*The 2024 World Congress on*
***The 2024 Structures Congress (Structures24)***
*19-22, August, 2024, The K hotel, Seoul, Korea*

# Experimental investigation on the aerodynamic force and pressure on rectangular section with side ratio of 3:2 under accelerating flow

*Xiu-Yu CHEN[1)], Zheng-Wei CHEN[2)], Yi-Qing NI[3)], Zhong-Xu TAN[4)] and Le-Dong ZHU[5)]

[1), 2), 3)] *Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong, People's Republic of China*
[1), 2), 3)] *National Rail Transit Electrification and Automation Engineering Technology Research Center (Hong Kong Branch), Hong Kong, People's Republic of China*
[4), 5)] *Department of Bridge Engineering, College of Civil Engineering, Tongji University, Shang Hai, People's Republic of China*
[1)] xiuyu.chen@polyu.edu.hk

## ABSTRACT

Downbursts and tornadoes are very common wind hazards characterized by accelerating airflow that suddenly increases in wind velocity, causing significant structural damage and property losses. This acceleration of airflow induces overshoot and unsteady characteristics in structural aerodynamic force. However, so far there is very little research on the mechanism of the overshoot phenomenon. In this study, direct measurement of aerodynamic pressure on a sectional model of rectangular cross-section with a side ratio of 3:2 was conducted under various accelerating flow conditions. The findings reveal that the unsteady characteristic of lift force is more pronounced than that of drag force, particularly at a wind attack angle of 10 degrees. Through the analysis of surface pressure on the section at representative wind attack angles of 0 and 10 degrees, the underlying mechanism of the unsteady effect of accelerating flow on aerodynamic force is explored. At a wind attack angle of 0 degrees, the amplitude of lift forces is smaller than quasi-steady values, attributed to the increased correlation of pressure on two side faces with the same streamwise coordinate. At a wind attack angle of 10 degrees, lift reverses in the early acceleration stage due to the reattachment of the separated vortex on the lower side face and enhanced vortex shedding intensity on the upper side face. Moreover, increasing starting wind velocity reduces the unsteady characteristics of lift under accelerating flow at wind attack angle of 10 degrees by eliminating the reattachment of separated vortex.

---

[1)] Research Associate
[2)] Research Assistant Professor
[3)] Chief Professor
[4)] Research Assistant Professor
[5)] Professor