Global Infrastructure Sector for “Emerging” fiber reinforced polymer (FRP) composites applications projected to INCREASE by 525% between 2000 and 2010 in buildings, bridges, ports, utilities, construction, and concrete repair. Composites Worldwide Inc.

In July 2003, UAB researchers successfully implemented a cost-effective and innovative Vacuum Assist Resin Transfer Molding (VARTM) Technology for the repair and hardening of girder cracks on I-565 in Huntsville, Alabama (Sponsor – Alabama Department of Transportation). Advanced materials - carbon fiber reinforcements and epoxy resin were used. The repair treatment was implemented without stopping traffic on I-565 and is expected to significantly improve the life-span of girder.

Why FRP in Civil Infrastructure?

- Structural enhancement including strength and stiffness, afforded by FRP rehabilitation technique
- Corrosion Resistance
- Ease of Repair
- The economics and ease of use of FRP rehabilitation systems.
The overall objective is to pioneer a new and promising technology to reduce the vulnerability of bridges to dynamic loads that delivers high energy to the structure in a very short amount of time, e.g., impact from unknown threats such as collisions from trucks/trailer or blasts and earthquake effects. A novel versatile, cost-efficient method of providing structural retrofitting for the protection of existing and new bridge piers is expected.

Thermoplastic composites such as glass/PP, glass/nylon, carbon/PP offer low cost, light weight, high stiffness, high strength and energy absorption benefits. The thermoplastic resin can be recycled and is environmentally friendly.

Thermoplastic Composite Wrap For Vulnerability Reduction of Bridge Structures

**Project Deliverables**

- **Manufacture of Low-cost Thermoplastic Composite Protective Enclosures for Bridge Columns and Piers**
  Glass fiber/polypropylene thermoplastic tapes are manufactured in a direct impregnation process at the Southern Research Institute and woven into fabric form.

- **Material Characterization and Structural Testing of the Retrofitting Scheme**
  The study evaluates the peak strength, stiffness, stress concentrations and identify potential debonding problems.

- **Evaluation of High Strain Rate Impact to Glass/PP andWrapped Concrete Structure**
  High strain rate impact testing of thermoplastic matrix/concrete systems using Split Hopkinson Pressure Bar apparatus

**Sponsor:** University Transportation Center of Alabama (UTCA)
Grant No. UTCA - 03229

**Glass/Polypropylene Tape Reinforced Concrete Column subjected to Uniaxial Compression**

**Interface Modeling**
**Mechanical Testing**
**Impact Testing**

**Dynamic Response of Glass reinforced Composite under High Strain Rate Impact**
Autoclaved Aerated Concrete (AAC) an ultra-lightweight concrete building material produced from sand (or flyash), lime, cement, water and an expansion agent. Due to the nature of the manufacturing process and the use of the expansion agent, the finished AAC products weigh as little as one-fifth the weight of ordinary concrete, producing structural, noncombustible, inorganic, thermally efficient and effective sound attenuators.

**RESEARCH FOCUS**
- Develop vulnerability reduction concepts in structures using AAC and fiber reinforced plastics/composites (FRPs)
- Develop low cost manufacturing methods to reinforce AAC with FRP
- Study different failure modes present in the capacity upgrade of AAC
- Optimize geometry, fiber orientation, processing and selection of the reinforcement, for structural wall, floor panels
- Develop modular structural concepts for AAC-FRP material
- Understand axial, flexure and shear behavior of AAC
- Assess vulnerability by dynamic testing methods - Low & ballistic velocity, and high strain rate impacts
- Develop standardized building construction procedures using AAC/FRP

**Applications:** Load bearing Floor and Wall Panels, Composite Plate Girders, Decks

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