Department of
Mechanical Engineering
The University of Hong Kong

DEPARTMENT OF MECHANICAL ENGINEERING
THE UNIVERSITY OF HONG KONG

SEMINAR

Scaling Problem in Urban Airflow Modelling

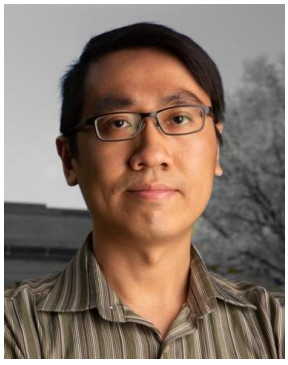
Date: 28 July, 2023 (Friday)
Time: 3:30 p.m. to 5:00 p.m.
Venue: CPD-1.21, Centennial Campus
HKU

Speaker: Assistant Prof. CHEW Lup Wai
Airflow-Buildings-Cities Laboratory
Department of the Built Environment
College of Design and Engineering
National University of Singapore
Singapore

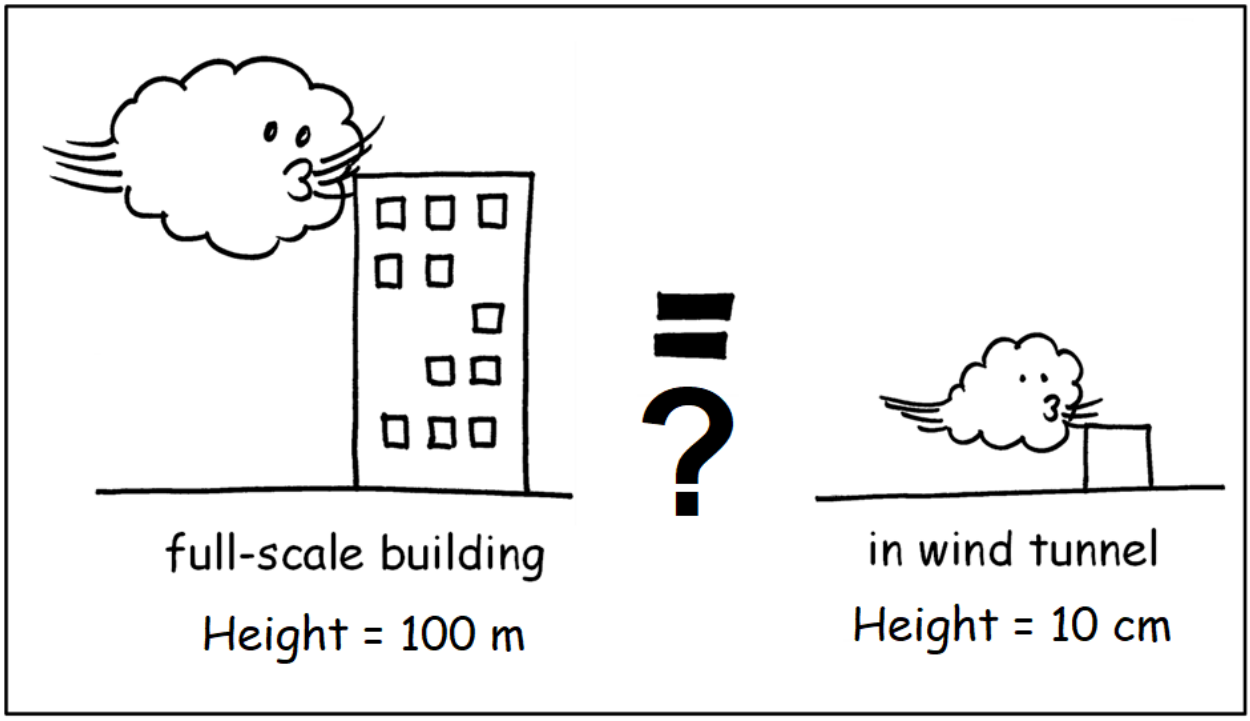
Abstract:

Ever wondered why we can study airflows across buildings using scaled-down models to represent real, full-size buildings? This seminar discusses two mistakes we have been making in the research of urban airflow modelling. Airflows across buildings are characterized by the Reynolds number, $Re = UH/\nu$, where U is a reference wind speed, H is building height and ν is air kinematic viscosity. Full-scale buildings have H ranges from a few meters to hundreds of meters, with corresponding Re on the order of 10^6 to 10^7. However, in wind tunnel experiments, building models have H on the order of centimetres, with corresponding Re on the order of 10^3 to 10^4, much lower than the Re at full scale. This mismatch of Re between reduced scale and full scale is circumvented by the Re-independent assumption, which allows us to study airflows across buildings at reduced scale in wind tunnels and apply the results to full-scale buildings. Using both experiments and computational fluid dynamics, I will show that the commonly adopted Re-independent assumption is valid only in simple cases, e.g., isothermal flows across a single building. Generalizing this assumption to cases with multiple buildings or flows with heat transfer can introduce significant errors and lead to wrong prediction of the entire wind field around buildings. Potential mitigation strategies to the issue of Re mismatch will be proposed and discussed.

Biography:



Dr. Chew Lup Wai is an Assistant Professor in the Department of the Built Environment, College of Design and Engineering at the National University of Singapore (NUS). He is the principal investigator of the Airflow-Buildings-Cities Laboratory at NUS (https://blog.nus.edu.sg/lupwai). He obtained his PhD in Mechanical Engineering from Massachusetts Institute of Technology. Prior to NUS, he worked as a postdoctoral scholar at Stanford University. His specialization lies in urban airflow modelling, focusing on natural ventilation, outdoor wind field, and the physics of flows, using both experimental and numerical approaches. In his free time, he enjoys reading, painting and traveling.



ALL INTERESTED ARE WELCOME

For further information, please contact
Dr. C.-H. Liu at 3917 7901 or chliu@hku.hk.