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Spotlight on *Structures*

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Best Research Paper

Experimental investigation of wind effects on a 282-meter-high tower with complex aerodynamic shapes based on a rigid model and multi-degree-of-freedom aeroelastic model

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Slender and flexible high-rise structures are very sensitive to large wind-induced vibration phenomena such as vortex-induced vibration and galloping under strong winds. However, pressure measurements on rigid models cannot consider coupling aeroelastic effects, and single-degree-of-freedom aeroelastic model wind tunnel tests can only consider the contribution of the first-order linear mode. For wind-sensitive structures with complex aerodynamic shapes, the effect of higher-order modes on the wind-induced response may not be ignored. In this study, a series of multi-degree-of-freedom (MDOF) aeroelastic model wind tunnel tests and pressure measurements of a rigid model were conducted to comparatively investigate the wind effects of a 282m-high tower with complex aerodynamic shapes. A detailed analysis of the aeroelastic effects on the high-rise tower is presented, and the effects of the structural damping ratio, wind speed, and wind direction are also discussed. The results show that the variation trends of the peak acceleration responses are generally consistent, while in those wind-sensitive directions (165-degree wind direction), the peak acceleration responses of the MDOF model are almost 1.5 times larger than those of the rigid model, indicating that the aeroelastic effects are remarkable. The corresponding response spectral peak values of the MDOF model are significantly larger than those of the rigid model by a factor of more than 3 and the correlations of responses in the two orthogonal directions also increase greatly by 43.5%. However, the 'set-back' aerodynamic shape (180-degree wind direction) can considerably weaken aeroelastic effects and the peak acceleration responses are close to those of the rigid model. The generalised aerodynamic force spectrum also shows broadband features, implying its superior aerodynamic performance. The comfort assessments for different structural damping ratios are conducted based on various codes and criteria, suggesting that the structural damping ratio should be larger than 3%. The equivalent static wind loads on the upper floors are notably affected by aeroelastic effects while the lower floors are relatively insensitive. This study provides a detailed perspective of the aeroelastic effect for slender tower, and hence facilitates the wind-resistant design of flexible structures.

→| Read the full paper at **https://doi.org/10.1016/j.istruc.2023.03.033**

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Best Research into Practice Paper

Pull-out resistance of stud groups embedded in concrete
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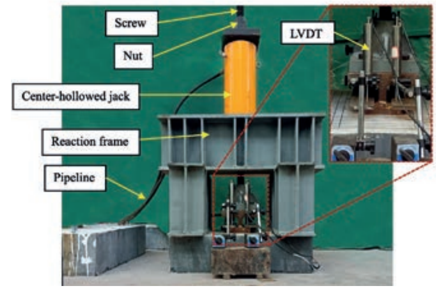
This paper experimentally and numerically investigated the pull-out behaviour of stud groups embedded in concrete. Seven groups of pull-out tests were conducted to study the effect of the arrangement (i.e. single row and matrix) and spacing on the pull-out resistance. Results from the tests indicated that the strength reduction factor considering the group effect increased with increasing spacing (when the ratio to depth is less than 3.0) and was influenced by the arrangement. A detailed finite element (FE) model was also developed and benchmarked. The benchmarked model was then used to investigate: (i) the effect of the concrete strength and the number, spacing, and arrangement of studs, (ii) the force distribution among studs, and (iii) the tensile stress distribution along the concrete failure surface. Results from the FE analyses showed that the force resisted by the external stud was greater than the internal stud, and the stress decreased from the stud head to the concrete surface. Finally, a new design equation for estimating the pull-out resistance of stud groups was proposed.



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Read the latest issue

The Featured Article for Volume 62 of *Structures* is now available. Mario D'Aniello, Associate Editor, has selected a review paper on the current research into progressive collapse on building structures.

This article is available to read free of charge.

Editor's Featured Article

Progressive collapse: Past, present, future and beyond
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The world has seen a surge in rigorous study efforts on the progressive collapse of structures in the past few decades. These events have led to new standards and provisions in building codes of practice, many of which are still being developed and updated today. Although there have been some excellent reviews covering different aspects of progressive collapse, the sheer volume of research performed in this area in recent years means that highly relevant investigation methods and research findings are not covered by them. To fill this void, this review article aims to provide an up-to-date and comprehensive overview of progressive collapse research on building structures. The review is organised into eight sections that cover: (1) essential background information; (2) prominent collapse cases; (3) progressive collapse typology; (4) design standards; (5) investigation methods; (6) prevention and mitigation strategies; (7) structural types and characteristics that require special consideration; and (8) future research needs.

In addition to the fundamental concepts, this review encompasses recent advances, such as employing physics and game engines, and machine learning to study progressive collapse. It also explores the potential future applications of these new concepts in research. Furthermore, the review emphasises recent progress in improving the robustness of timber and modular structures. Therefore, this review provides a crucial resource to acquire a global overview of current state-of-the-art progressive collapse research and future requirements, making it valuable to both novice and experienced practitioners and researchers.

→| Read the full paper at **https://doi.org/10.1016/j.istruc.2024.106131**