Transmission Pattern of Aerosol from Rooftop Ventilation Pipe in Residential Building in Hong Kong under Different Air Velocity

Mr WONG Wang Yan, BEng (Hons) in Building Services Engineering,
Faculty of Science and Technology
Supervisor: Dr ZHOU Yang Phil, Lecturer

1 Introduction

This project investigates the phenomenon of COVID-19 ventilation pipes and vertical transmissions in residential buildings in Hong Kong, where a pattern of COVID-19 spreading across the storeys can often occur.

2 Objectives

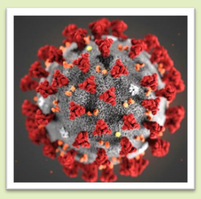
1. Review similar literature in the aerosol transmission that investigates the hypothesis
2. Identify the aerosol spread pattern on the roof of residential building
3. Investigate the implications of air velocity on the pattern of aerosol transmission

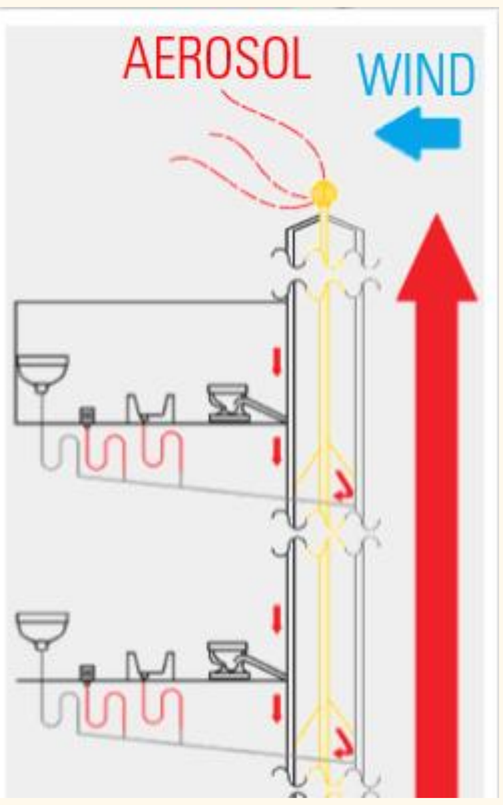
3 Background

The COVID-19 pandemic in Hong Kong began since the first confirmation of infection on 23 Jan 2020, caused by a new coronavirus named “SARS-CoV-2”. A cumulative number of the infected was up to 1,660,455 cases, 13,120 deaths (since 2021 to 29 Jan 2023), and 9,238 buildings had cases. It also severely impacted various sectors in Hong Kong.

Characteristics of COVID-19:

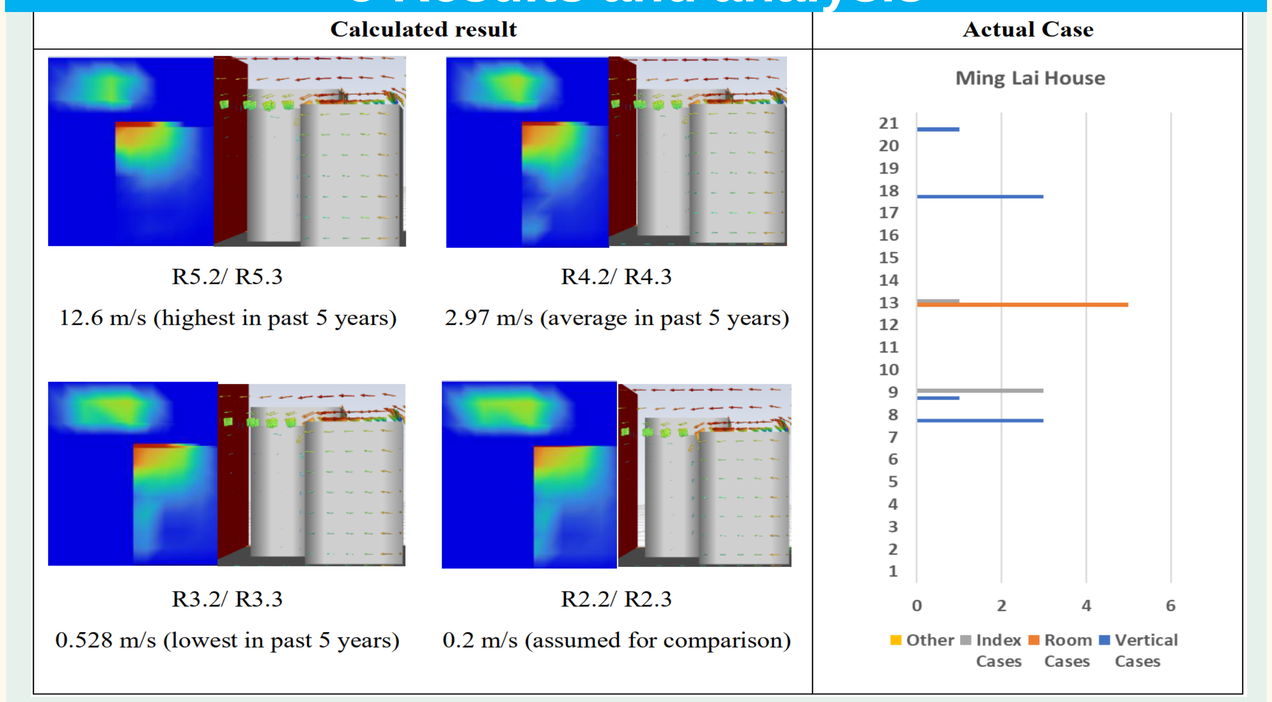
- **Very contagious,**
- **Airborne,**
- **Lethal,**
- **Can be transmitted via. bodily fluids (including feces, spit, etc.)**





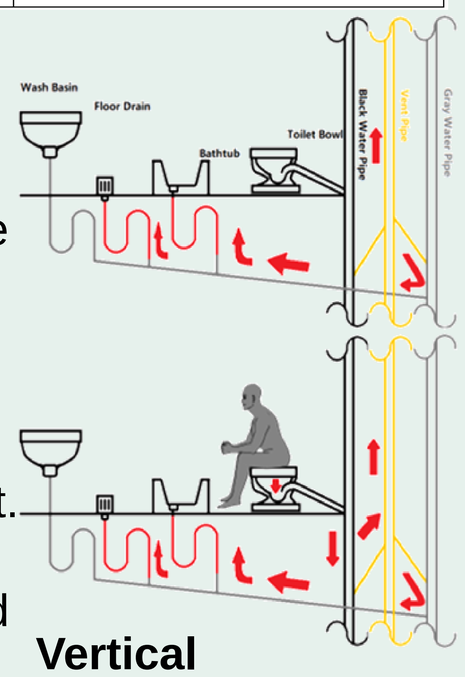
Drainage system &
Rooftop ventilation pipe
Aerosol affected by air velocity

5 Results and analysis



Based on the simulation results and literature reviews conducted:

1. The lower the air velocity, the higher the affected building surface area and concentration of aerosol.
2. The vertical transmission is affected by the drainage stack, architectural design, indoor negative pressure, and stack effect.
3. Latent virus fecal aerosol can be transmitted via the exhaust fan and ventilating pipe.



Vertical transmission via. drainage systems

6 Conclusion

In a **low air velocity** environment, the **ventilation pipe and vertical transmission** in residential building **is the most severe**. Apart from the effects of air velocity in vertical transmission, the **drainage stack, architectural design, indoor negative pressure, and stack effect** are considered the **major factors in the transmission of latent virus aerosol**.

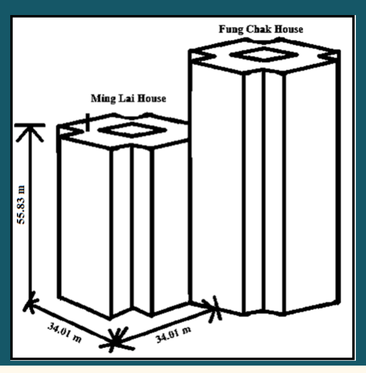
4 Methodologies

- Conducting a Literature Review
- Conduct Computational Fluid Dynamic Simulation (CFD) using Ansys Fluent

Preparation

Gather information:

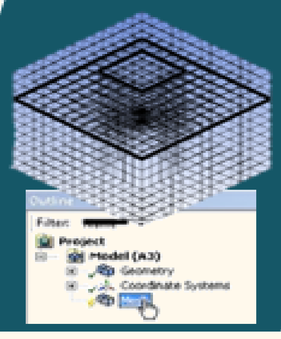
- Air velocity
- Floor plans (Ming Lai House)
- Ansys Fluent manual



Develop the Geometry

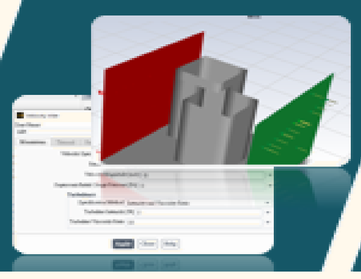
- Develop the 3D model in Design Modeler

Generate the Mesh



Setup and calculate

- Input the air velocity,
- ventilation outlet flow rate



Obtain result for analysis