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Machine Learning-Based Approach to Development of Simplified Wind Load Formula for Concrete Structures

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ABSTRACT

The complexity of wind load calculations arises from numerous parameters and assumptions between load factors and responses. This study focuses on developing simplified load equations to enhance practicality in structural wind engineering by eliminating variables and equations with low frequency of use, low practicality, and variability across diverse environments. Utilizing time-series wind pressure data provided by Tokyo Polytechnic University (Tamura 2012), finite element analysis was conducted, and equivalent static wind loads were determined based on the load-response-correlation method (Holmes 2002) (Fig. 1). To simplify code formulas while maintaining reliability and provide equations composed of variables, symbolic regression, a genetic algorithm-based machine learning technique, was employed using the pySR library (Cranmer 2023). This approach addresses the 'black box' problem, a drawback of many models including deep learning.

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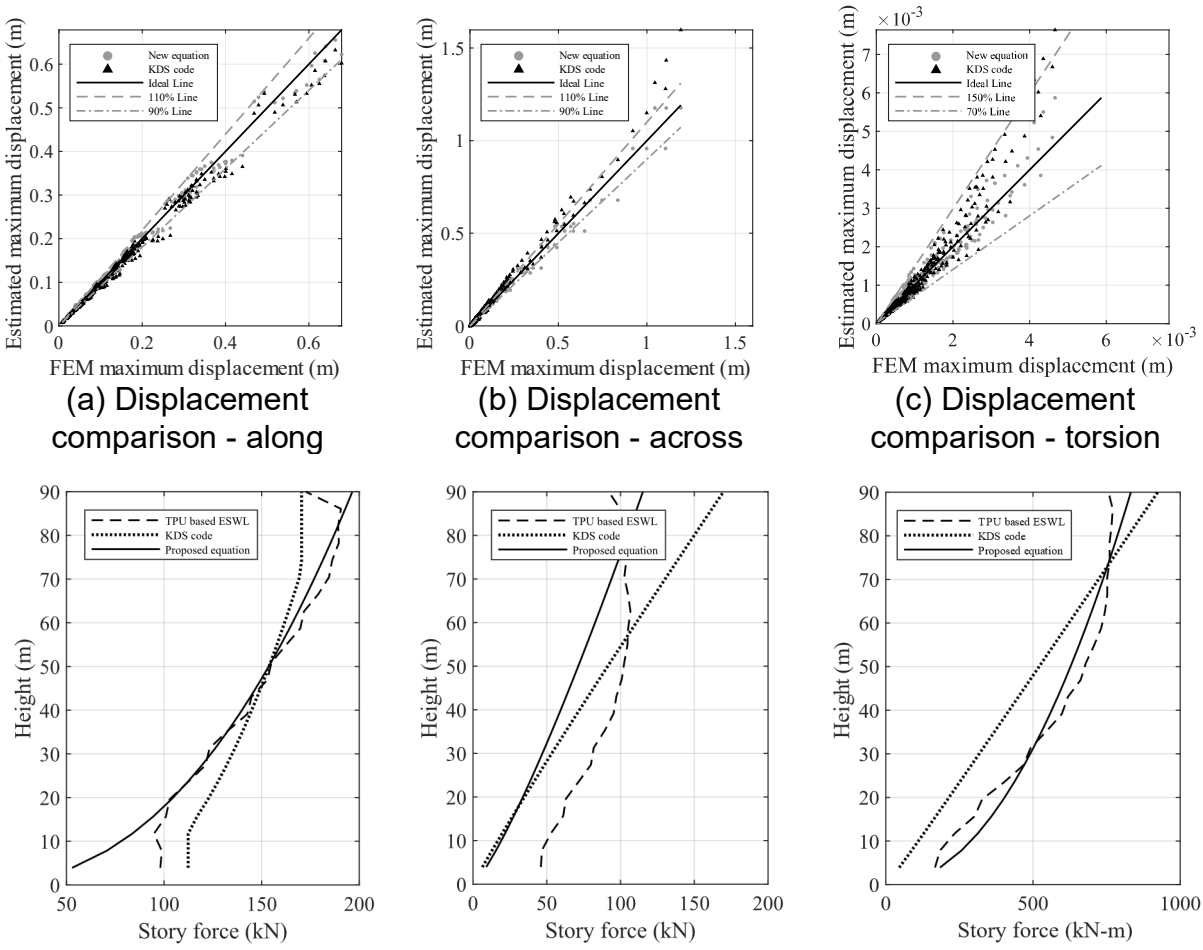

(a) Displacement comparison - along (b) Displacement comparison - across (c) Displacement comparison - torsion

(d) Story force - along (e) Story force - across (f) Story force - torsion

Fig. 1 Comparison of top floor displacements and story shear forces: wind tunnel test, KDS code, and proposed equation

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