Feel free to interrupt me and ask any questions.

1. Quick updates on my computational models

2. Research framework,

Two computational models and two experiments.

3. First model is simple model, runs fast 1d heat equation for volume-averaged quantities

4. For validation, we measure ACH in the target house.

I am currently focusing on the Outfall house.

5. Let’s move to my model and the way I use your field experiment to validate my model.

As the model is simple, I only consider the field measurements with only two openings among all of them.

This is because the model is low fidelity, and the more the ventilation gets complex, the more inaccurate the model prediction.

I first export weather data from the weather station in Dhaka airport, outdoor temperature and solar radiation data.

Using the data as inputs, the governing equation is solved. The equation is one dimensional heat equation includes all heat transfers occurring in a house, such as thermal conduction, convection, radiation and heat exchange by air change.

The we will have the prediction of our quantity of interest in a time period. For this case, our quantity of interest is ACH of the outfall house.

6. However, there are several uncertainties that associated with the governing equation. So we propagate uncertainties that are in the model. Combining with UQ, the computational model predicts the mean and confidence interval of our QoI.

7. To validate this result, we compare it to the ACH experiment you conduct.

Since the value is the ventilation at one time point.

The result is compared at the exact time.

8. This is the result.

I am showing you the comparison between the field measurement and model predictions.

I assumed the buoyancy dominates. Wind-driven ventilation is not included in this model for now.

We have 14 ACH measurement in the configurations with two openings and I have 14 predictions.

9. First, if you look at the lower left corner, the model prediction compares pretty well with the experiment.

10. Second, there are two outliers, which the model over-predicted than the measurement.

These two samples are both the case with window and skylight open.

The discrepancies between the measurement and model prediction can be explained by these factors.

11, 12. To explain these discrepancies I will introduce field experiments

13. This is the measurement setup.

I have briefly introduced the result previously but want to show you more.

The experiment were conducted for a week,

* I used thermocouples for temperature measurement, 5 spatial locations at 2 different heights.
* Sonic anemometer for wind speed and direction at roof height
* Hot wires for volume flow rate at openings.

14. Time evolution of temperature in the day among the 7 days of results.

15. I want to point out two things.

* First one is the temperature gradient. For additional measurement, we need to use a fan just for mixing, not keep it on during the entire measurement.
* Second the temperature pattern. Difference in temperature patterns between the day and night. As I got some results during nighttimes, I will run some results and get them back with you probably next meeting.
* And I am planning another temperature measurement and visit Bangladesh over winter. Since it is more appropriate for the temperature measurement.

There were possibility that rain may affect the temperature measurement.

So I am thinking winter is better season.

16. Next thing is wind and volume flow rate measurement.

I got wind speed and direction at the roof height with sonic anemometer.

And volume flow rates at two openings.

Here are the results: there are some discontinuities due to technical issues.

Power was kind of unstable

What we can learn from the measurement are :

They both capture peaks in common, this is fluctuating component, so

If we average them, they will become insignificant.

17. However we wanted to understand the wind-driven ventilation in the area

We utilized high fidelity model as it provides more accurate solutions in 3D domain.

18. Here is the setup, the model considers only wind-driven ventilation for now. And

19.Preliminary results: flow pattern around the target house.

It confirms the mean velocity is pretty low.

And local flow patterns are determined by surrounding geometries.

20. Another result I want to show is the comparison between the two configurations.

One of the configurations in the lower left corner, which is

Velocity contour on the vertical plane crossing the house, white dashed line.