Multifamily Ventilation – Best Practice?

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Presentation Outline

- Basic Objectives
- Exhaust Systems
- Make-up Air Systems

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Two Primary Ventilation Objectives

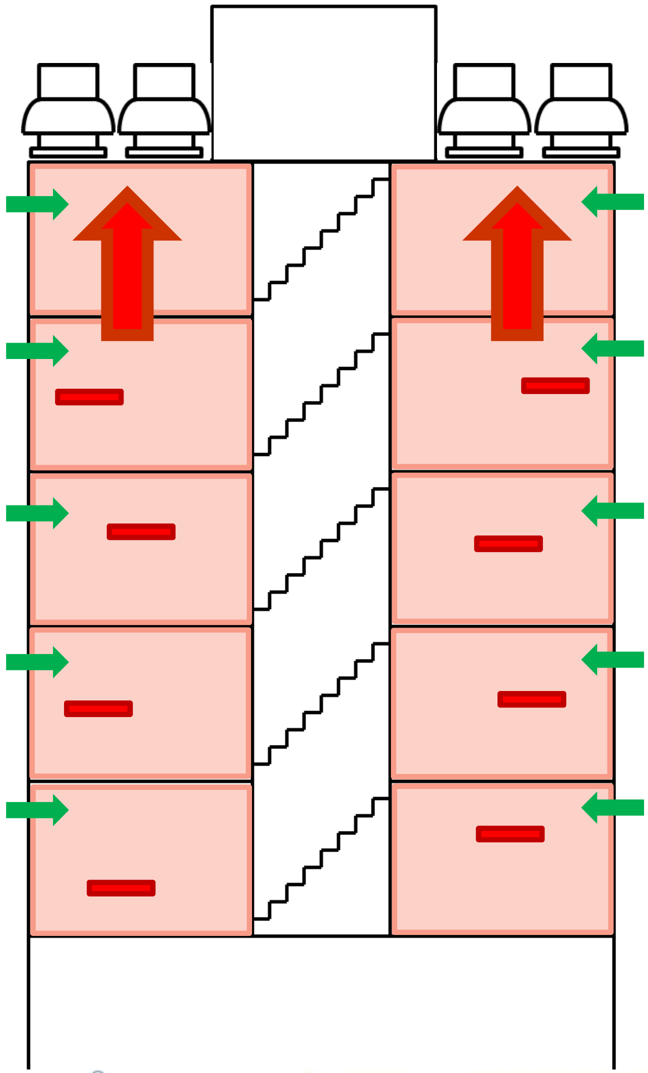
1) Providing Fresh Air - *Whole-House*
2) Removing Pollutants - *Local Exhaust*

Our goal is to find the simplest solution that satisfies both objectives while minimizing cost and energy impacts.

Common Solution: Align local exhaust with fresh air requirements *(Ex: 25 Bath + 25 Kitchen)*

Exhaust-Driven Fresh Air Design

- Exhaust slightly depressurizes the units
- Outside air enters through leaks, cracks, or planned inlets
- Widely used in the North

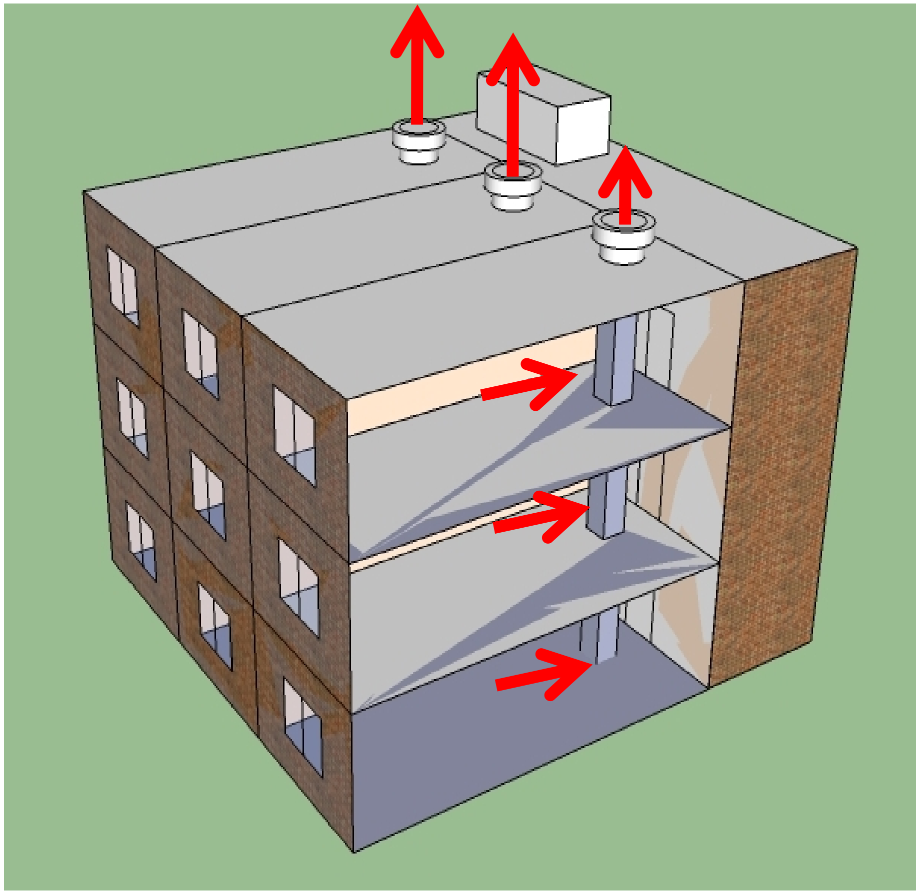


Multifamily Ventilation Best Practice

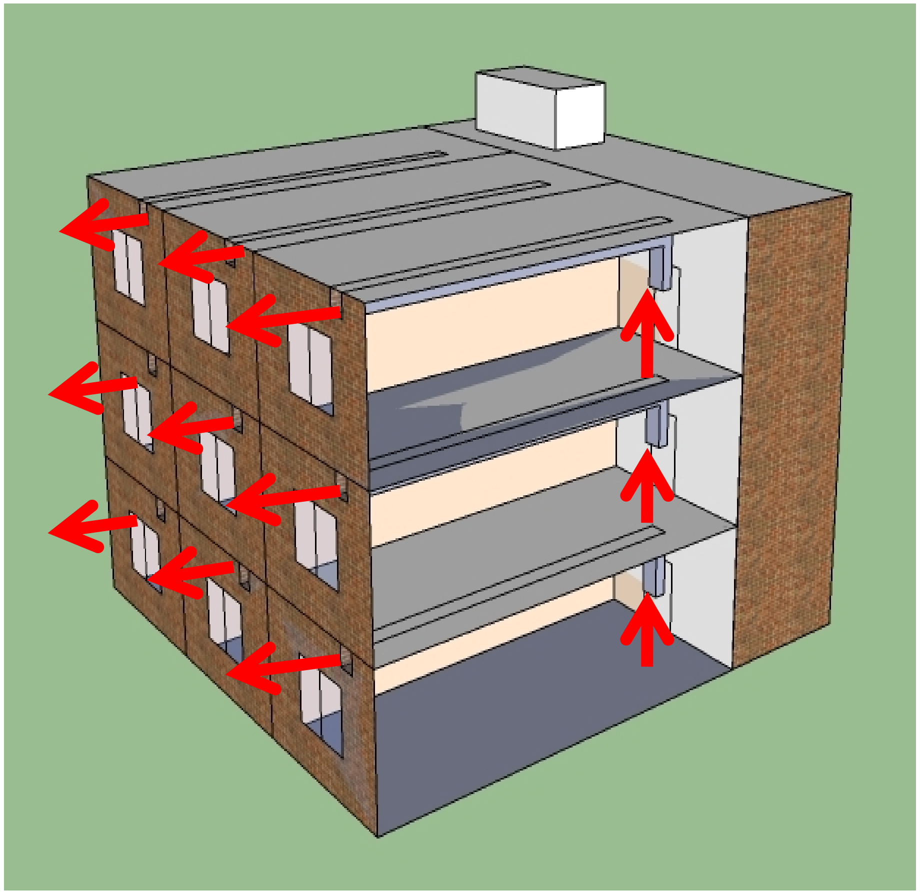
- Step 1: Understand ventilation requirements
- Step 2: Select the simplest design that can achieve both air quality and energy objectives
- Step 3: Build a tight building
- Step 4: Pay attention to installation quality
- Step 5: Check to make sure ventilation works
- Step 6: Educate users

Exhaust: Central and Unitized

Central Exhaust



Unitized Exhaust

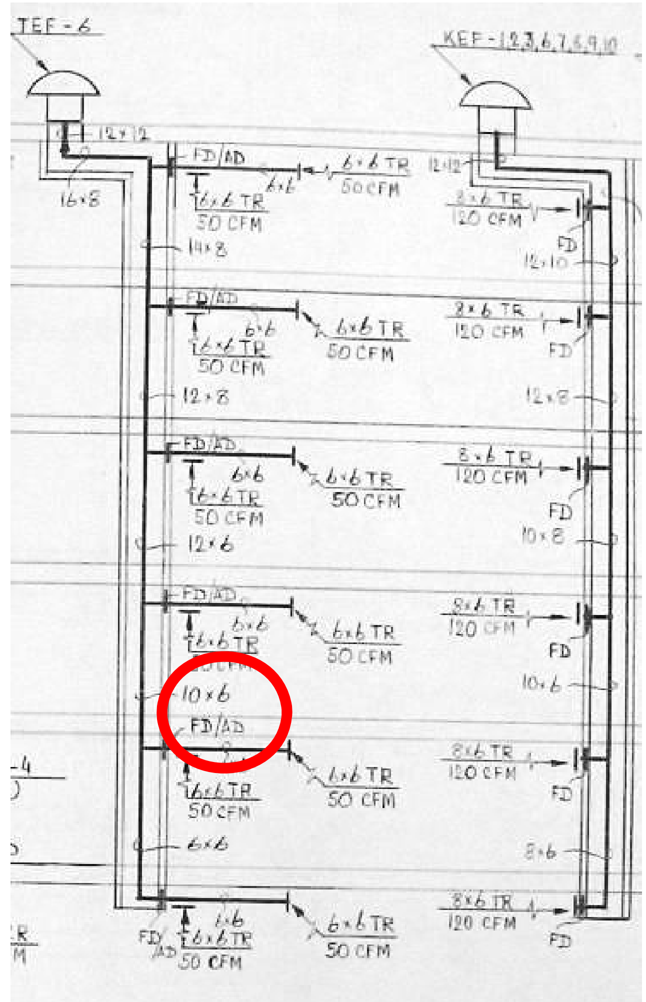


Standard Central Exhaust Practice

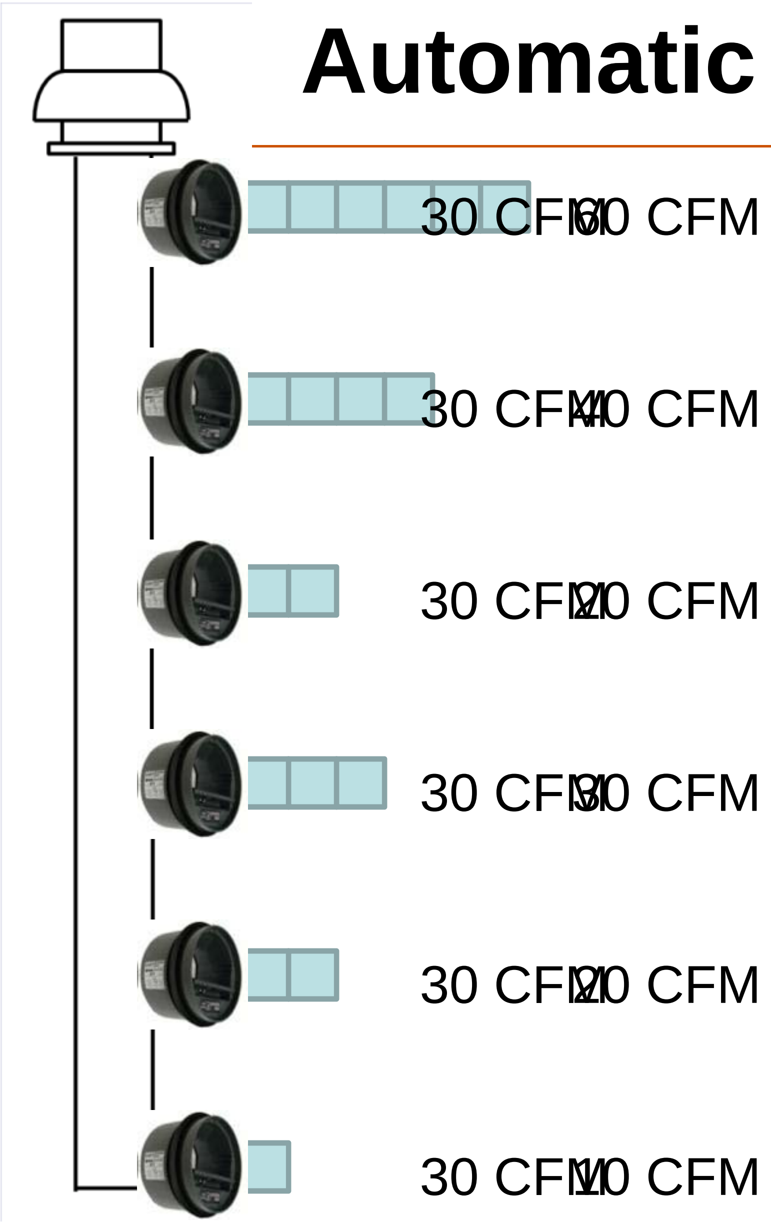
- Roof or mushroom fans
- Vertical shaft with horizontal take-offs
- Sidewall or ceiling grilles at each floor
- Continuous operation

Mechanical Designers' Intent

- Balancing damper → transferring responsibility to balancing contractor
- Many grilles, many floors, relatively low flow targets, plus wind and weather on balancing day = balancing is difficult



Automatic Balancing Dampers



Balance in two ways:

- Provide restriction in size of opening (increase static pressure)
- Dynamically self-adjust to changes in the system (automatic balancing)

Duct Leakage

Roof curb?

Takeoffs?

Transverse
(sectional) joints?

Longitudinal (lengthwise)
joints?

Register
connections
can be the largest
set of leaks

Best Practice

- Include performance specifications for duct tightness in construction documents
- Call out specific details to be sealed: all joints, takeoffs, connections, registers, etc., etc.

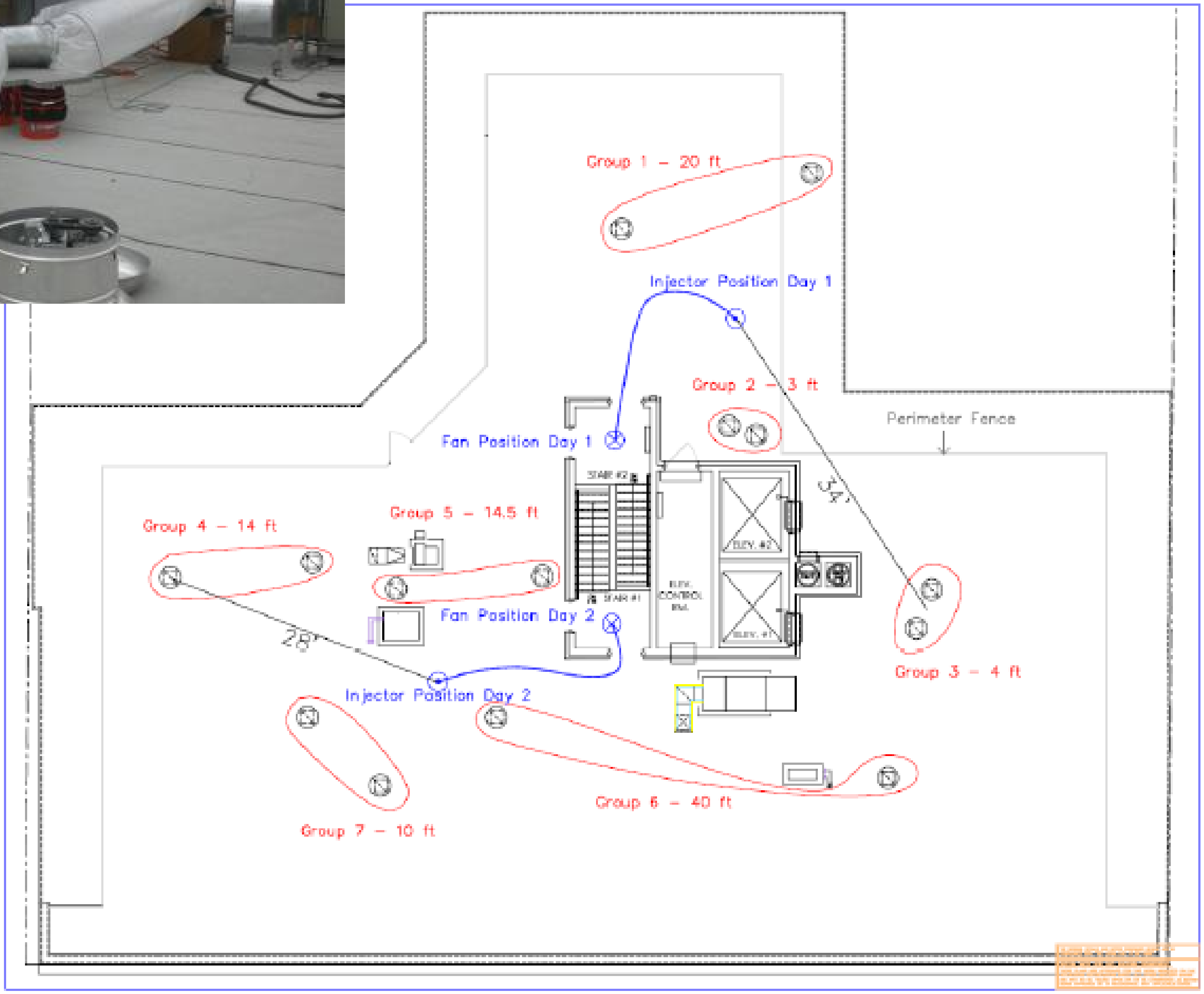
Then test for leakage:

- Good =
  10 CFM50/register
- Better =
  5 CFM50/register

Duct Sealing Methods

Aeroseal® aerosol duct sealant sticks to holes in ductwork and seals them

Working elevators and power on the roof are helpful.



- Prepare a plan.
- Check weather report!

Mastic Spray

Rotating spray head applies mastic directly to leaks identified by camera

-Simple concept

-Very effective on straight shafts

In-Unit Exhaust Systems

Small fans, relatively low flow (50-100 CFM), low power consumption, easier to balance floor to floor

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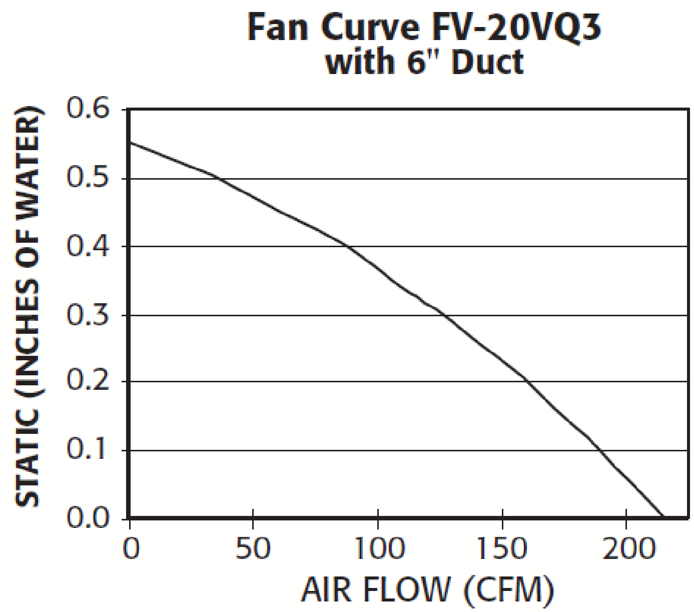
In-Unit Ventilation Quality Control

- Duct sealing
- Avoid kinks, long duct runs; use rigid duct



Exhaustive System Design Parameters

Central Systems	Unitized Systems
• Constant Air Regulating (CAR) dampers to balance flows	• ENERGY STAR fans with variable speed where appropriate
• **Airtight ductwork**, including fan and grille connections	• Short straight duct runs
• **Tightly compartmentalized units**	• **Tightly sealed ducts**
	• **Tightly compartmentalized units**

Exhaust-Driven Make-up Air Strategies

Current Research Focus

Where is the make-up air coming from?

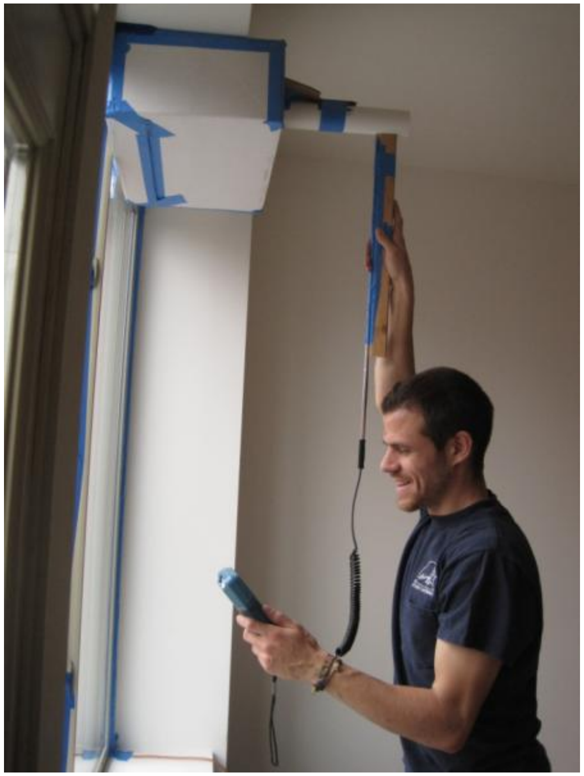
- Leaks
- Trickle vents
- Make-up air supplied to corridor
- Vent or fan within PTAC

Trickle Vents - Designed Inlets

- Intentional openings in building envelope that allow a trickle of air into buildings in response to pressure differential
- Trickle Vents often built into window frames

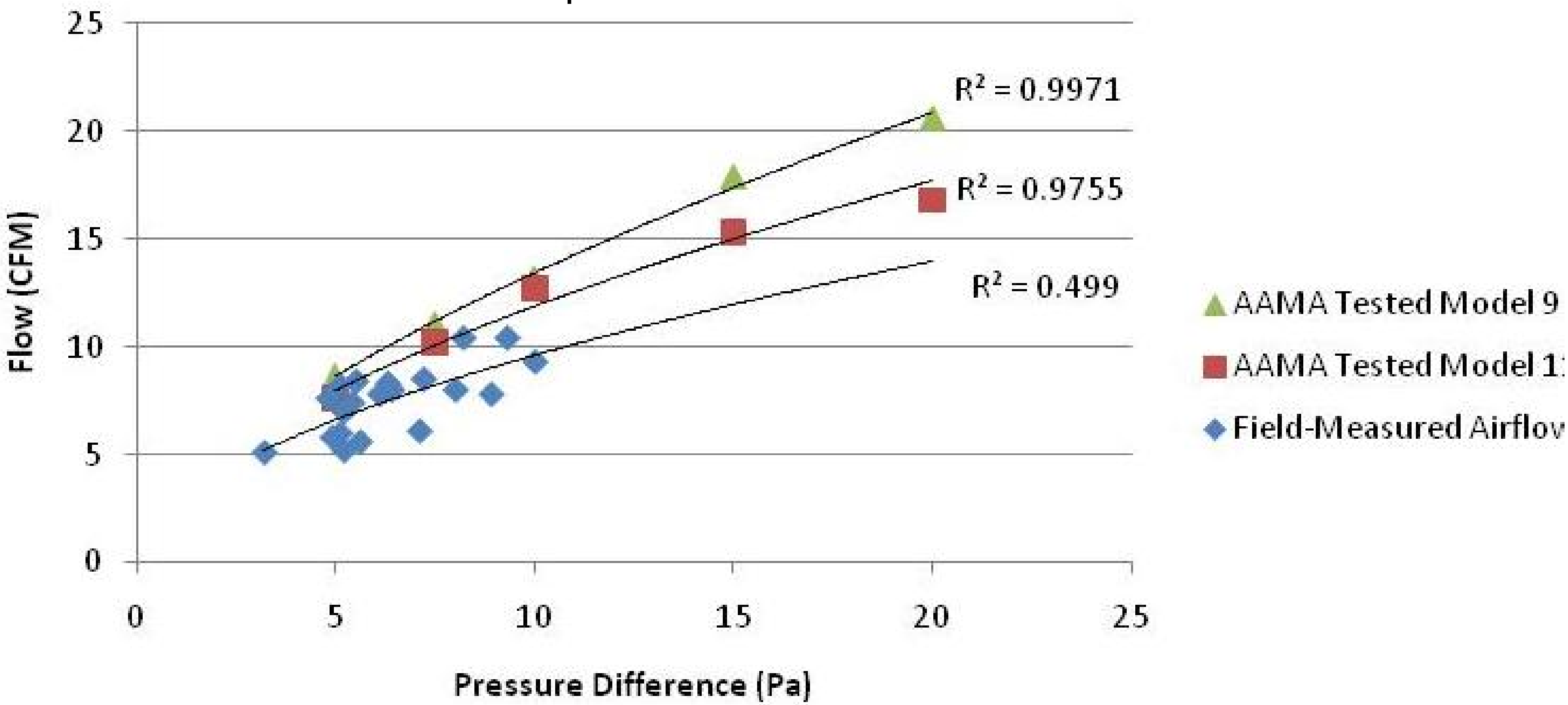
Trickle Vents – Installed Performance

- Flow from trickle vents measured with hot wire anemometer in a building under actual operating conditions.
- Also measured inside/outside pressure difference across exterior window.



Trickle Vent Airflow vs. Pressure Difference

Air flow at typical building operating pressures is expected to be about 5-10 CFM per trickle vent – a “trickle”



AAMA = American Architectural Manufacturers Association

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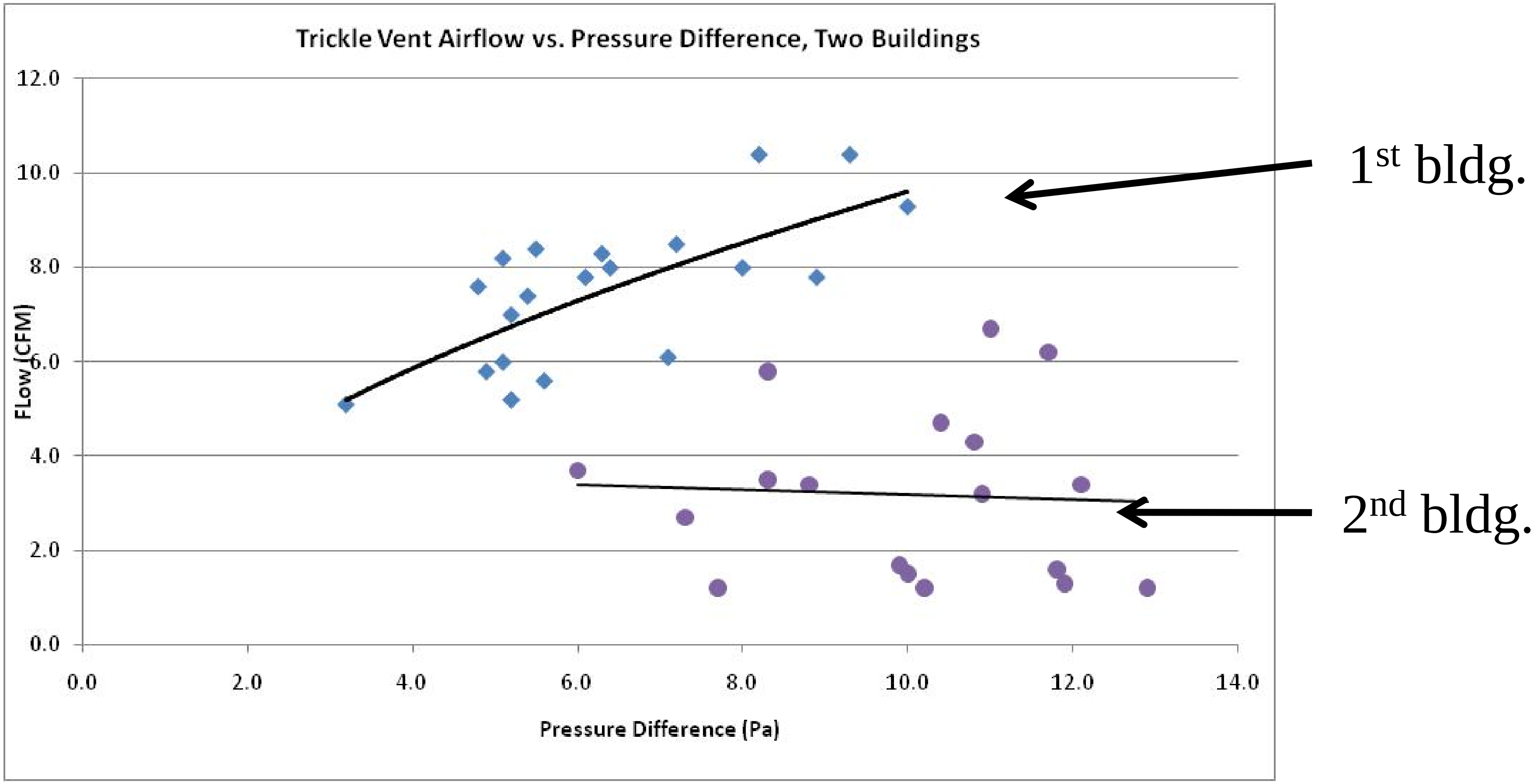
Comparison of trickle vents in two buildings



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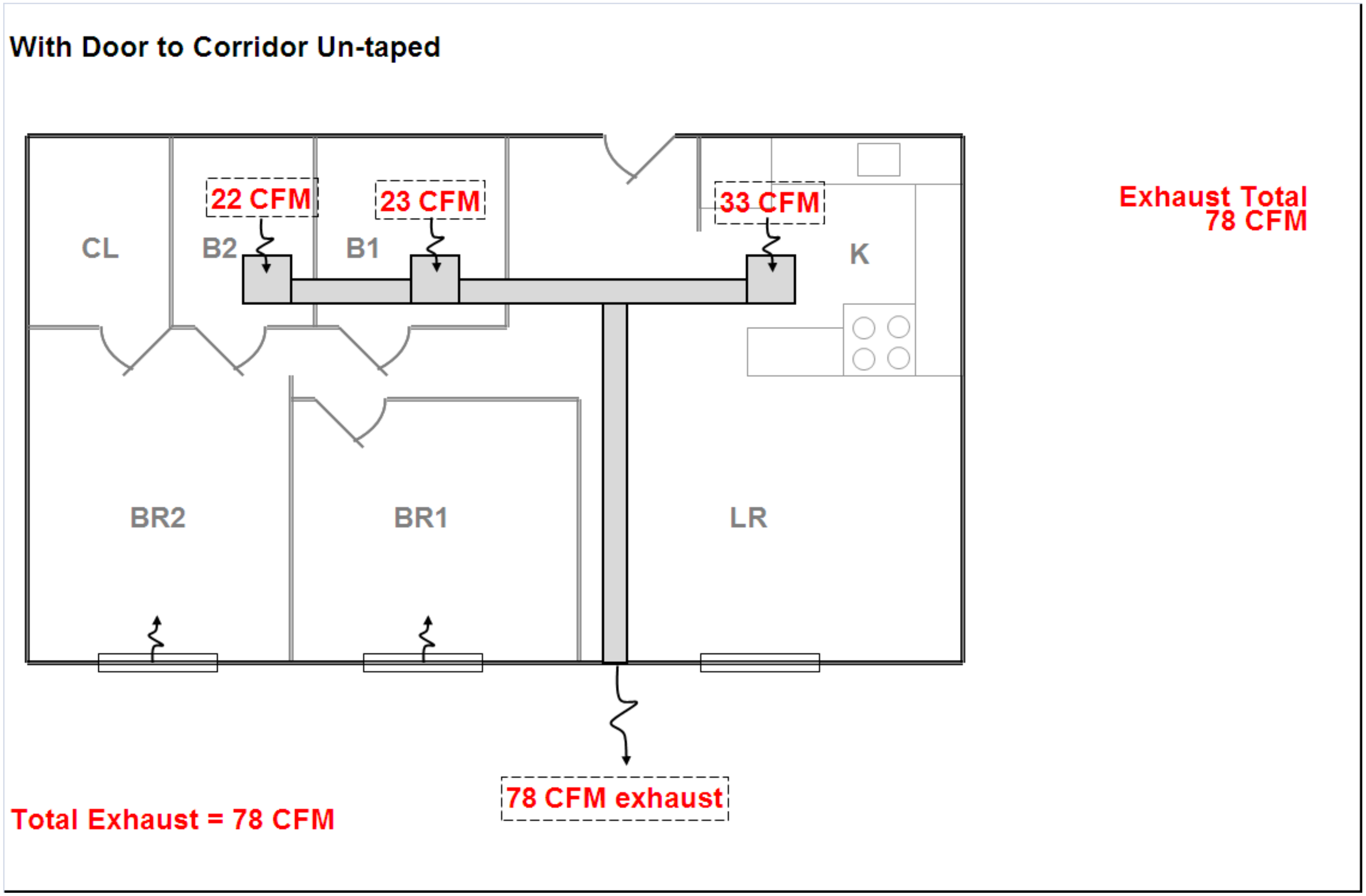
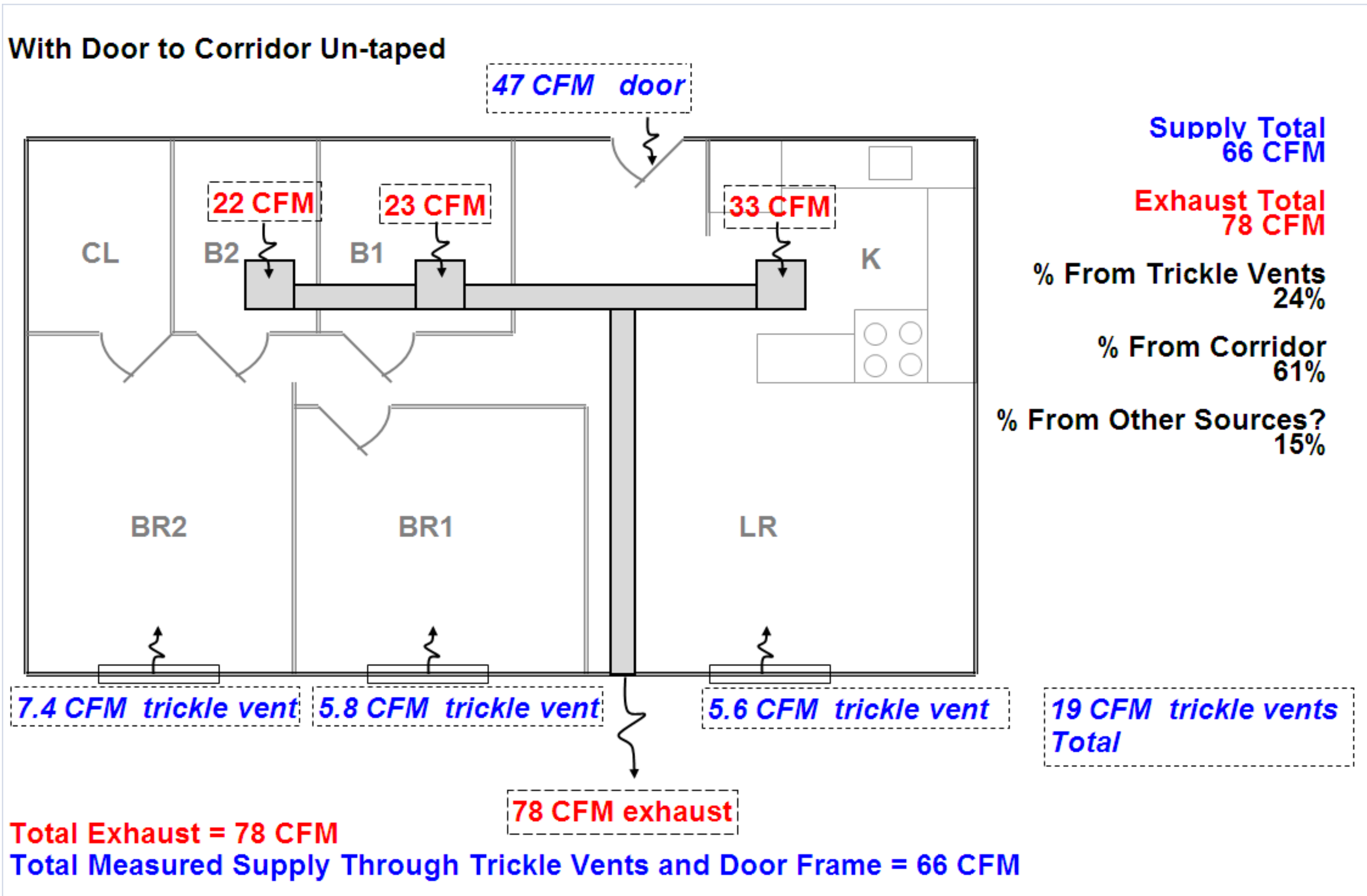
Airflow patterns in a tight unit with trickle vents



Airflow patterns with trickle vents



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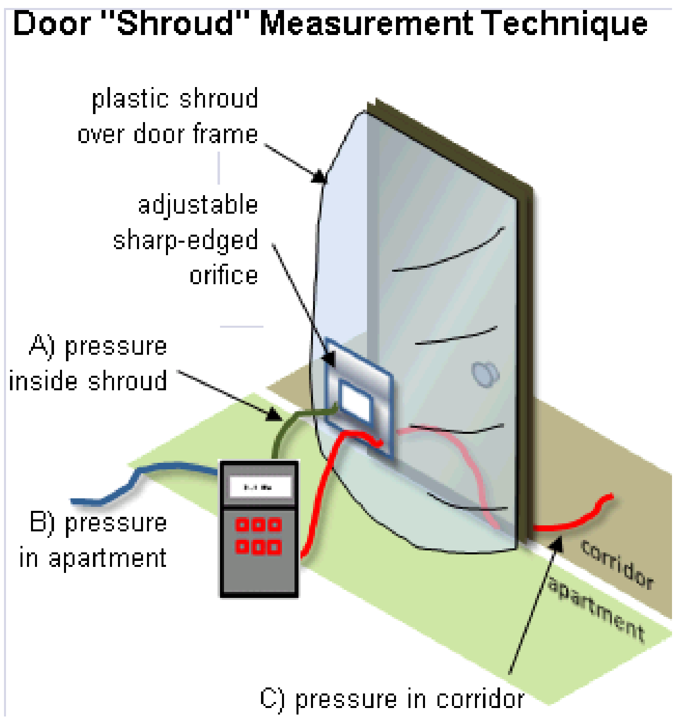
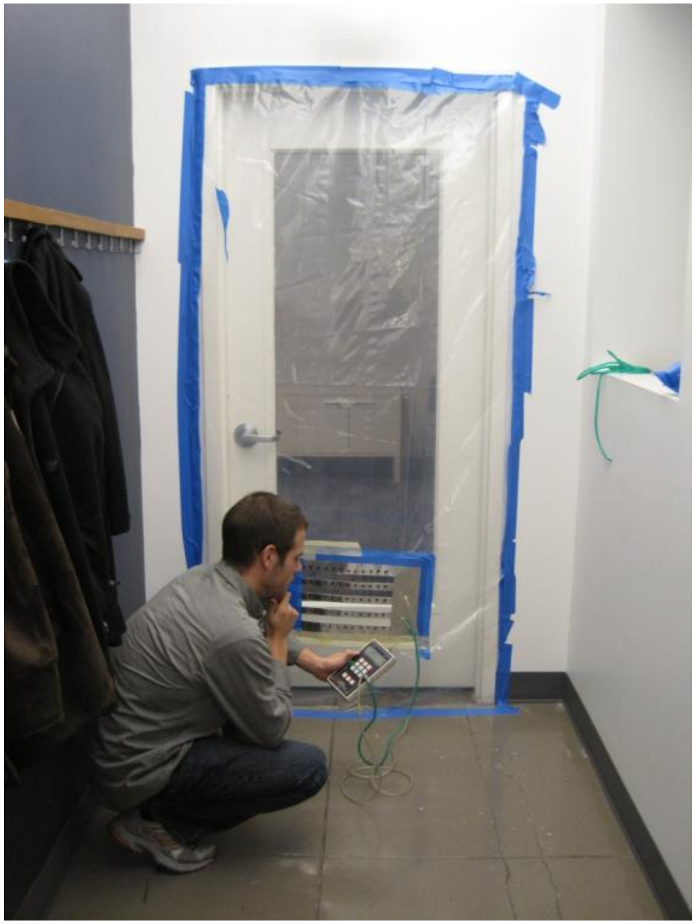
This Year's Research Plan

1. Evaluate performance of more systems in more buildings
   – Corridor supply systems
   – Trickle vents
   – PTAC outside air vents
2. Measure pressure variation within buildings and apartments over time
   – 2 weeks in winter and 2 weeks in summer

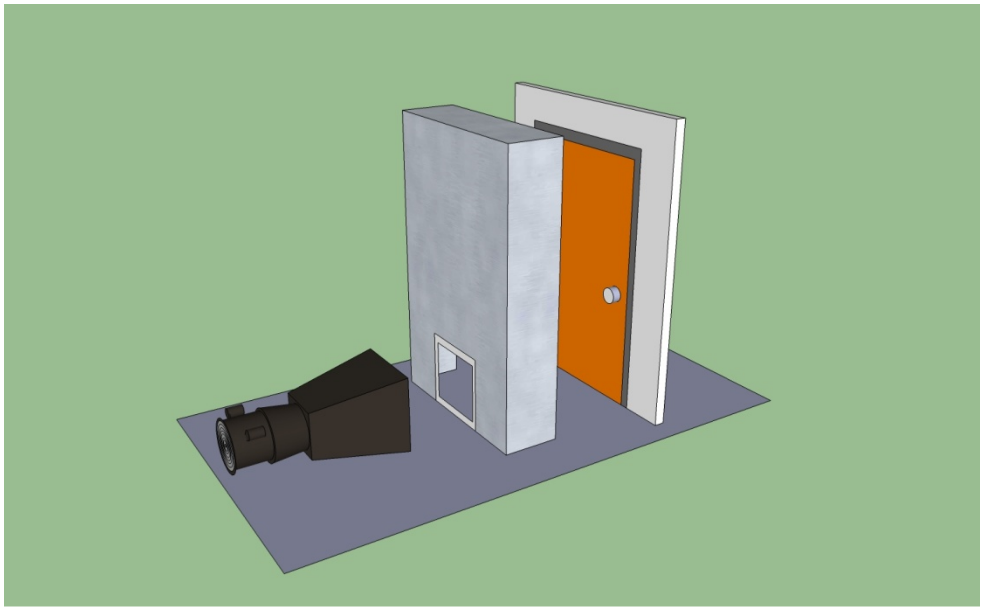
Earlier Testing

- Airflow through gaps in apartment door





Latest Test Rig



Powered Flow Hood
Energy Conservatory's FlowBlaster™

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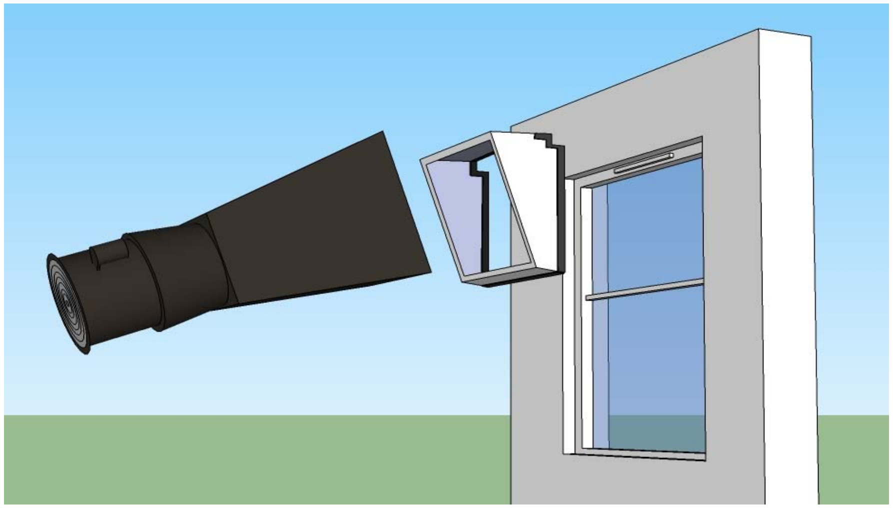
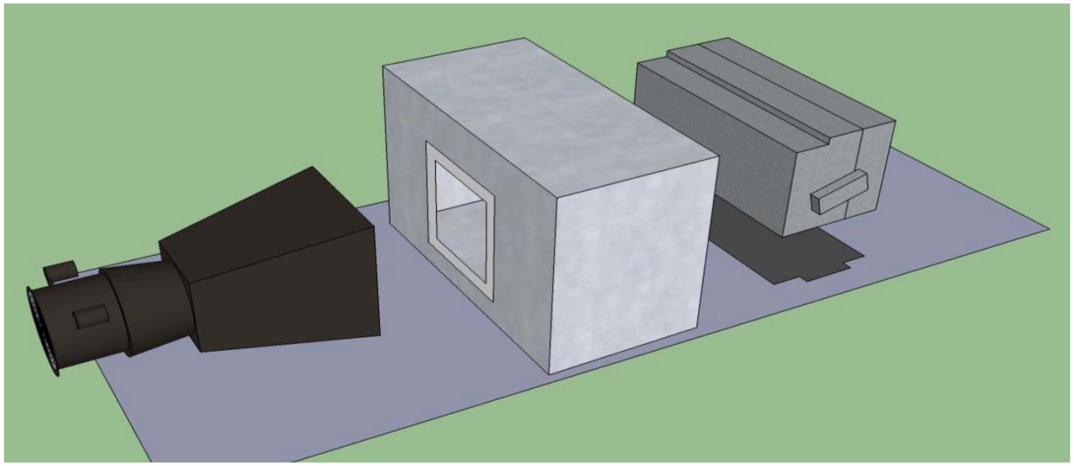
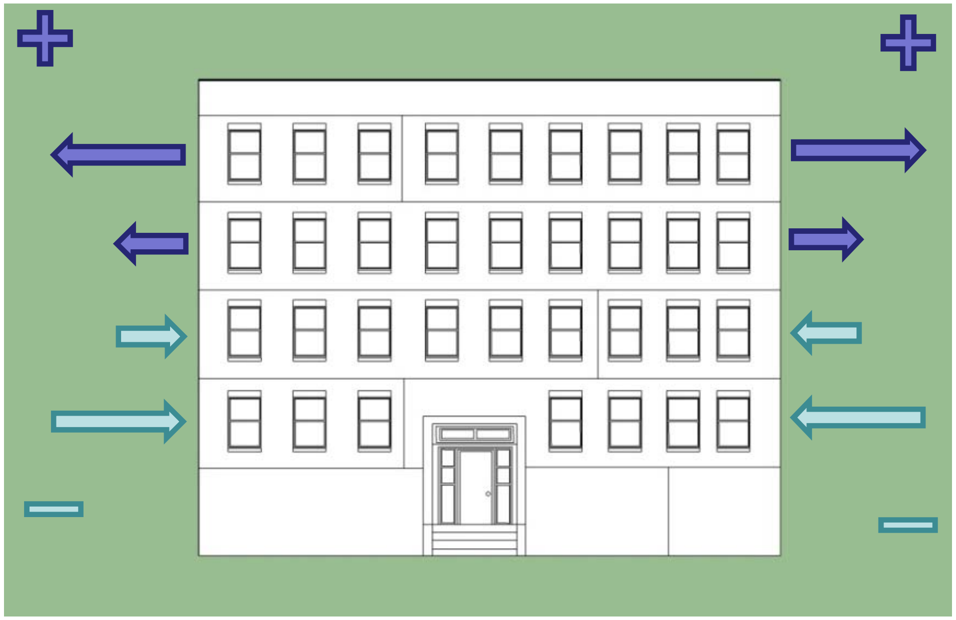
Other Make-up Air Inlets



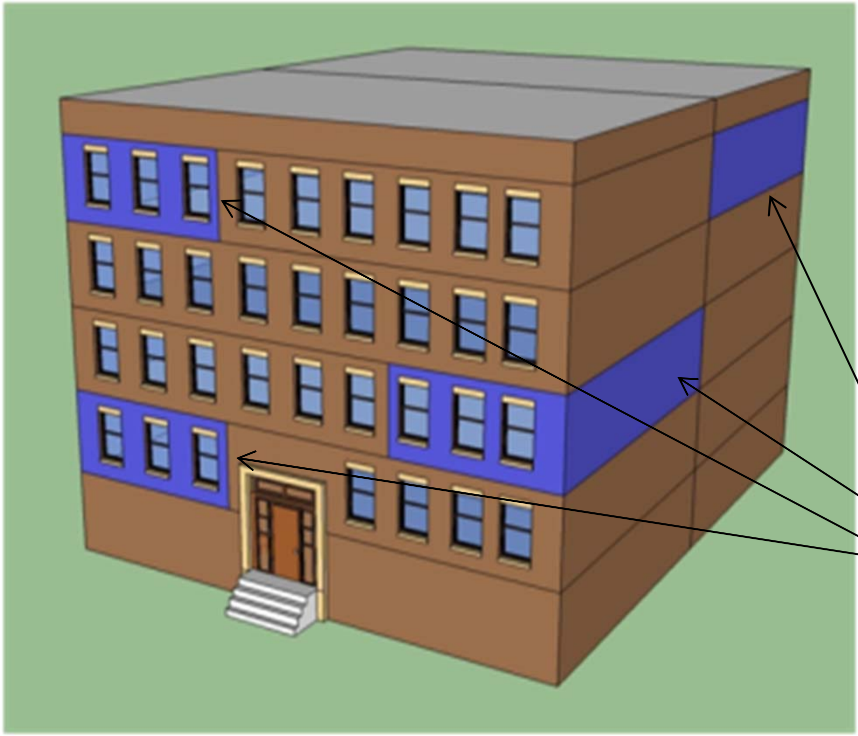


Variability in Driving Forces



Typical for Winter – But what about summer, windy days, …

Pressure Monitoring



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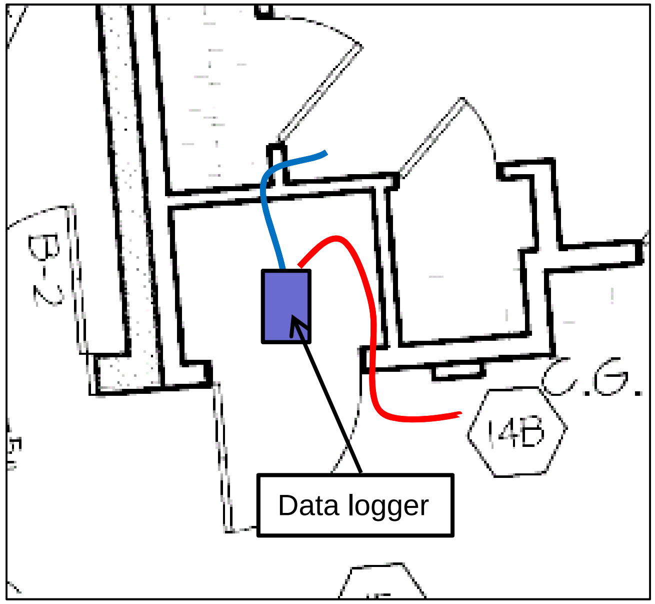

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Thank You