DESIGN AND PERFORMANCE OF TALL BUILDINGS FOR WIND

ASCE MANUALS AND REPORTS ON ENGINEERING PRACTICE NO. 143

EDITED BY PREETAM BISWAS
JOHN PERONTO



TASK COMMITTEE FOR THE DESIGN AND PERFORMANCE OF TALL BUILDINGS FOR WIND

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Edited by Preetam Biswas and John Peronto

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In February 1962 (and revised in April 1982), the Board of Direction voted to establish a series titled "Manuals and Reports on Engineering Practice," to include the manuals published and authorized to date, future Manuals of Professional Practice, and Reports on Engineering Practice. All such manual or report material of the Society would have been refereed in a manner approved by the Board Committee on Publications and would be bound, with applicable discussion, in books similar to past manuals. Numbering would be consecutive and would be a continuation of present manual numbers. In some cases of joint committee reports, bypassing of journal publications may be authorized.

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PREFACE

The Tall Buildings Committee of the Structural Engineering Institute of the American Society of Civil Engineers comprises senior leaders active in the field of tall buildings from both industry-leading professional consulting firms and academic institutions. The goal of this committee is to publish an industry consensus manual of practice that provides guidelines on the design and performance of tall buildings for wind effects. This publication provides recommendations and guidance on tall building design industry standard practice and approaches to complement current literature, model codes, and other standards. This publication should be used in conjunction with local building codes and considered a current consensus document developed by industry leaders for the design and performance of tall buildings for wind effects. However, it is the opinion of the committee that this consensus will evolve over time and as the industry advances.

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CHAPTER 1
INTRODUCTION

1.1 PURPOSE

This Manual of Practice is intended to provide best-practice guidelines for the design of tall buildings for wind. Current building codes and design standards focus primarily on strength design for ultimate wind loads, offering little guidance related to the evaluation and establishment of acceptance criteria for tall building performance under varying levels of wind effects. As such, current design practice varies widely across the industry. The goal of this document is to promote consistency and best practices within the industry for the design of tall buildings for wind. It is envisioned to apply to buildings with height greater than 120 m (400 ft) and/or a height to width aspect ratio greater than 5:1.

1.2 SCOPE

The design recommendations provided in this manual are primarily focused on the wind design of building structures that are especially tall, slender, and/or prone to wind-induced movement. A discussion of both static and dynamic approaches to wind design are presented in subsequent chapters. Wind design performance objectives are achieved by

- Ensuring structural integrity under ultimate loads;
- Limiting lateral deflections under service loads to prevent permanent deformations, damage to nonstructural elements, or adverse effects on the serviceability of the building's services and vertical transportation systems;

- Preventing excessive wind-induced motions, as well as visual and acoustical disturbances that may impact occupant comfort;
- Limiting surface wind intensity to improve pedestrian comfort; and
- Achieving these objectives while working to minimize structural materials and associated embodied carbon and cost.

The manual provides recommendations on achieving the aforementioned performance objectives, including the selection of the wind loading mean recurrence interval (MRI) for serviceability, the establishment of acceptance criteria, guidance on addressing uncertainty in building structural properties such as stiffness and damping, as well as modeling of uncertainties in wind climate, wind loading, and other effects.

A concurrent effort to this Manual of Practice is the ASCE/SEI *Prestandard for Performance-Based Wind Design* (ASCE 2019). The Prestandard provides a performance-based approach for the design of buildings for wind to help resolve the conflicts in performance objectives that exist in using prescriptive procedures for the wind design and performance-based approach for the seismic design of individual buildings. Among other things, the Prestandard will introduce the use of nonlinear dynamic analysis for wind design and limited nonlinearity in the main wind force resisting system elements. Both these topics are outside the scope of this manual.

1.3 USE OF THIS MANUAL

This manual is compatible with the requirements of ASCE 7-16 (ASCE 2017) for the determination of wind loads and provides additional guidelines beyond the building code for the establishment and evaluation of performance objectives when designing tall buildings.

The chapters are ordered in a manner that closely resembles the typical design approach for a tall building. This usually involves the establishment of performance objectives and completion of a preliminary structural design using code-based wind loads, followed by a more detailed assessment of the wind climate and wind-induced response through wind tunnel testing. The results of the wind tunnel testing program are then used to refine the preliminary design and complete the final design and construction documents.

To the extent possible, the chapters are written in a self-contained format to allow ease of reference regarding specific topics. Significant topics, such as damping, have dedicated chapters and are cross-referenced from other chapters to avoid duplicating information.