The impact on structural embodied carbon of using loads obtained from wind tunnel testing vs code-based loads

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Abstract

RWDI possesses one of the world's most extensive portfolios of data from structural wind tunnel tests. Drawing upon our wealth of experience, RWDI has carried out studies to compare wind loads achieved by undertaking site-specific wind tunnel tests against values obtained using an analytical code-based approach. In one of the studies, the peak overturning moments of ten prominent tall buildings in the UK were estimated from wind tunnel tests conducted by RWDI. Comparing these loads against values based on Eurocode and the UK National Annex, wind tunnel testing led to an average 35% reduction in wind loads for structural design. The loading reduction is attributed to various important factors that are elaborated further in this paper. In addition, notable UK and worldwide case studies are presented to demonstrate the benefits of wind tunnel testing in delivering more optimised structures and contributing to the reduction of embodied carbon.

Keywords: wind tunnel testing; code-based approach; wind loading; high-rise buildings; concrete and steel buildings; structural wind loads; wind-induced accelerations; embodied carbon footprint.

1 Introduction

With the increasing cost of construction materials and a move towards reducing the construction industry's carbon footprint, there is an increasing requirement for a building's structural system to be as efficient as possible. While accounting for a smaller proportion than the *operational carbon*, reducing the **embodied carbon** associated with building materials and construction is critical to achieving Net Zero targets.

Lateral **wind loads** govern the structural design of high-rise buildings in the UK and affect various critical elements such as shear walls, cores, and the layout of columns. Having a good estimate of wind loads acting on a building that are based on site-specific conditions becomes more critical than ever, to optimising the structural design, allowing efficient usage of materials and contributing to the overall reduction of carbon footprint.

Structural wind loads can be significantly affected by various parameters, including the building geometry and surrounding buildings. Wind loads for the structural design of tall buildings are often initially determined using analytical code-based analysis, such as the Eurocode (BS EN 1991-1-