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Design of Steel Lighting System Support Pole Structures

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PREFACE

Lighting system support structures (primarily cold-formed single- and multi-pole tubular steel structures) differ from buildings in many performance-related characteristics. But, like buildings, lighting systems support structures are a critical public safety issue if they are not properly specified, designed, fabricated, installed, and actively inspected and routinely maintained by competent professionals. Current practices related to support structures of this type have been inconsistently developed and even more inconsistently applied, rendering many of those practices confusing—and even worse—ill-advised. The catastrophic failure of dozens of lighting system support structures around the country and the removal from service of hundreds more as a precaution in view of faulty or incomplete specifications for design, fabrication, installation, or ongoing maintenance prompted several members of ASCE's Structural Engineering Institute to begin development of this document in the interest of improving public safety related to these structures. This consensus standard has been specifically written to unify the core body of best practice knowledge available in the structural engineering community and to provide public and private agencies, practicing engineers, installers, and facility owners a consistent roadmap for the safe specification, design, fabrication, installation, and ongoing maintenance of structural supports of this type.

The standard includes design parameters applicable to self-supporting structures, with base plates for installation on a concrete pier foundation, or as direct embedded, backfilled poles with the base section being either steel or concrete. The standard provides for the proper specification and/or development of the various loads and load combinations to be applied to support structures of this type, as well as safe load resistance requirements. Special design issues for these structures include structure deflection, vibration, and fatigue. Issues related to fabrication and installation, as well as critical ongoing inspection and maintenance best practices, are also addressed.

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These committee members participated in developing this standard:

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CHAPTER 1
GENERAL

1.1 SCOPE

Lighting system support structures have unique design and performance-related characteristics.

This standard provides recognized literature for the structural design, fabrication, installation, inspection, and maintenance of cold-formed single and multiple-section tubular steel lighting system support pole structures.

The standard is applicable to self-supporting poles with base plates supported on foundations with anchor rods, and to poles without a base plate supported on direct embedded, backfilled steel or concrete sections. This standard applies to round and symmetrical multisided cross section galvanized steel poles.

Minimum design criteria are specified, including combinations of loadings, strength requirements, deflection limitations, and fatigue strength considerations. Guidelines for fabrication, installation, inspection, and maintenance are also provided.

The design, fabrication, and installation provisions of this standard are intended for new structures.

Means and methods for construction are not within the scope of this standard.

1.2 DEFINITIONS

Azimuth of Lighting Fixture: Direction in a horizontal plane that a lighting fixture is pointed to result in the desired lighting intensity.

Ballast: Electrical device used for starting and regulating lighting fixtures, either integral to a lighting fixture or mounted remotely.

Corrosive Soil: Soil identified in a geotechnical report as being corrosive to concrete or steel.

Design Strength: Product of nominal strength and a resistance factor.

Direct Embed Foundation: Steel pole or precast concrete section extending below grade and acting as the foundation.

Discrete Appurtenance: Remote ballasts, speakers, signs, anticlimbing devices, or other similar attached items that may be modeled as a concentrated load.

Effective Projected Area: Projected area of an object multiplied by a drag coefficient.

Elastic Structural Analysis: Structural analysis based on the members of the structural model not exceeding their yield strength, resulting in the structure returning to its original geometry after the removal of loading.

Equivalent Constant-Amplitude Stress Range: Constant-amplitude nominal stress range that is theoretically equivalent, with respect to fatigue damage, to a lifetime of variable cyclic stress ranges from wind loading.

Fatigue Failure: Visible crack growth from cyclic loading to an extent that the structure cannot be safely used in service.

Fatigue Limit State Static Pressure Range: Damage-equivalent wind pressure for determining nominal stresses in structural members and components for the investigation of fatigue strength.

Fatigue Threshold: Stress range below which a particular detail can withstand an infinite number of stress cycles without fatigue failure.

Fixture Projected Area: Maximum fixture area projected onto a vertical plane within the range of working tilt angles prescribed by the fixture manufacturer.

Flange Plate: Base or intermediate exterior flange welded to a tubular pole structure.

Foundation: Substructure or extension of the superstructure designed to transmit reactions to the underlying soil or rock.

Headed Anchor Rod: Deformed or a smooth bar with an attached end plate or nut.

High-Risk Seismic Location: Location where the spectral response acceleration parameter at short periods defined by ASCE 7-16 exceeds 1.0.

Lens: Surface from which light is emitted from a lighting fixture.

Lighting Fixture: Enclosure with a lens to focus light in a specific direction.

Lighting Fixture Mounting Plane: Vertical plane generally containing a group of lighting fixtures, or, for a single lighting fixture, the vertical plane normal to the azimuth of the lighting fixture.

Lighting System: Combination of lighting fixtures and support members.

Linear Appurtenance: Coax, conduit, lines, ladders, safety climb devices, step bolts, brackets, or other continuous or regularly spaced attachments that may be modeled as a distributed load.

Mounting Components: Components used to mount a lighting fixture to a mounting pipe, frame, or other mounting system.

Mounting System: Structural members used to support lighting fixtures on a supporting structure.

Nominal Strength: Capacity of a structure or member to resist the effect of loads without a resistance factor applied.

Nominal Stress: Stress in a member or component based on its cross-sectional properties without the use of magnification or stress concentration factors.

Resistance Factor: Factor applied to the nominal strength to obtain the design strength that accounts for the unavoidable deviations of the nominal strength from the actual strength and for the manner and consequence of failure. Also referred to as a strength reduction factor.

Service Basket: Mounting system that accommodates service personnel.

Tilt Angle: Acute angle in a vertical plane between a line normal to a lens of a mounted lighting fixture and the horizon.

Visor: Component used to minimize light scatter and/or to improve the aerodynamic profile of a lighting fixture.