Rapidly Deployed Temporary Bridge

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Introduction

The New Hampshire Department of Transportation (NHDOT), along with a team of engineering students and faculty, have undertaken the project of developing a rapidly deployable temporary bridge for emergency purposes during storm events and critical condition red list bridges. This project included an analysis of readily available materials owned by the DOT to design a bridge that can span over or around existing structures to allow traffic to continue and remove live loads while minimizing cost and time of construction. Services provided by the student team included material inventory, cost analysis, structural analysis, and outlined construction procedures.

Decision Matrix

The decision matrix was used in the preliminary stages of the project to decide which bridge alternative to design. Each criterion was given a weight based on it's evaluated importance then each bridge option was given a value of that criterion. A score for each alternative was created by averaging its weighted scores of each respective category.

PERFORMANCE VALUES				
Criterion	**Weight**	**Full Acrow Bridge**	**Steel Girders & Timber Decking**	**Steel Girders & Acrow Decking**
Labor Costs	4	2	4	4
Speed of Construction	5	1	5	4
Availability of Materials	4	3	3	4
Efficiency of Space	5	1	4	5
Pedestrian Safety	2	3	4	3
Total	**25**	**1.80**	**4.05**	**4.15**

Construction

Erection plan:

- Site preparation and soil compaction will be the first step to construction to allow trucks and heavy machinery to safely drive around the site.
- Two crane trucks (HIAB X-HiDUO 258 E-7) will be used on tandem on either side of the bridge gap to suspend the girders from either end for placement.
- The trucks will be set back from the abutments on a 1 to 1 slope with the placement depth of the abutment plus an extra 6in as a safety factor.
- Girders will be modified before placement with attachment points for the decking panels allowing for easy installations with the crane trucks after girders have been set.

Temporary Structures

Design Constraints for a Temporary Bridge:

- Bridge overtopping designed to 2-year storm
- 50-foot span bridge, intended to replace bridges with spans between 30 and 50 feet
  - NHDOT owns 875 bridges meeting this criteria
- Segmented constructed and deconstruction

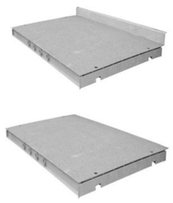
Challenges:

- Lack of single project location, no geotechnical analysis for abutments
- Theoretical load demand too high for DOT owned steel girders, purchasing steel would be required

Acrow Decking

Prefabricated deck units from Acrow with high friction surfaces will:

- Decrease construction time
- Increase reusability
- Save on cost



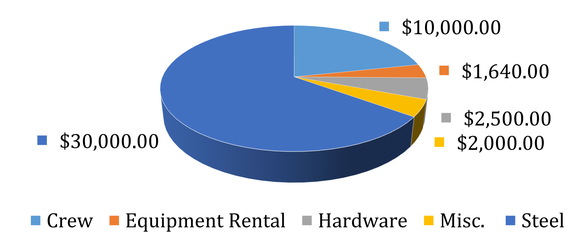
Load Calculations

Dead Load DC		
Component	**Load**	**Unit**
Acrow Deck Units	31.15	kip
Diaphragms	8.70	kip
Girders	30.60	kip
Stiffener Plates	0.26	kip
Factored DC Moment Demand Per Girder	**61.38**	**kip-ft**
Factored DC Shear Demand Per Girder	**9.82**	**kip**

Factored Loads all assume Strength 1 load case per AASHTO standards. Live loads consider an HL-93 truck.

Live Load LL		
Component	**Load**	**Unit**
Truck+Impact Moment	837.12	kip-ft
Truck+Impact Shear	78.08	kip
Lane Moment	200.00	kip-ft
Lane Shear	16.00	kip
Factored LL Moment Demand on Interior Girder	**540.71**	**kip-ft**
Factored LL Shear Demand on Interior Girder	**78.89**	**kip**
Factored LL Moment Demand on Exterior Girder	**416.34**	**kip-ft**
Factored LL Shear Demand on Exterior Girder	**47.33**	**kip**

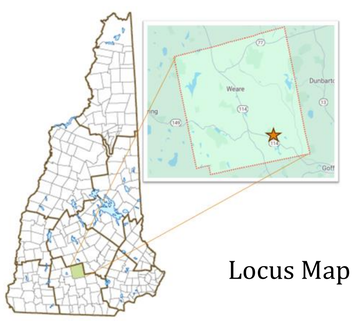
Cost



- Steel: $0.99 per pound
- Crew: $1000 per day
- Excavator: $82 per hour
- Hardware includes bolts, DTI washers, etc.
- Misc. includes modification of sections, transportation to site

Theoretical Location

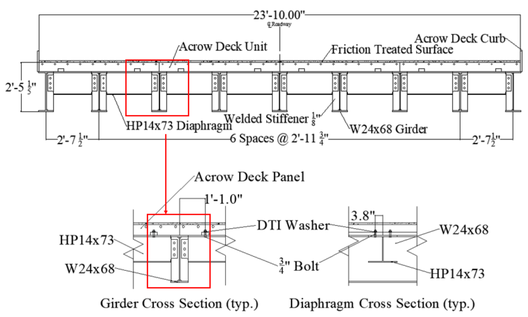
- Weare, NH. Route 114 over Otter Brook
- AADT of 7,807
- Two lane, box culvert
- Red listed due to culvert deterioration



Locus Map

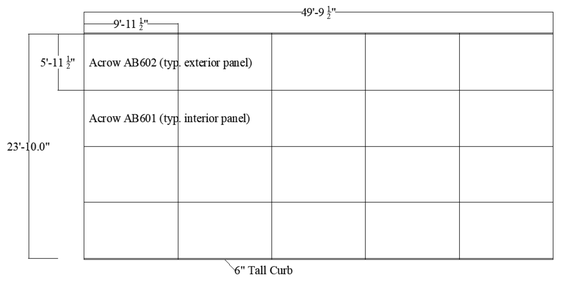
Bridge Design

Bridge Cross Section



Cross section of full bridge deck, connection detail of diaphragm and girders

Bridge Deck Layout



Plan view of Acrow deck panels

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