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Wind

Certain cities are inherently windier than others. The wind environment within a city is influenced by:

- the wind characteristics of the region the city is part of
- the characteristics of the terrain beyond the city boundary
- the morphology of the terrain as well as the presence of any topographical features within the boundary of the city itself
- the alignment / misalignment of major roads with respect to the prevailing wind directions
- urban vegetation
- and by the density, orientation and layout of the buildings within the city boundary.

From a wind environment perspective, in high-density cities and mega-cities where 'day-to-day' winds are typically benign (e.g. Hong Kong), the main goal of designers is to ensure that the massing of new developments is specifically tailored to enhance and promote air ventilation at street level so that areas of stagnant contaminated and / or polluted air can be avoided [1]. On the other hand, in cities where 'day-to-day' winds can be moderately high (e.g. UK), the addition of a new building development has the potential to have a negative impact on the wind microclimate conditions within the urban fabric itself. This is particularly relevant for buildings which are taller than their surroundings. Stronger winds impacting the upper portion of a high-rise (or a cluster thereof) can in fact downdraught to street level, accelerate around building corners and / or through restrictions between buildings. This can cause localised regions of relatively high wind speeds that can detrimentally impact planned pedestrian activities and, even, reputation or commercial success of a development with reduced footfall for extended periods.

Historically, pedestrian level wind conditions within and in the vicinity of a new building development have been assessed, studied, and mitigated using experimental wind tunnel testing. For the more complex and challenging schemes, to achieve comfortable and safe pedestrian level wind conditions, a series of wind tunnel workshop sessions are often required. These are interactive sessions conducted in a wind tunnel facility where wind specialists guide the wider design team on the development of bespoke and site-specific aerodynamic solutions that can lessen the impact of the new building development [2].

In more recent years, the drive for shortening the building form development cycle time has generated an 'optioneering space' where database-assisted advice, data-driven approaches, machine learning-based assessments as well as computational wind studies using computational fluid dynamics (CFD) software [computational wind engineering (CWE)] have started to play a much more important role during the feasibility and conceptual stages of a project. This space allows for a much larger number of design options to be investigated in a much shorter period with wind-related risks better managed right at the start of the project (when the design is still fluent) leaving confirmatory wind tunnel tests for a later stage [Figure 1].

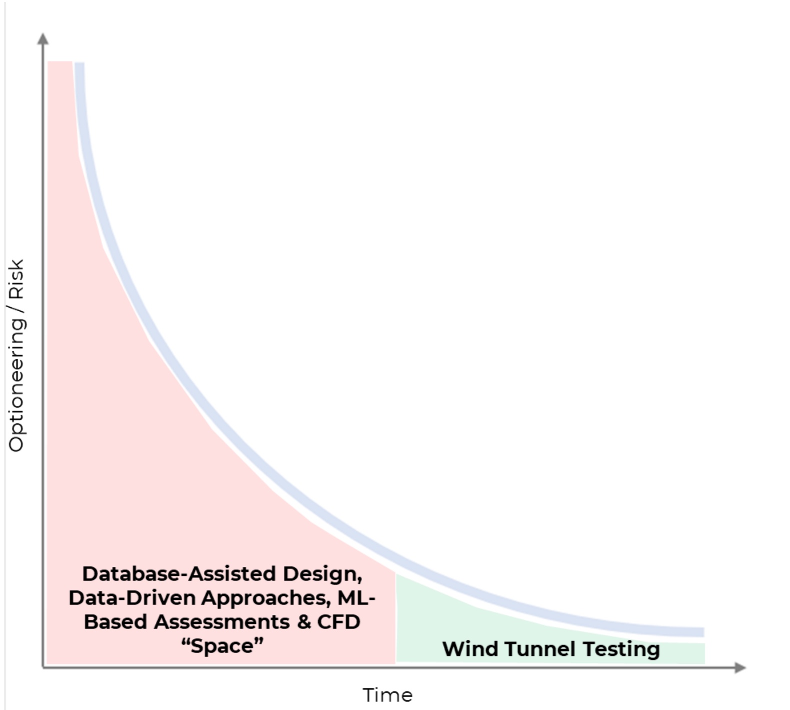

Figure 1: Shortened building form development cycle time

The importance of CWE in the context of urban wind microclimate has been recognised by the UK Wind Engineering Society [3] as well as by the City of London Corporation [4].

References

1. Cammelli and Wong (2016). Urban ventilation design for megacities: Hong Kong and beyond. Proceedings of the Institution of Civil Engineers - Civil Engineering, Volume 169, Issue 6, November, pp. 35-40.
2. Cammelli and Stanfield (2017). Meeting the challenges of planning policy for wind microclimate of high-rise developments in London. Procedia Engineering, Volume 198, 43–51.
3. UK Wind Engineering Society (2022). A position paper on experimental and computational methods in wind engineering. ISBN 978-1-7396424-0-2
4. City of London Corporation (2019). Wind microclimate guidelines for developments in the City of London.

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