

## **Section 36 - Highway Lighting, Traffic Signal and ITS Monitoring Equipment Support Structures**

### **36.1 Design**

The 2001 Edition and Interim of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals* shall be used for the design of the subject structure types.

The following stipulations to the usage of the AASHTO Specifications shall be followed for such designs:

1. In lieu of following the criteria of Section 3 of the cited AASHTO Specifications, Appendix C of the Specifications shall be referenced for determination of design wind pressures.
  - a. Accordingly, the minimum design wind speed to be used shall be 80 miles per hour. This will be based on a 50 year mean recurrence interval.
  - b. If, based on engineering judgment, a design wind velocity greater than 80 miles per hour is felt to be applicable for a particular project in areas where extreme exposure conditions exist, the Appendix C criteria should be followed for this determination.
2. Additional criteria for design considerations are as follows:
  - a. Luminaire Dead Load: Approximately 80 lbs each. Maximum projected area: 3.75 square feet per luminaire.
  - b. Weight and projected area of other equipments (traffic signals, CCTV camera, other type of luminaires, etc.) shall refer to the Manufacturer's Specifications.
  - c. Table C-2 of the *AASHTO Specifications'* Appendix C shall be referred to for identification of applicable wind drag coefficients.
  - d. The wind pressure load shall be computed according to Subsection C.3 of the above cited Specifications' Appendix C.

Section 3 of the cited AASHTO Specifications shall then be used to identify Group Load Combinations. As discussed in Subsection 3.9 of the cited AASHTO Specifications, the same calculated wind pressure value shall be used for application of the load on the various support structure components.

- e. Maximum horizontal deflection at the top of the assembled standard (except CCTV pole) with fixtures attached due to a 40 miles per hour wind (V) shall not exceed 1.25% of the total shaft height.

When addressing a permitted horizontal deflection for CCTV pole designs, the design should be based on provision of a viewable installation. Accordingly, designing for a horizontal deflection of  $\pm 2$  inches from centerline of the pole at the top should be pursued.

3. Fatigue
  - a. Section 11 of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals* provides criteria for the fatigue design of cantilevered steel and aluminum support structures.
  - b. A fatigue design of aluminum traffic signal support structures may be waived.

- c. Steel traffic signal support structures whose mast arm is greater than 50 feet shall be designed for fatigue to resist equivalent static wind effects that are specified in the AASHTO Specifications.

The fatigue design will be based on designing to resist Fatigue Category II wind load conditions.

Fatigue Importance Factors listed in Table 11-1 of the AASHTO Specifications shall be used for each fatigue design wind load.

- d. Designers are advised that when a traffic signal structure configuration with an arm length greater than 50 feet is required, an independent foundation for the structure shall have to be designed. In order to accommodate the foundation, the area where the foundation is to be constructed shall be assessed to verify the feasibility of constructing a shaft foundation that will facilitate a maximum 24 inch bolt circle.

### **36.2 Support Structure Standards**

1. Details and material adherence criteria of lighting support, traffic signal and CCTV structure standards are provided in the *NJDOT Standard Electrical Details*.
2. The NJDOT Standard Specifications should be referred to for requirements regarding proper bolt assembly installation procedures.

### **36.3 ITS Support Structures**

Criteria specified in Section 30 of this Manual should be referred to for design of VMS (DMS) ITS structural support systems.

### **36.4 Foundations**

1. The *NJDOT Standard Electrical Details* should be referred to for foundation detailing. Otherwise, if a unique design is required, a design shall be in accordance with applicable requirements in the *AASHTO Standard Specifications for Structural Supports* as well as in the 17th Edition of the *AASHTO Standard Specifications for Highway Bridges*.
2. At the time of work request, the following information for lighting support structures, on an individual contract basis, will be furnished by the Department's Traffic Signal and Safety Engineering Unit.
  - a. Interchange layout showing location of towers by station and offset.
  - b. Height of towers and number of luminaires.
  - c. If other than 3 inches above existing (or finished) ground line, elevations of the top of concrete pedestals.
3. The Structural Design Engineer shall initially refer to previous construction contracts to review previous borings which may be useful in determining preliminary foundation design. Boring log identification numbers for previous construction contracts shall be shown on the contract plans.
4. The proposed subsurface exploration (see Section 34) at each tower lighting location shall be submitted to the Geotechnical Engineering Unit for approval. One deep boring and one or more shallow borings may be required by the Geotechnical Engineer. Continuous sampling, to a reasonable depth, may be necessary and if so will be ordered by the Geotechnical Engineer.

Boring requests shall be directed to the Geotechnical Engineering Unit as soon as possible.

5. The foundations of tower lighting support structures that are located on undisturbed soils shall be designed for an allowable soil pressure that is estimated for a differential settlement that shall not exceed 1/2 inch.

Careful consideration shall be given to ground water conditions when estimating allowable pressure and settlement of the soil.

Rotation and displacement of a foundation must be restricted to alleviate the possibility of failure of the structure or its having an unsightly visual appearance. Deep foundations shall be used when soil conditions do not readily and reliably indicate the use of spread footings.

The foundation design criteria for tower lighting located on embankment fill shall be established with respect to soil bearing capacity and settlement. Consideration must be given to the stability of the embankment with respect to any possible vertical and/or horizontal movements.

The most important factor to be considered in the foundation design of a lighting support structure is the overturning factor. This will require an adequate provision for passive resistance and upward pull on spread footing and deep foundation design, respectively.

6. Adverse foundation conditions, property lines, subsurface utilities, temporary sheeting, traffic maintenance, and other special conditions which may require individual foundation designs shall be investigated by the Structural Design Engineer at each support structure location.

### **36. 5 General Criteria**

Notes on the plans or guidance in the Special Provisions shall require that the contractor submit detail plans and calculations for the support structure shaft, mast arms, luminaires, anchor bolt assembly, and connection details. The contractor or his designer shall review these drawings to determine that design loads and forces are in accordance with the design assumptions of the foundations shown on contract plans.