Promoting the Use of Effective Vibration Mitigation Devices for Traffic, Sign, and Lighting Structures in the Existing AASHTO Specifications

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Traffic, sign, and lighting structures are characterized by high flexibility & low damping, prone to wind-induced vibration, and susceptible to fatigue and failure.

There have been many documented wind induced vibration occurrences, some causing structural failure.

These vibration occurrences are dependent on structure, site and specific wind conditions, and are difficult to predict.
Indiana – 1st Mode, Aluminum Lighting Pole
Watertown, SD – High Mast, 1st Mode
Canada – Bridge Mono-tube Sign Structure
Colorado – Cantilever Mono-tube Sign Structure
Galloping Traffic Signal Structure
Austin, Texas - Traffic Arm Failure
Denver, Colorado - High Mast Failure
Typical Parking Lot Light Pole Failure
AASHTO LTS Specifications

- Support structures shall be proportioned such that the wind-load-induced stress is below the constant amplitude fatigue threshold (CAFT) – Ensuring Infinite Fatigue Life.
  - Certain load cases govern design – producing overdesigned and expensive structural members and critical connections
  - Specifications can result in inefficient structural designs – a questionable use of resources
AASHTO LTS Specifications

- Cantilevered Sign and Traffic Signals
  - 1. Galloping
  - 2. Natural Wind Gusts
  - 3. Truck-Induced Gusts

- Non-cantilevered Sign and Traffic Signals
  - 1. Natural Wind Gusts
  - 2. Truck-Induced Gusts

- High-Mast Lighting Towers (55’ and taller)
  - Design wind pressure includes natural wind, natural wind gusts, and vortex shedding

- Roadway Lighting Pole Structures (less than 55’)
  - Do not need to be designed for Fatigue
AASHTO LTS Specifications

- In lieu of designing to resist periodic galloping forces, the AASHTO specifications suggest the use of effective vibration mitigation devices for cantilever traffic and sign structures.

- The mitigation device should be approved by the Owner, and based on historical or research verification of its vibration damping characteristics.

- The AASHTO specification makes no reference for the allowance of effective vibration mitigation devices for other fatigue load cases such as Truck, Natural Wind Gusts, or High Mast; or for other Structure types such as non-cantilevered Sign and Traffic Signal Structures.
Vibration Mitigation Devices

 Owners rarely consider the use of mitigation devices because:

- It’s difficult for owners to reliably define how effective a vibration mitigation device functions.
- The AASHTO Specifications gives no guidance as to how to qualify or quantify the effectiveness of a device.
Research Objectives

- Develop test procedure that can be followed by traffic, sign, and lighting structure owners to qualify particular mitigation devices as being effective for specific structures and loading conditions
- Provide accompanying set of design procedures to incorporate the added performance of the vibration mitigation device into the design of the structure
- Develop recommendations to enhance AASHTO Specifications
Research Phases and Tasks

- **Phase 1:** Quantifying Performance of Vibration Mitigation Devices
- **Phase 2:** Identifying Test Procedures to Qualify Mitigation Devices
- **Phase 3:** Incorporate *Effective* Vibration Mitigation Devices into Specifications

- Research Period: 2 ½ years (30 months)
- Recommended Funding: $400,000
Broader Impacts and Benefits

- Owners can provide smaller, more efficient, traffic, sign, and lighting structures
- Improve public safety at reduced costs
- Extend the life of new and existing traffic, sign, and lighting structures
- Get existing inventory compliant to current AASHTO specifications
- Spur innovation of new vibration mitigation devices by making a clear path to implementation
Thank You