

## Review of wind tunnel tests of Lotte World Tower

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### Summary

Lotte World Tower which is a super tall building with about 555m height (123 stores) has been under construction in Seoul, Korea. When the Lotte World Tower is constructed, it will become the highest building in East Asia. Generally, super tall buildings shall be checked for vortex-induced vibration and aeroelastic instability by the appropriate methods such as wind tunnel tests. The wind tunnel tests on the Lotte World Tower were conducted by RWDI. Wind tunnel tests were performed to determine the structural wind loads and building motions by high frequency force balance (HFFB) test, and local wind loads on cladding of the building by pressure measurement test, respectively. To evaluate the habitability of the building, acceleration responses at specific structural levels were compared with present acceleration criteria from International Organization for Standardization (ISO 10137: 2007) criteria, Architectural Institute of Japan (AIJ 2004) guidelines, and RWDI's criteria. Those results for Lotte World Tower were reviewed and discussed in this paper.

**Keywords:** Lotte World Tower, wind-tunnel tests, design wind loads, habitability, tall buildings, skyscrapers

### 1. Introduction

Improved structural design systems and construction methods as well as enhanced structural material strengths have enabled construction of increasingly tall buildings. Further, urbanization has accelerated demand for tall buildings, and the incidence of tall buildings is increasing in various countries.

When the Lotte World Tower in Seoul, South Korea is constructed, it will be one of the tallest buildings in the world. The tower will be 555 metres (123 stories) tall tapering gently from a wider base. The shape of the tower is also manipulated starting off with a square floor-plate of 70 x 70 metres and gradually morphing into a circular 40 metre one as height progresses.

Such tall buildings are among the more wind-sensitive of structures, and are vulnerable to lateral forces such as dynamic response and extreme local cladding pressure. The dynamic response in along-wind, across-wind and torsional modes are a feature of the overall structural loads. Extreme local cladding pressures may be experienced on their side walls. In addition, Serviceability problems may arise from excessive motion near the top of tall buildings. Thus, tall buildings shall be checked for vortex-induced vibration and aeroelastic instability by the appropriate methods such as wind tunnel tests and full scale experiments. The first major boundary-layer wind tunnel study of a tall building was that carried out for the twin towers of the World Trade Center, New York, in the mid 1960s, at Colorado State University. This was the first of many commercial studies, now numbering in thousands, in boundary layer wind tunnels [1].

The objective of this paper is to review the results of structural wind loads, and cladding wind loads on Lotte World Tower obtained by boundary layer wind tunnel tests of Rowan Williams Davies & Irwin Inc. (RWDI). To evaluate the habitability of Lotte World Tower, the accelerations at specific structural levels were compared with present acceleration criteria of International Organization for Standardization (ISO 10137: 2007) [2], Architectural Institute of Japan (AIJ 2004) [3], and RWDI.