Title: Short- and long-range transmission of SARS-CoV-2

Prof. Yuguo Li
Department of Mechanical Engineering, the University of Hong Kong

Abstract

Although inhalation transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has already been acknowledged by leading health authorities, our understanding remains large incomplete. No existing standard for building ventilation yet considers the need to control respiratory infection. Our preliminary studies so fat appear to have explained why outdoor generally has a lower infection risk than indoor spaces, and why poor ventilation worsens both short- and long-range airborne transmission. I hope to present some simple models for short-range airborne transmission that offer some novel insights on the paired roles of social distancing and ventilation/masking/filtration.

Title: Will COVID-19 change the way we control airborne transmission of respiratory infections?

Distinguished Prof. Lidia Morawska
School of Earth and Atmospheric Sciences, the Queensland University of Technology (QUT)

Abstract

Abstract: The COVID-19 pandemic has demonstrated how ill-prepared the world has been to address the basic question: How can we minimise the risk of airborne infection transmission for any respiratory viruses in a countless number of buildings where most of the population spends a substantial fraction of the day. We need a profound change in how we view this risk and how we apply science, building engineering solutions and public health policies to reduce it. But in doing this we need to consider all other requirements, including comfort and the control of indoor air quality, and energy-efficiency in the context of local climate and outdoor air quality. The presentation will explore how to turn this vision into a reality.

Title: Airflow and airborne diseases transmission characteristics in the microenvironment of a human body

Prof. Naiping Gao
College of Mechanical Engineering, Tongji University

Abstract

The outbreak of COVID-19 throughout the world has drawn attention to indoor airborne transmission of suspended viruses. The spread of droplets and viruses exhaled by the occupants could be divided into the first-stage transport close to the human body and the second-stage dissemination at a long distance. The first-stage transport is mainly affected by the exhaled characteristics and the microenvironment around the body, and the second-stage is mainly influenced by the room ventilation airflow. This talk mainly introduces the study on the characteristics of airflow in the microenvironment surrounding the human body, and analyzes the first-stage close-range transmission between occupants. Through adopting numerical thermal manikin and computational fluid dynamics simulations, the interaction among the personnel thermal plume, the respiratory airflow, and the personalized airflow is obtained and its effect on short-range transmission is analyzed.

Title: Countermeasures against the SARS-CoV-2 in built environment

Prof. U Yanagi
Department of Architecture, Kogakuin University

Abstract

Infectious diseases occur when three elements (infectious agents, susceptible persons and transmission routes) overlap, and a susceptible person is exposed to an amount of pathogen that exceeds the threshold of dose-response relationship. Covid-19 is a respiratory infection, and its transmission routes include direct and indirect contact, droplet, and aerosol. Primary engineering mitigation strategies for respiratory infections are countermeasures against aerosol transmission route. Since the droplets released from an infected person contain water, and particle shrinkage caused by water evaporation in the environment, aerosol particles form various diameter. In addition, the survival time of SARS-CoV-2 in the air is affected by the temperature, humidity, and germicidal UV (GUV) in built environment. This lecture mainly describes engineering mitigation strategies of ventilation, central filtration, local filtration, and GUV in Japan.

Title: Ventilation as engineering control measure to reduce COVID-19 airborne transmission – REHVA guidance

Prof. Jarek Kurnitski
Department of Civil Engineering and Architecture, Tallinn University of Technology

Abstract

New evidence on SARS-CoV-2 airborne transmission has made ventilation measures the most important engineering controls in the environmental infection control. Adequate ventilation, air filtration and effective air distribution help to reduce especially long-range aerosol transmission. The presentation will discuss how to operate HVAC in existing buildings during an epidemic, and what would be more far-reaching actions to further reduce the spread of viral diseases in future in buildings with improved ventilation systems. This includes infection risk based ventilation design to control the event reproduction number, that could lead to higher ventilation rates than the current ventilation criteria based on perceived air quality. Finally, recent evidence on relative humidity effects on infection risks are discussed.

Title: Key droplet sizes mediating the airborne and droplet-borne transmission of respiratory infections

Assoc. Prof. Jianjian Wei
College of Energy Engineering, Zhejiang University

Abstract

Exposure to respiratory droplets does not guarantee infection. By utilization of impactors, we designed a pioneering animal exposure apparatus that is able to separate smaller droplets from larger ones in a controllable manner. Ferret experiments show that droplets below 5 μm in diameter are also important in transmitting H1N1 subtype of influenza, while the transmission of H3N2 subtype is mainly mediated by droplets larger than 5 μm. On the other hand, droplet deposition characteristics inside the respiratory tract during exhalation were investigated by CFD simulations, showing that the maximum size of droplets released from the lower respiratory tract or around the vocal cord and able to escape into external environments is 20 μm; larger droplets may originate from the oral cavity with lower viral loads. Key droplet sizes mediating the transmission of respiratory infections is worth further investigation, which is the prerequisite to take efficient control measures.

Title: Assessment of exposure to infectious aerosol particles using a respiratory aerosol simulator

Assist. Prof. Masayuki Ogata
Department of Architecture, Tokyo Metropolitan University

Assoc. Prof. Yoshihide Yamamoto
Department of Architecture, Tokyo Polytechnic University

Abstract

Through the response to the SARS-CoV-2 from 2020 to the present, the importance of indoor environmental control measures, mainly ventilation and filtration, against respiratory tract infections have become widely recognized. In this talk, we shall describe the results of an experiment to evaluate the exposure to aerosol particles and droplets using a simulated cough generator after organizing the infection transmission routes by modes of exposure. Our research aims to evaluate and improve the effectiveness of existing infection control measures and propose practical countermeasures and guidelines for the design of future building facilities based on a comprehensive infection risk assessment based on exposure to aerosol particles that cause infection.