Prestressed Concrete Transmission Pole Structures

Recommended Practice for
Design and Installation





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Prestressed Concrete Transmission Pole Structures

Recommended Practice for Design and Installation

Prepared by
the Task Committee on Concrete Transmission Pole Structures of
the Committee of Electrical Transmission Structures of
the Structural Engineering Institute of
the American Society of Civil Engineers

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PREFACE

The purpose of this manual is to provide the reader with a basic knowledge of the principles and methods for the design, manufacturing, and use of prestressed spun- and static-cast concrete poles for overhead utility line structures. This manual is the result of a multiyear collaborative effort by engineers from electric utilities, consulting firms, and manufacturers engaged in the design and application of these structures.

Since the publication in 1987 of the ASCE *Guide for the Design and Use of Concrete Poles* and the 1994 ASCE-PCI Committee Report "Guide for the Design of Prestressed Concrete Poles," significant advancements and innovations have been realized in concrete pole design and manufacturing technologies. These advancements have propelled the use of concrete poles into an ever-increasing and significant role in the design and construction of overhead utility line structures.

Technological advances have occurred in three key areas. First, the types and quality of the raw materials used in the production of high-performance concrete have improved dramatically. Second, advanced manufacturing methods and equipment to produce high-quality, stronger, and longer length poles are being used. Third, with meaningful research and development (R&D) investment in the technology, significant and innovative enhancements to the engineering design technology of concrete poles are being developed. In addition to their use in distribution, subtransmission, or wood replacement applications, concrete poles are being designed and used in major transmission line projects up to and including 345kV and 500kV transmission lines.

Following is a brief summary of this manual's content:

Structural Configurations and Pole Applications: A variety of structural and phase wire configurations are needed by utilities to address different power line environments. A number of arrangements are

discussed and illustrated for common applications using prestressed concrete poles.

Initial Considerations: The purchaser should provide design specifications to assure the manufacturer designs and supplies a product meeting the intended need. Physical characteristics, structural loads, deflection limits, attachments, guying, climbing, grounding, transportation, construction environment, maintenance considerations, and more are discussed to assist in development of pole specifications.

Materials: A prestressed concrete pole is primarily high-strength concrete reinforced with prestressed and static steel components. Various other materials are used as attachments for supporting the power lines, grounding, climbing, and more. A structural material criterion is provided.

Design: More in-depth information and methodology for prestressed concrete pole design related to loads, connections, multipiece pole consideration, foundation type, material strength, deflection, capacity, linear, and nonlinear behavior is presented.

Connections: Properly configuring and designing attachment connections are critical to the design of a prestressed concrete pole. Conductor arms, brackets, insulators, guy attachments, grounding, and climbing provisions are some of the normal connection items requiring design. Many types of connections are illustrated along with further discussion on design considerations.

Foundations: Most prestressed concrete poles are directly embedded into the ground and backfilled. However, other options may be required based on the need or environment. These types of foundations are explained and design considerations discussed.

Manufacturing and Quality Assurance: Many of the basic principles related to manufacturing are very similar for both static-cast and spun-cast prestressed concrete poles. Production, tolerances, materials, concrete mix, curing, finishing, and quality assurance processes are outlined.

Assembly and Erection: Common practice is for concrete poles to be delivered full length. The pole length can exceed 100 ft or more. Some poles may need to be assembled if they are multipiece or framed structures. Handling, hauling, storing, assembling, erecting, climbing, construction environment, and other considerations are addressed.

Inspection, Maintenance, and Repair: Inspection of poles is important during the construction phase and through their service life. This portion of the manual discusses the common points of inspection, maintenance aspects, and repair considerations.

Structure Testing: A structural load test may be required to verify a pole design. This portion of the manual focuses on test facility

procedures, structure test configurations, loading and deflection criteria, and application and reporting requirements.

Supplements: This manual includes an Appendix section with sample purchaser technical specifications for both static- and spun-cast prestressed concrete poles and a methodology for selecting an appropriate concrete compressive strength for design. Other reference pages include a glossary and nomenclature listing.

Every effort has been made to ensure the accuracy and clarity of this information. The user is reminded that utility line structures are an integral part of a larger overhead line system. The user is therefore cautioned that the application of these structures should come only after sound engineering judgment has been applied. Furthermore, as an overall treatise covering a wide variety of line applications, this manual cannot conceivably comply with all conditions. The user should bear in mind that often there will be specific local conditions and requirements that may dictate design and usage conditions that differ from those described herein.

The task committee is grateful for the dedicated effort of all who participated in the development of this manual. The task committee also wishes to acknowledge the excellent work of prior committees of both ASCE and PCI, which have served to provide an excellent foundation for the development of this manual.

We also wish to extend our appreciation to the following contributors for the many photos, illustrations, graphs, and tables that further enhance the value of this manual for the reader. Contributors include Alabama Power Company, American Electric Power Company, CenterPoint Energy, Georgia Transmission Company, University of Alabama–Birmingham, and Valmont Newmark.