Composite Bridge Decking
- Abbreviated Work Plan -

Project Objective:
The project objective is to develop manufacturing methods that will allow New York State's hybrid deck design to be produced cost-competitively so it is feasible for use on moveable bridges.

Table 1. Project Tasks

Project Administration
- Task 1

Preliminary Design and Analysis
- Task 2 Define performance criteria
- Task 3 Set geometrics
- Task 4 Create finite element model
- Task 5 Analyze details
- Task 6 Design review

Testing of Materials and Subcomponents
- Task 7 Qualify materials
- Task 8 Qualify subcomponents
- Task 9 Evaluate alternative assembly methods
- Task 10 Fabricate and test 3' x 10' deck panels
- Task 11 Evaluate connection details
- Task 12 Report of performance of test panels
- Task 13 Design review

Final Design
- Tasks 14 Select materials and fabrication methods, produce drawings, specifications, work instructions, and test methods.
- Task 15 Solicit comment from Technical Advisory Panel
- Task 16 Update finite element model

Proof-of-Concept Installation
- Tasks 17 Fabricate proof-of-concept deck panels
- Task 18 Field installation
- Task 19 Field validation

Technology Transfer

Preliminary Design and Analysis
Deck performance criteria and dimensions will be determined through deliberation with end users who comprise the Technical Advisory Panel. A finite element model will be created using assumptions about material properties. Special details will be investigated analytically (e.g. attachment details, panel to panel connections).

Testing of Materials and Subcomponents

With the geometry being set, material options will be explored and investigated through testing. Coupons will be made with various resins, different types of glass reinforcement, and using various fabrication techniques. The resins which are most likely to be used in this project are epoxy-vinyl ester or polyurethane, but phenolics (for fire resistance) and/or bio-resins may also be considered. Basic mechanical tests will determine what tensile, compressive and shear strengths can be obtained in practice. The values obtained will be used to calibrate the finite element analysis and the products selects will be used for production of the deck. Other materials such as grouts and adhesives will also be tested during this phase.

A specification for the tube subcomponents will be written so their manufacture can be outsourced as a commodity to obtain the best unit price. To determine which fabrication method to use in the final design, an assortment will be requested from various suppliers and tested. Hand-made tubes will be compared against pultruded ones and those made using a vacuum process. Both consistency of quality and cost will be considered when the selection is made.

The three most promising subcomponent types will be selected and made into test panels. Twelve full depth test panels measuring 3’ by 10’ will be tested: all twelve will be tested in flexure; both positive and negative bending moment; one will be selected for testing in shear, punching, and fatigue and one tested for fire resistance. Sections of panels will be used to test railing anchorage methods, the field joint, wearing surface, and connection to structural steel.

Final Design

Data collected through analysis and testing will be used to determine the most promising combination of materials, geometry, and fabrication method. The multidisciplinary project team and the Technical Advisory Panel will discuss findings and decide on best practice for materials selection, design, fabrication, testing & installation. If necessary, the design and/or fabrication techniques will be revised based on results of the testing. The finite element model will be updated analysis based on properties of FRP and panel configuration selected for use.

Proof-of-Concept Installation

The field installation of the deck will demonstrate that the installation procedures and connection details are practical. Due to project cost constraints, the demonstration will not be a moveable bridge but will be done on a small local bridge by project partner Allegany County using in-house bridge maintenance forces. Once the bridge is redecked, a load test will be conducted to compare actual stresses against values predicted in the finite element analysis to validate and/or refine the model.

Technology Transfer

A final report will document the design and provide specifications necessary for manufacturing and installation.