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DESIGN TOPICS FOR PRECASTERS

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Precast Utility Pole Foundations

By Ronald Thornton, PE

A lot of precast producers have added utility pole foundations to their product mix over the last several years due to a high demand from electrical and site work contractors as a means to accelerate construction. This article looks at how pole foundations are designed in order to determine the proper depth and reinforcing for a given application.

Utility poles are intended to carry fixtures such as lights, cameras, etc., all of which must be designed to resist forces due to wind. Wind loads are then transferred from the pole and fixtures to a base plate and anchor bolts embedded into the foundation. Precast pole foundations are either round, square or tapered and can vary in cross-sectional diameter, dimensions, and depth.

The analysis method for foundations can be found in AASHTO "Standard Specification for Structural Supports for Highway Signs, Luminaries, and Traffic Signals". Wind pressure, P_z, is a function of wind velocity coupled with a number of other factors:

$P_z = 0.00256 k_z G V^2 I_r C_d$ *(psf), where:*

- I_r = Importance Factor
- V = Wind Velocity (mph)
- k_z = Height and Exposure Factor
- G = Gust Effect Factor
- C_d = Drag Coefficient

Drag coefficient is related to the shape of the fixture or pole. For example, a rounded pole will have less drag than a square pole and, therefore its force effect will be less. A common term you may see in light fixture literature is "EPA". This term stands for Effective Pressure Area and is simply the surface area of the pole or fixture times the drag coefficient, C_d. If the EPA is given for a particular design, then C_d should be set to 1 regardless of the shape.

The magnitude of force transferred to the foundation is determined by summing the moment, shear, and axial forces from the resulting wind load acting against the exposed surface of the pole and fixtures.

Precast bases are then designed using the same method as drilled shafts according to Section 13 of the AASHTO standard. As with any type of foundation, it is important to know what type of soil is present at the site as the foundation will behave differently in cohesive soils such as clay and loam, as opposed to non-cohesive soil such as sand.

A pole base is prevented from overturning through the development of passive soil resistance on the side of the unit. Using what is known as the Broms method, the required shaft length, L, is computed based on the applied moment and shear, soil type, and shaft diameter (or width). A safety factor of 2, for sandy soils, and between 2.9 and 4.3, for cohesive soils, is applied.

The development of passive resistance is critical to the performance of a pole foundation. Therefore, proper backfilling around the shaft must be employed. Crushed stone or flowable fill is recommended.

Reinforcing steel is designed based on the maximum bending moment occurring in the shaft according to the above analysis.

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The Delta Advantage
Editor: Ronald E. Thornton, PE
rthornton@deltaengineers.com
Tel: 607-231-6612

DELTA
ENGINEERS, ARCHITECTS, & LAND SURVEYOR

184 Court Street
Binghamton, NY 13901-3515
Tel: 607.231.6600
Fax: 607.231.6650
www.deltaengineers.com

Featured Project

Project Name: Rehabilitation of NY 104 over Jeddo Creek
Owner: New York State Department of Transportation
Produced by: Kistner Concrete Products, Lockport, NY
Structural Design by: Delta Engineers, Architects, & Land Surveyors, P.C.

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This project included the specialty design of a 7.6m diameter precast arch unit used as a liner under an existing metal arch. The precast arch elements were slid into position along a CIP stem wall foundation after which the annular space between the precast arch and the deteriorating metal plate was filled with grout. Endwalls were also precast.

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184 Court Street
Binghamton, NY 13901-3515