A Framework for Vibration Attenuation in Traffic Mast-Arm Structures under Wind Loads

Aly Aly (aly@lsu.edu)
Louisiana State University https://orcid.org/0000-0002-1253-139X
Hamzeh Gol-Zaroudi
Louisiana State University and A&M College: Louisiana State University
Milad Rezaee
Louisiana State University and A&M College: Louisiana State University

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Abstract

Traffic signals and information signs play a vivid role in guiding drivers on highways and urban roads, to maintain safe travel. For this reason, it is crucial to ascertain the functionality of signal support structures. This paper lies the foundation for a fully computational framework to model and attenuate wind-induced vibrations in traffic lighting structures by using computational fluid dynamics (CFD) simulations & dynamic analysis. Dependence of flow pattern and aerodynamic loads on Reynolds number reveals the importance of full-scale CFD with Large Eddy Simulation for mast arm structures. By employing available weights of lighting boxes, distributed tuned mass dampers were created. The results obtained show that distributed tuned lighting boxes are effective devices for vibration suppression. In addition, damping enhancement can significantly reduce vibration-induced stresses, and hence extend the fatigue life with promises to reduce the cost of building new structures and improve the safety of the traveling public. The procedure followed for creating time histories of wind loads integrated with finite element modeling is useful for the investigation of other vibration lessening techniques.

Full Text

This preprint is available for download as a PDF.

Declarations

Competing interests: The authors declare no competing interests.