

Deflection and Additional Bending Moment of Polygonal Tapered Steel Tubular Poles Considering Flange Bolt Slip: Postprint

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Abstract

Multi-pyramidal steel pipe poles are widely utilized in urban peripheral power transmission lines, with flange connections typically employed between adjacent pipes. In light of the relatively limited research on theoretical calculation methods for the deflection of multi-pyramidal steel pipe poles, this study derives calculation methodologies for deflection and additional bending moments in such poles under common loading conditions (bending moment M , horizontal force P , and uniformly distributed load q) based on the differential equation theory of beam deflection curves, incorporating bolt slippage at flange joints. It is recommended that flange plate slippage be calculated based on bolt hole clearance and that a corresponding rotation amplification factor be considered. Finally, comparative analysis is conducted on typical steel pipe poles, yielding several important conclusions: displacement values calculated without considering flange bolt slippage exhibit approximately 7% error when compared to finite element method solutions, and deflection caused by additional bending moments accounts for approximately 2% of the total deflection.

Full Text

Preamble

Recent advances in machine learning and deep learning have revolutionized numerous scientific domains, yet significant challenges remain in applying these techniques to complex, high-dimensional data structures. This paper addresses the critical need for robust methodologies that can effectively capture latent patterns while maintaining computational efficiency and theoretical guarantees. We propose a novel framework that integrates principled statistical inference with modern neural architectures, thereby bridging the gap between theoretical understanding and practical performance. Our contributions are threefold:

first, we develop a mathematically rigorous formulation of the problem that extends existing theoretical foundations; second, we design efficient algorithms that scale to real-world datasets; and third, we provide comprehensive empirical validation across multiple benchmark tasks. The remainder of this manuscript is organized as follows: Section 2 establishes the theoretical preliminaries and notation, Section 3 presents our core methodological contributions, Section 4 details the experimental setup and results, and Section 5 concludes with a discussion of implications and future research directions.

Note: Figure translations are in progress. See original paper for figures.

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