Florida Department of Transportation Research

Wind Effects on Mast Arms

July 2018

Project Number
BDV31-977-59

Project Managers
Christina Freeman
FDOT Structures Office

Principal Investigator
Jennifer Bridge
University of Florida

Current Situation

In 1992, Hurricane Andrew cut across South Florida and left a path of unprecedented destruction. In particular, a vast number of downed traffic signals complicated response and recovery efforts, made travel more dangerous and time-consuming, and occupied large amounts of repair team time. To address this issue, the Florida Department of Transportation (FDOT) developed a mast arm structure which is less likely to fail in a storm, and many post-and-cable suspended traffic signals have been replaced with mast arms. In the years since the mast arm was introduced, updated signaling, monitoring, and signage systems have created opportunities to further improve driver safety and traffic management. Before adding these features to mast arms, FDOT sought to reevaluate the capacity of mast arms.

Residual mast arm system capacity allows for the addition of reflective backplates and signs to existing mast arm structures.

Research Objectives

University of Florida researchers reviewed current FDOT procedures for design and analysis of mast arm structures and conducted experiments on mast arm wind resistance with different signal configurations and backplate designs.

Project Activities

Nine mast arm configurations were selected to represent designs commonly used in Florida, as well as those most often identified as being at capacity, based on the current design and analysis procedures. The selected mast arms varied in many factors that affect wind resistance, including arm diameter, pole diameter, arm length, pole height, number of traffic signals and signs, signal orientation, presence or absence of backplates, and applicable design standard. These factors were used to design scale models of mast arm signals that were tested in a wind tunnel.

Wind tunnel experiments were conducted in three phases: primary testing, supplementary testing, and hardware modification testing. Primary testing focused on aerodynamic shielding, an effect in which the air flow around an object alters the airflow around an object behind it, and on evaluating specific parameters used in mast arm design, especially the drag coefficient. Supplementary testing was used to further investigate the drag coefficient under a wide range of conditions. In hardware modification testing, backplates altered to reduce their wind resistance were tested.

The researchers found that current methods of evaluating the wind resistance of existing mast arm structures might be too conservative, and they suggested appropriate modifications to the methods of analysis for existing mast arms. However, they recommended maintaining the conservative methods for the design of new mast arms. They also found modifications of backplates that were able to reduce the wind profile of mast arm-signal structures.

Project Benefits

Motorist safety is improved through enhanced visibility of signals and signs. The results of this project will help FDOT use current mast arm structures more fully, avoiding the need for costly replacements.

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