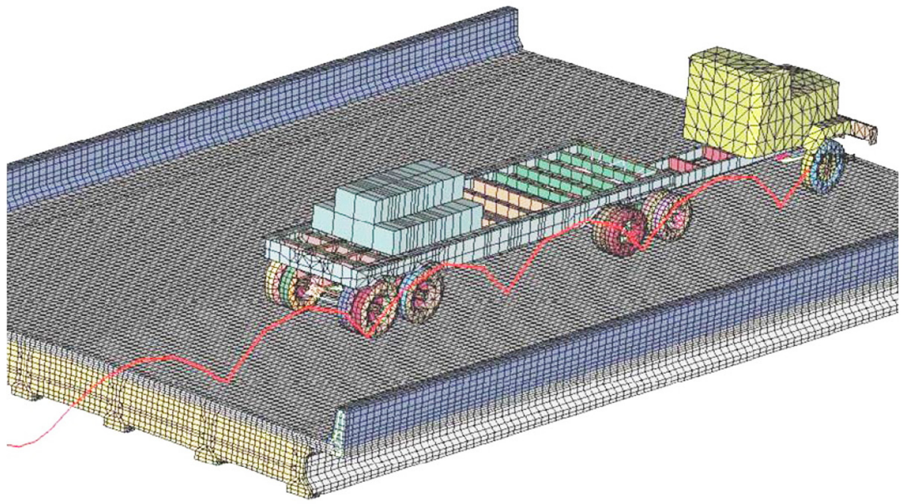
# Florida Department of Transportation Research

Investigation of Impact Factors for FDOT Bridges
BDK83 977-03

Modern prestressed reinforced concrete bridges are designed according to Load and Resistance Factor Design (LRFD) standards and are more efficient with optimum load factors. At the same time, they are loaded with heavier vehicles with a larger mass when compared to the mass of the bridge. FDOT manages more than 6400 such bridges and receives frequent requests to permit vehicles to use them that are larger than the normal loads for which the bridges were designed. Understanding how these vehicles interact with and affect the bridges is critical to the permitting process, as well as to design, maintenance, and planning.



*Complete finite element model of a vehicle-bridge system, among those used to simulate the dynamic loading of the bridge.*

Researchers from the Florida State University-Florida A&M University College of Engineering developed new finite element models of highway bridges with AASHTO Type II and Type IV girders. They also refined an existing model for a bridge with Type III girders. They used these models to investigate the dynamic loading of bridges and complemented simulation studies with field experiments.

Experimental tests were carried out on a bridge on US 90 with AASHTO Type III girders. A span of the bridge was instrumented with linear variable transformers, strain gauges, and accelerometers. Static and dynamic tests were carried out using three representative vehicles: a Mack CH613 truck with a single drop trailer; a Terex T-340 crane; and an FDOT truck with a very stiff suspension.

The bridge and the vehicles were modeled using finite element methods. A vehicle and its load can be a significant portion of the mass of a vehicle-bridge combination, and they must be modeled as one time-dependent system to understand the dynamic response of the bridge. Increases in computer power allowed the researchers to update and refine existing models, to create new ones, and to run simulations to investigate realistic time-dependent scenarios.

To investigate factors that affect dynamic loading, researchers added several road and vehicle features, including a depression in the pavement approach to the bridge, an uneven abutment joint, and the hammering effect of an unsecured load, which can bounce when the vehicle encounters an uneven abutment joint, for example. These features contributed significantly to dynamic loading.

More than 100 vehicle-bridge interactions were simulated and their dynamic load allowances (DLA) estimated. All values were within AASHTO recommended values for design at reasonable speeds, however, the variation of DLA with speed was far from linear and showed a series of ascending maxima with deep troughs in between. The researchers recommended investigating this phenomenon and an active program of bridge monitoring.

**Project Manager: William Potter, FDOT Structures Research Laboratory**
**Principal Investigator: Jerry Wekezer, Florida State University**
**For more information, visit http://www.dot.state.fl.us/research-center**