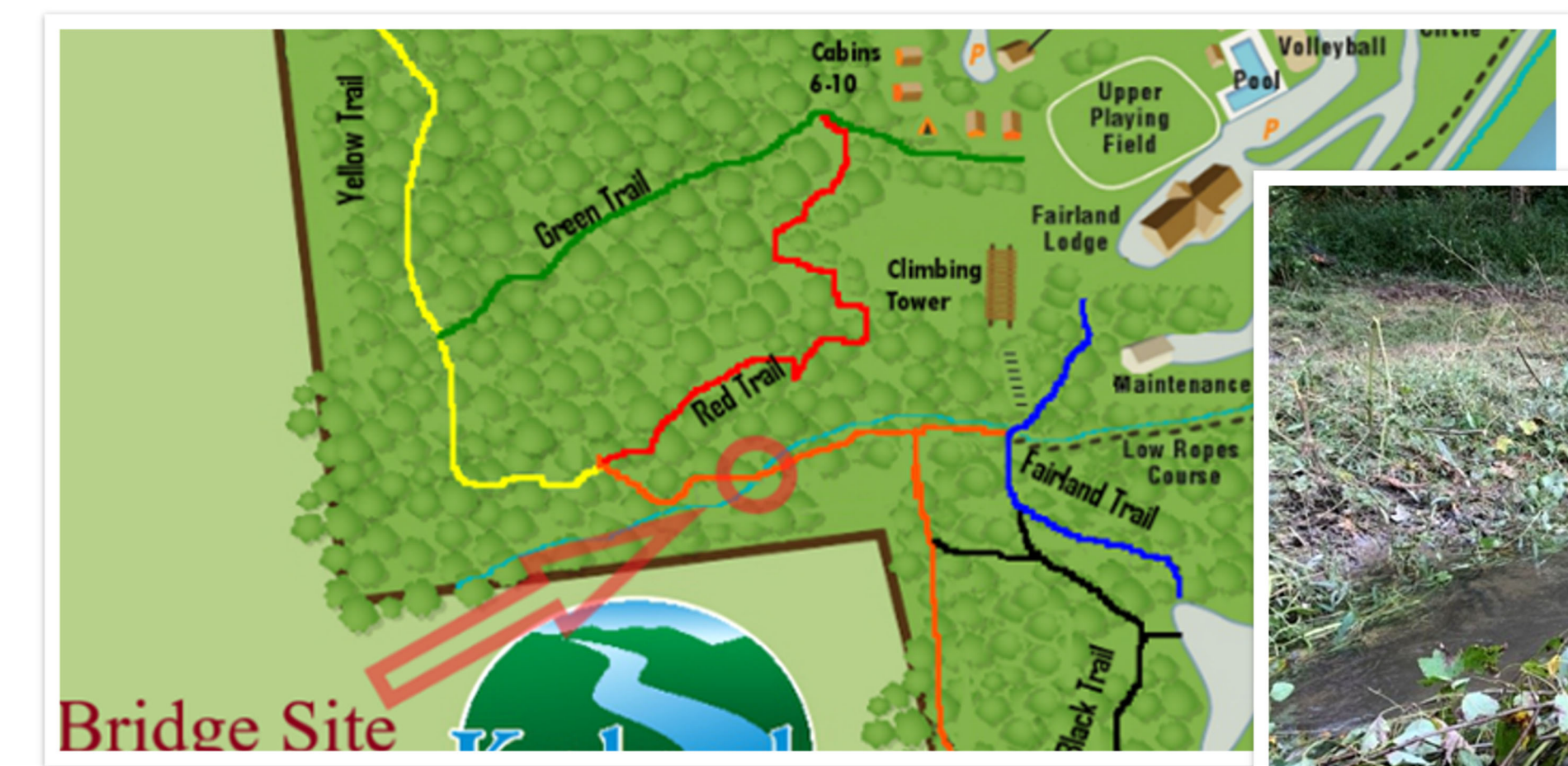
Kenbrook Bridge Project



Logan Horst and Noah Thrush

Problem Statement

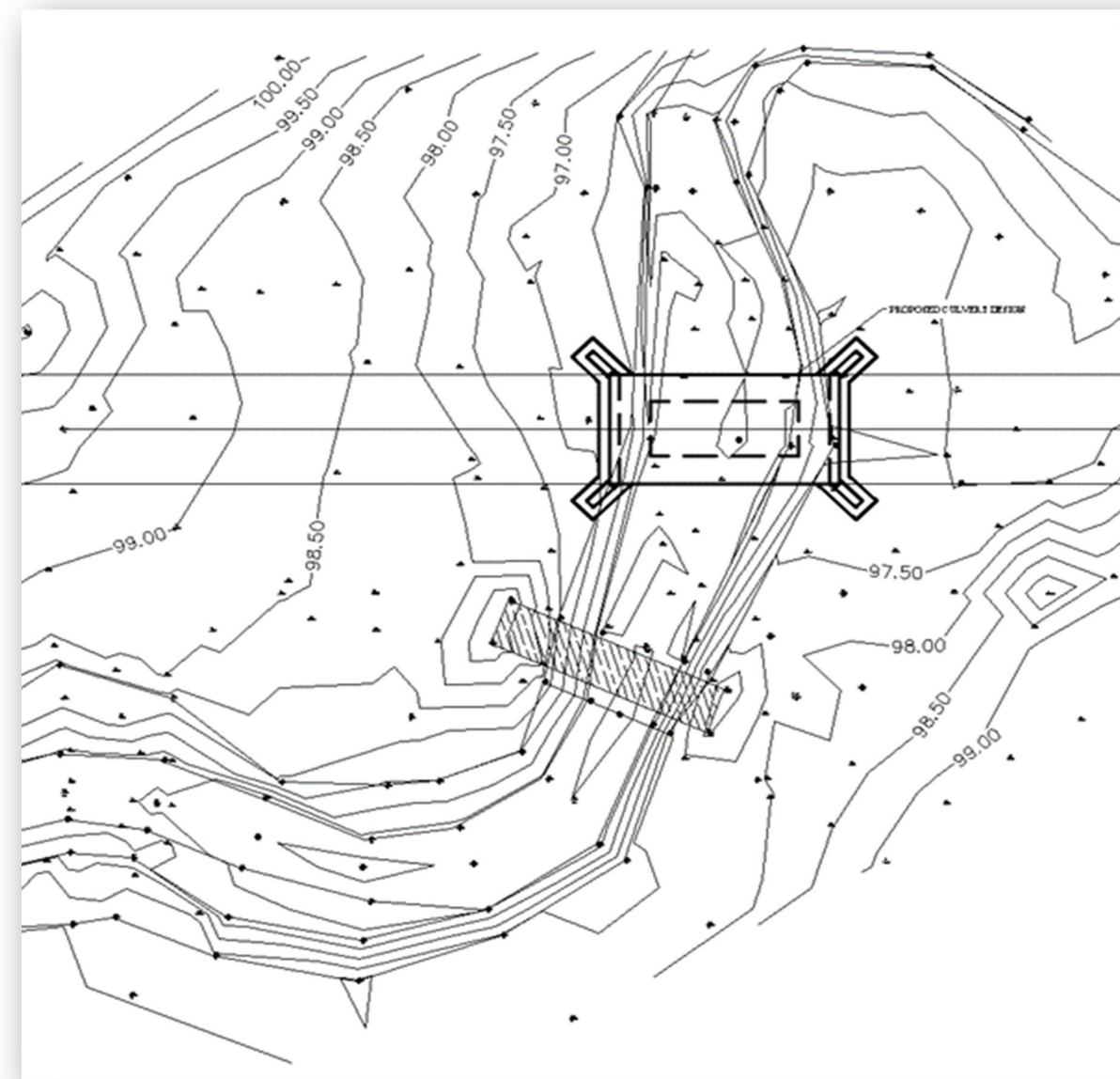
The Kenbrook Bridge Team seeks to address Kenbrook Bible Camp's need for a fully serviceable maintenance access structure over a small stream to connect their main office location to their northwestern cabins for general use and in case of emergencies. The existing bridge in this location is insufficient to support heavy equipment, such as a tractor, that may be used by the camp maintenance staff, so the team has designed a concrete box culvert capable of supporting such loads.



Design Criteria

The team had several design criteria to consider in developing a solution for Kenbrook.

- \$5000 budget
- Structure loading (particularly Kenbrook's tractor)
- Small stream size
- Site accessibility



Structure Type Selection

Concrete box culverts provide capacity for heavy loads and sufficient hydraulic opening for small streams. The concrete construction is economical with very little maintenance required over the life of the bridge.

Partner

Kenbrook Bible Camp, located in Lebanon, PA, seeks to be like Christ in all relationships to facilitate a closer connection to God, self, others, and nature. Kenbrook identified a need for a full serviceable maintenance access bridge, and has been a partner in the design and eventual construction of the bridge.



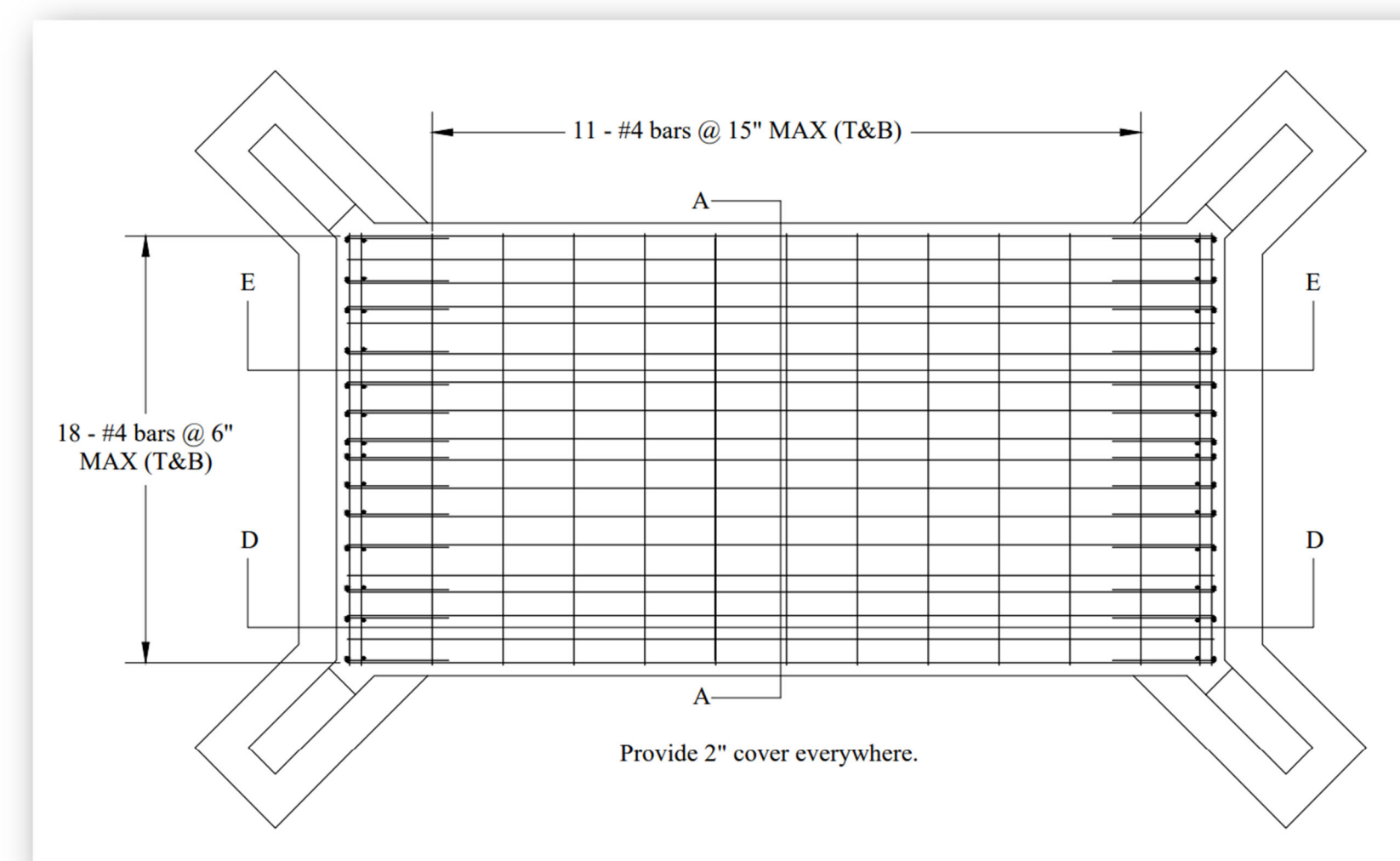
Structure Sizing

Key dimensions of the culvert that have been set by the engineering design process include:

- Span Length: 15 feet, to allow sufficient hydraulic opening and avoid disrupting the stream
- Height: about 6 feet, so that foundations are below the frost line
- Deck Width: 8 feet, to accommodate crossing by Kenbrook's maintenance equipment
- Top Slab Thickness: 10 inches, to provide sufficient structural capacity
- Bottom Slab and Wall Thicknesses: 8 inches, to provide sufficient capacity and cover for the reinforcement
- Wing Wall Length: 2 feet, to support finished grading that mirrors the original site condition

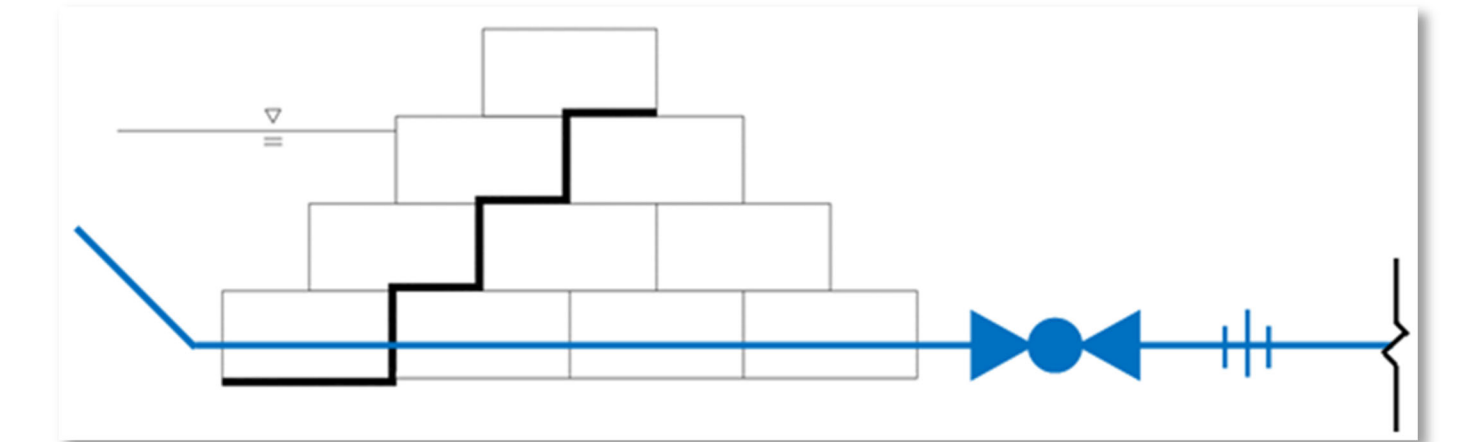
Reinforcement Design

The AASHTO LRFD Bridge Design Specifications were used in determining the structural capacity of the bridge. Structural analysis software helped the design team identify critical cross sections for analysis so that reinforcement could be sized. To simplify construction, #4 reinforcing bars are used throughout, so the design team needed to determine bar spacing and element thicknesses to meet capacity requirements. Areas of the bridge that are less critical for capacity are still reinforced to protect against cracking caused by temperature gradients and shrinkage.

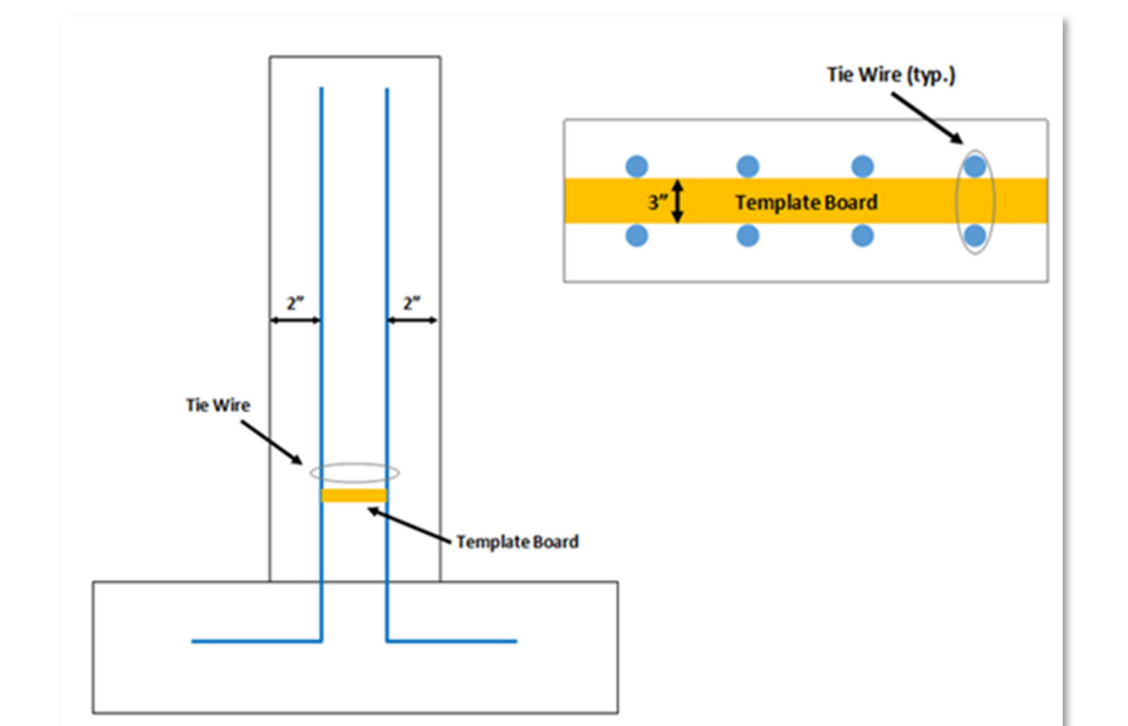


Construction Schedule

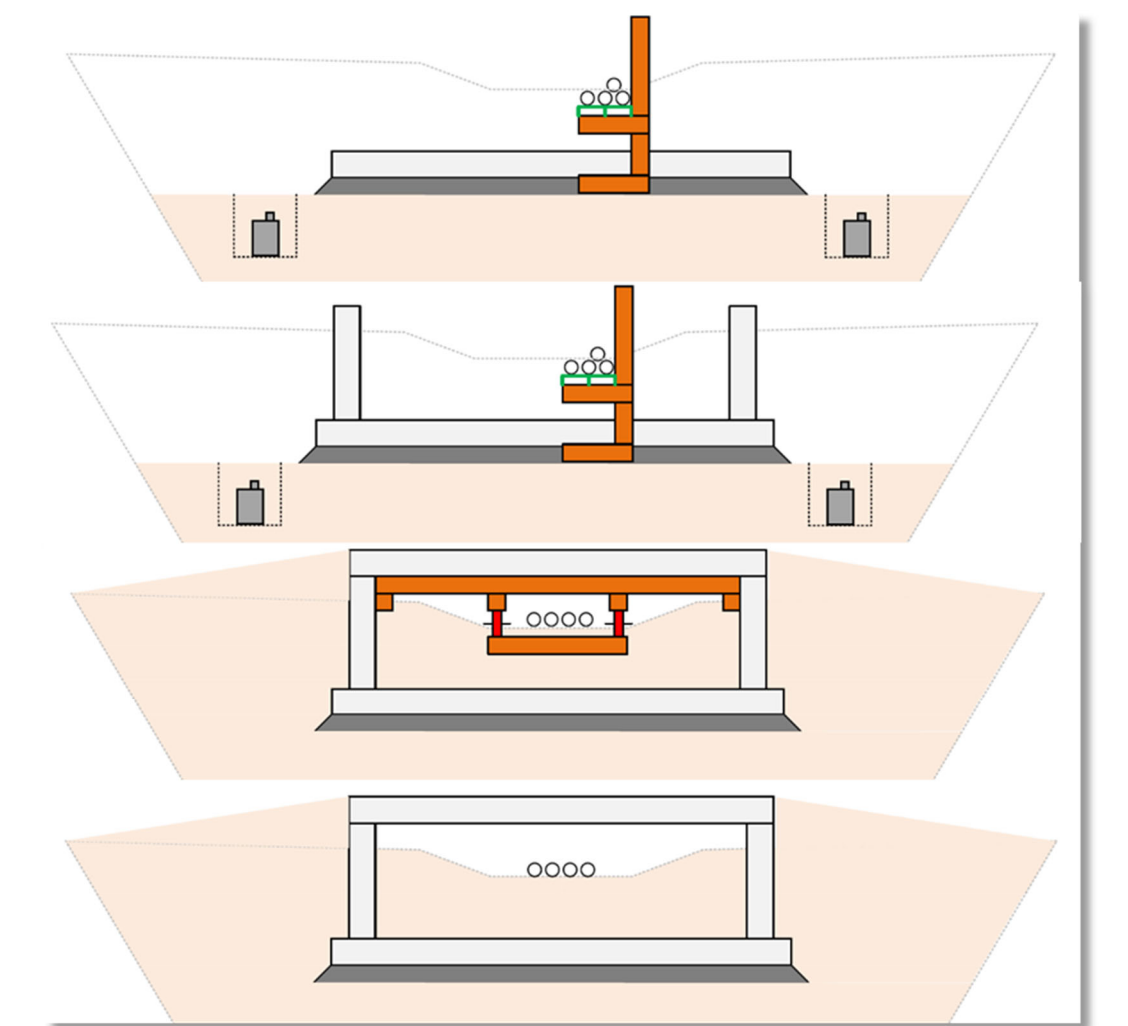
Place sandbag dam and piping for stream diversion and excavation



Set formwork and configure reinforcement



Pour concrete starting with the bottom slab, then the walls, and finishing with the top slab



Allow concrete to cure, seal concrete, finish final excavations

Acknowledgements

Mentors

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- Kyle Eshelman
- Jeff McIlhenny
- Mark Raup
- Mark Simpkins
- Doug Stumpp
- Dr. Brian Swartz (PM)
- Russ Woelsgle

Team Members

- Luke Fetterman (SPM)
- Jordan Barner
- Logan Horst
- Noah Thrush
- Joel Herman
- Noah Ling

Disclaimer

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