Florida Department of Transportation Research

Development of GFRP Reinforced Single Slope Bridge Rail

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Current Situation

In the design of highway bridges in Florida, glass fiber reinforced polymer (GFRP) materials are starting to replace mild carbon steel as the basis for reinforcing structural concrete components. While traditional steel rebar is susceptible to corrosion, GFRP rebar is not. GFRP rebar also weighs less than steel rebar, which can simplify construction processes and reduce construction costs.
The Florida Department of Transportation (FDOT) uses GFRP-reinforced concrete in a variety of bridge components (piles, pile caps, decks, etc.). However, FDOT needed a GFRP-reinforced traffic rail to complete a non-corrosive, steel-free bridge plan.

Research Objectives

The primary objectives of this study were to design a GFRP-reinforced 36-inch single-slope traffic rail and evaluate its impact performance using pendulum impact testing.

An impactor has been raised to 15-foot drop height prior to release.

Project Activities

After a literature review, the University of Florida research team established a design basis for GFRP-reinforced rail using finite element impact simulation. After this, the team designed a GFRP-reinforced 36" single-slope traffic rail.

The team directly compared GFRP-reinforced steel traffic rail and the conventional reinforced concrete rails using pendulum impact testing in center-of-rail and end-of-rail configurations. The testing delivered force equivalent to a test level 4 truck impact, as prescribed by AASHTO Manual for Assessing Safety Hardware.

Project Conclusions and Benefits

Based on the test results, the center and end GFRP rail specimens performed in a comparable manner to conventional reinforced concrete rails. Deflections for GFRP rails were acceptably small, and observed cracking was manageable (i.e., cracks could, if necessary, be injected and repaired). The team also learned lessons in terms of additional design modifications to ensure effective performance by GFRP rails. For interior (centrally located) impact locations, representing the most common practical design scenarios, a density of GFRP bar equivalent to that of mild steel rebar was determined to be adequate. Under the most severe (end-of-rail) impact conditions tested, however, a greater density of GFRP reinforcement was required, in comparison to mild steel rebar.

It was concluded that the tested GFRP rails may be considered for future implementation by FDOT.

For more information, please see *fdot.gov/research*.