UTC RESEARCH PROJECT DESCRIPTION

PROJECT NUMBER:
05228

PROJECT TITLE:
Design of a Low Cost Thermoplastic Bridge Superstructure

PRINCIPAL INVESTIGATORS:
Principal Investigator:
Nasim Uddin, P.E., Ph.D.
Assistant Professor
Department of Civil and Environmental Engineering
The University of Alabama at Birmingham
Telephone: (205) 934-8432; Fax: (205) 934-9855
Email: nuddin@eng.uab.edu

Co-Principal Investigator:
Uday K. Vaidya, Ph.D.
Associate Professor
Department of Material Science and Engineering
The University of Alabama at Birmingham
Telephone: 205-934-9199
E-mail: uvaidya@eng.uab.edu

PROJECT OBJECTIVE:
Recent developments in low-cost thermoplastic materials and fabrication technologies offer multiple avenues for the design and manufacture of very lightweight, low-cost thermoplastic (TP) composite structures with enhanced damage resistance and sustainable designs for bridge superstructure and deck systems. Consistent with FHWA’s current motto “get in and get out” for rapid bridge rehabilitation, the primary objective of this study is to (1) introduce innovative TP bridge deck systems through analysis and experimental procedures, and (2) optimize these systems to produce durable, structurally sound and cost effective systems that will take full advantage of TP technology for rapid and low cost construction.

PROJECT ABSTRACT:
There are no known ongoing attempts to use thermoplastic composites for bridge structures because of the perception of high cost and expensive manufacturing. Previous work in composite bridges focused on thermoset prepreg composites to enhance strength/stiffness. The use of thermoset composites in bridge construction and repair is relatively well-established. Recent work by the UAB investigators (Uddin, Vaidya) in the area of thermoplastic composites for protection of bridge piers has shown significant potential for use of TPs in civil structural applications. Most sub-elements can be fabricated in the factory; therefore, high quality control can be assured. Moreover, the construction period can be shortened because most of the parts are pre-fabricated. This project will examine key design parameters and a novel design concept for producing a low cost bridge deck. Due to inherent advantages of TPs in impact protection, the
deck will be able to sustain routine structural loads and accidental impact loads. The work is new, and open to significant development. Hence it will provide an opportunity to develop a novel versatile, cost-efficient solution for rapidly constructed bridges.

PROJECT TASK DESCRIPTIONS:
Task 1 – Analytical study using finite element modeling to optimize deck design
Task 2 – Design and manufacture of a segment of modular TP deck panel
Task 3 – Flexure, shear and bearing testing of a TP deck segment, and model validation
Task 4 - Final report

MILESTONES AND DATES:
Task 1, June 1, 2005 – May 31, 2006
Task 2, November 1, 2005-January 15, 2006
Task 3, January 15, 2006 – April 15, 2006
Task 4, May 1 – June 30, 2006

TOTAL BUDGET:
Thirteen month project: UTCA cash $50,000, total project budget $100,000. Matching will be SPR funds from Alabama DOT Project Number 930-607 - “Cost-effective VARTM Technology to Repair Bridge Girder Structures.”

STUDENT INVOLVEMENT:
The research effort will include two graduate students, whose departmental affiliations will be 75% Civil and Environmental Engineering and 25% Material Science and Engineering.

RELATIONSHIP TO OTHER RESEARCH PROJECTS:
This project is a continuation of the investigators investigations into thermoplastic composites: UTCA project 03229 – “Vulnerability Reduction in Bridges,” 03405 – “I-565 Bridge Repair with VARTM,” (also ALDOT project 930-607), and 04210 – “Low Cost Thermoplastic Wrap to Enhance the Bridge Safety.”

TECHNOLOGY TRANSFER ACTIVITIES:
Knowledge transfer will be enhanced through technical reports, and dissemination of information through documentation and on-site laboratory demonstration to industry and engineering professionals. ALDOT will be given seminars in the middle and at the end of the project.

POTENTIAL BENEFITS OF THE PROJECT:
The program is consistent with current DOT initiatives on integrity evaluation of affordable advanced materials and structures. Advanced materials are a priority area amongst almost all federal agencies and relevant industries. The work is new and open to significant development, hence collaborative and consortia activities can be developed to further the proposed concepts.

TRB KEYWORDS:
Bridge decks, Thermoplastic Composite, Rehabilitation, FRP, and Superstructure