Measuring Air Leakage in Commercial & Multi-Family Buildings

Denali Jones
Retrotec

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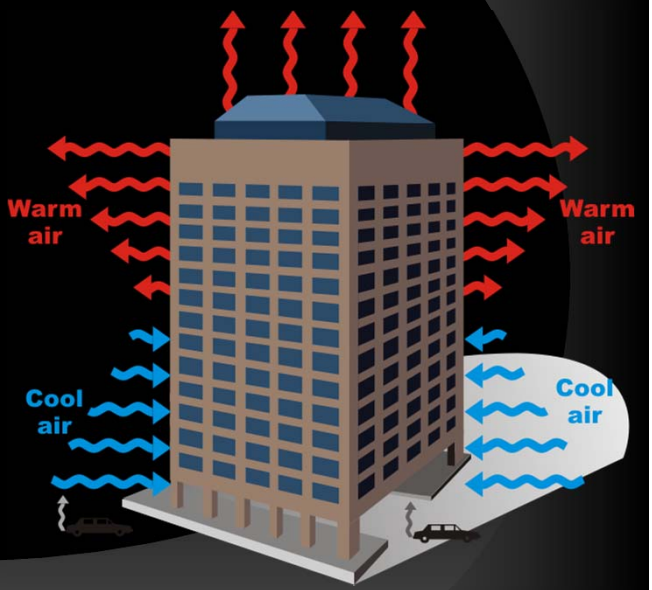
Stack Pressure + Holes = Leaks

Stack Effect

Warm air rising

Cold air falling



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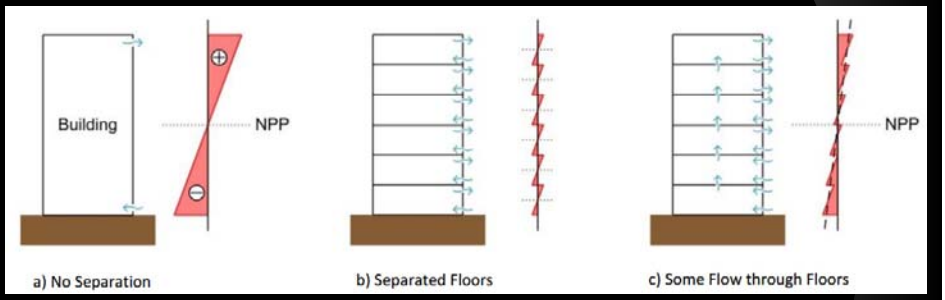
Separation of floors reduces stack



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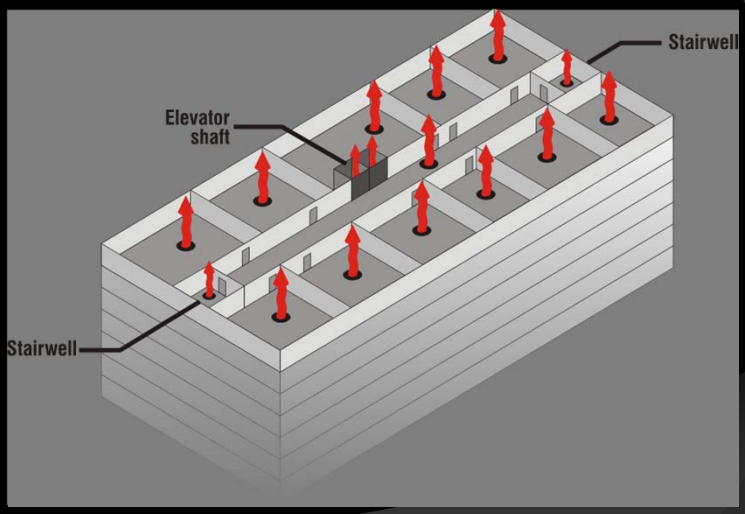
Primary Boundaries for cold climates



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14 windows open at -25 C

inset shows open window

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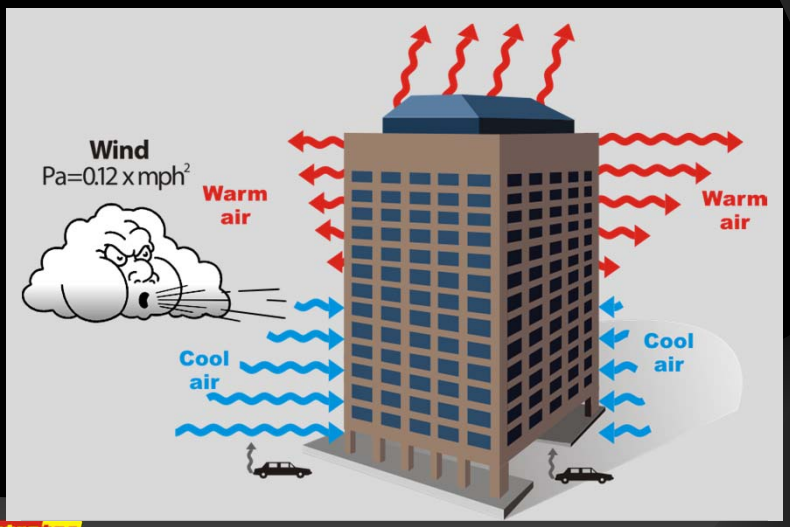
Stack Pressure + Wind Pressure + Holes = Bigger Leak



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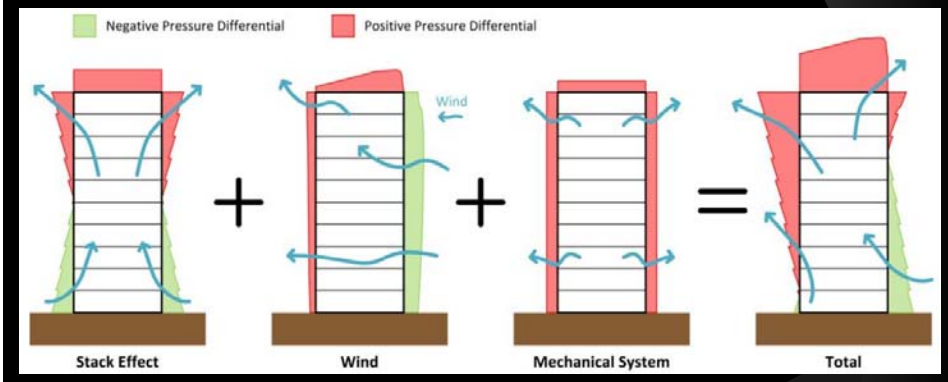
Adding all driving forces



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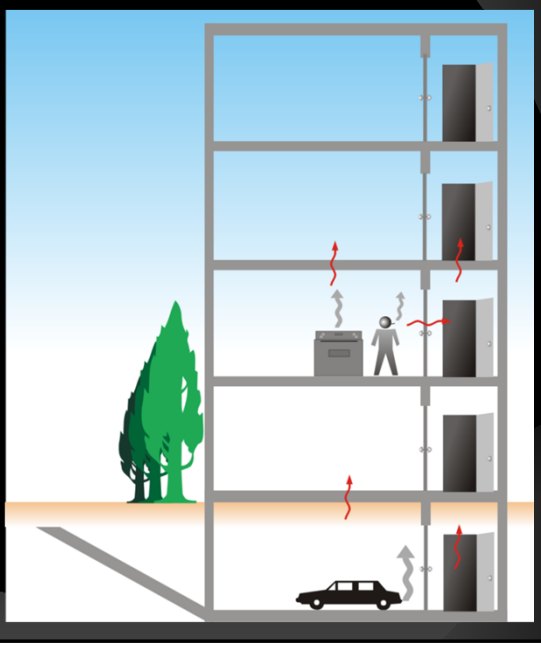
Real problems



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Smoke safety is affected by floor to floor leakage

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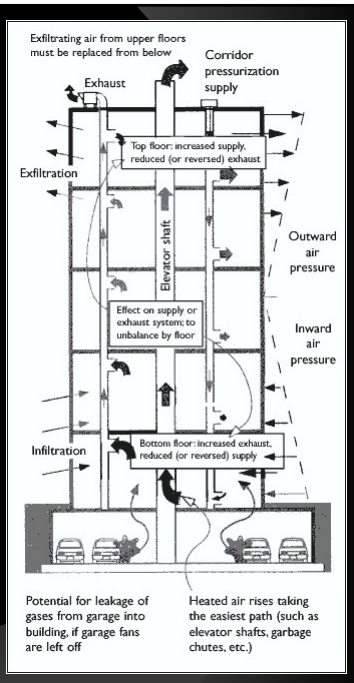
Hallway mechanicals cannot keep up with flow requirements



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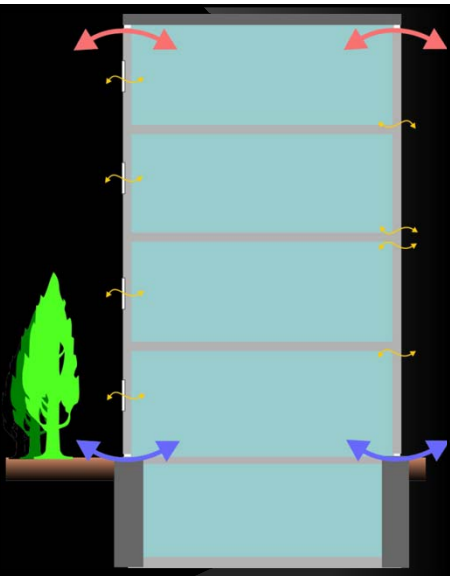
Most important leakage at top and bottom



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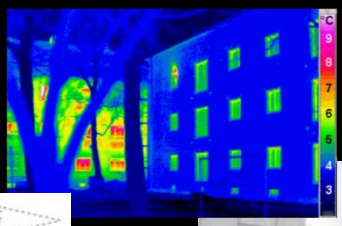
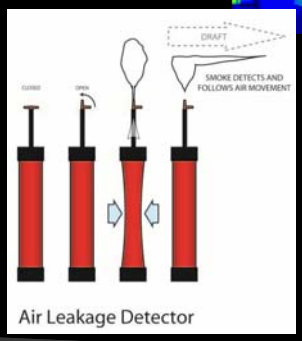
Smoke and IR identify air leakage paths





Air Leakage Detector

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T=-22°C T=+19°C ΔT=41 °C

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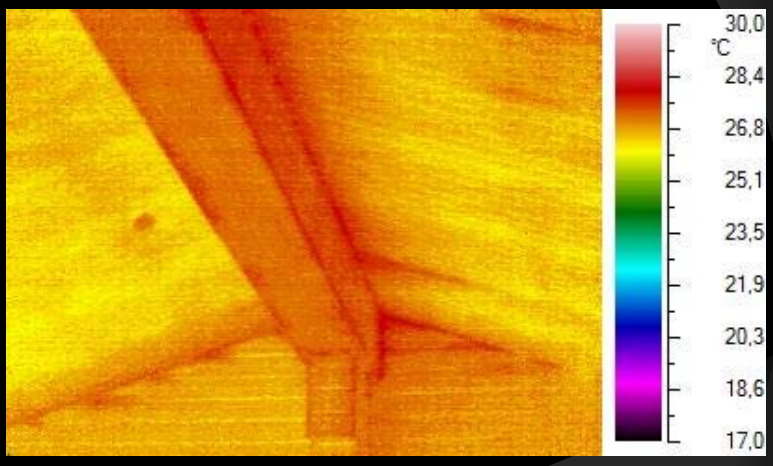

ΔP= + 8 Pa

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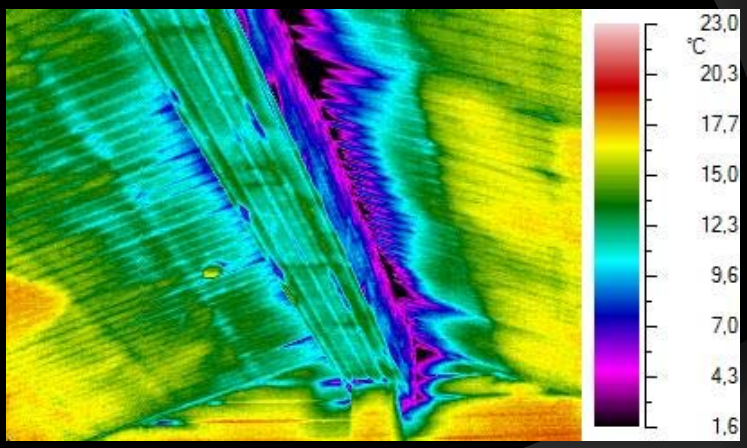
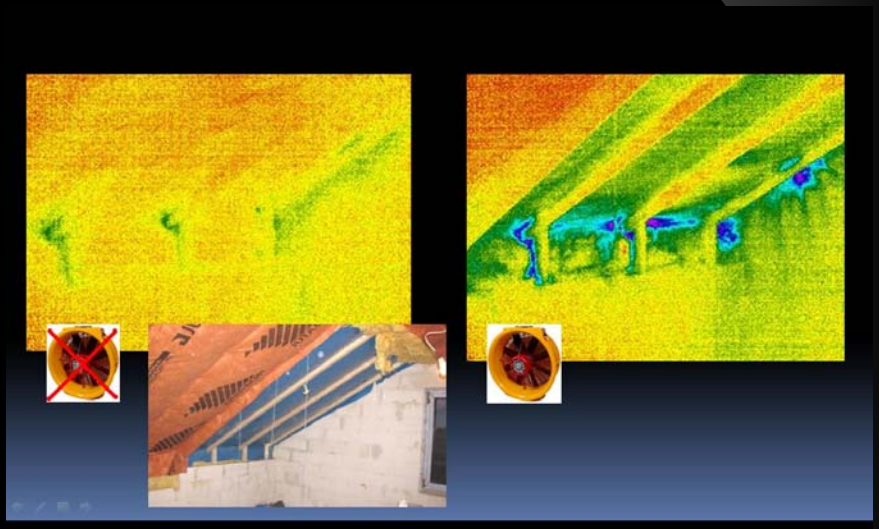


ΔP= - 8 Pa

retrotec



Without and With depressurization

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What components of buildings can be measured?

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USACE pass/fail for new construction

"shall pass …0.25 CFM/sq ft …at 75 Pa …"

=1.0 L/s-m^2 at 50Pa

US Army Corps of Engineers®
Engineer Research and Development Center

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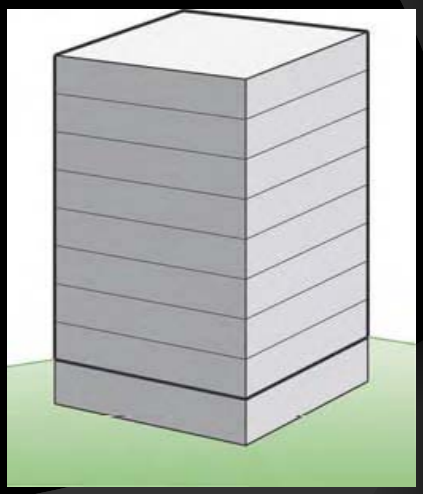
Whole building envelopes can be measured



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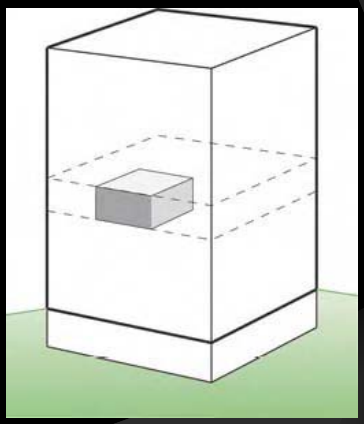
Individual apartments can be measured



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Hallways can be measured

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Stairwells can be measured

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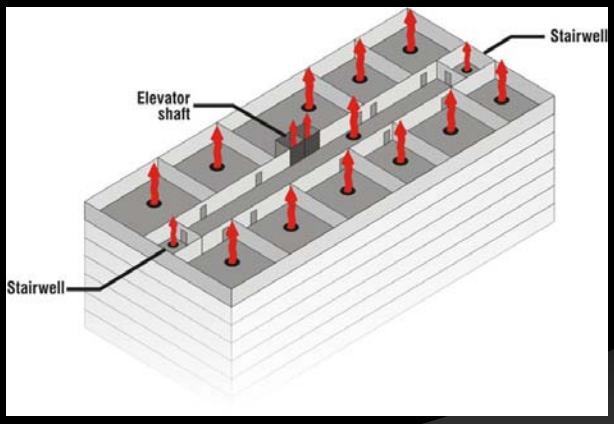
Floor to floor leakage can be measured



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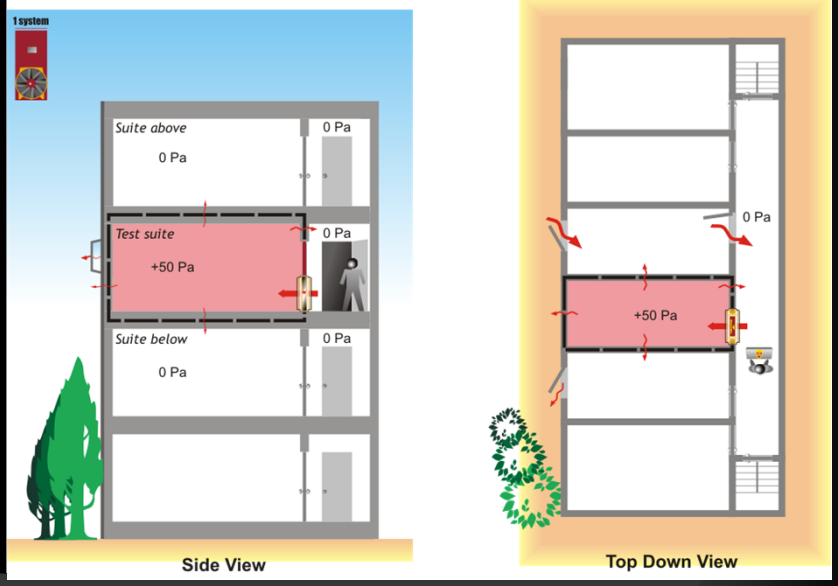
Total Unit Leakage - All 6 Sides, 1 Door Fan



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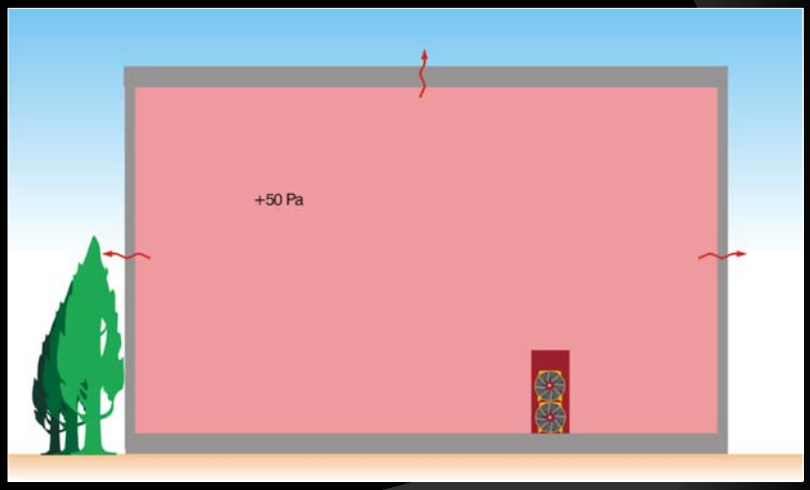
Measure Entire Envelope



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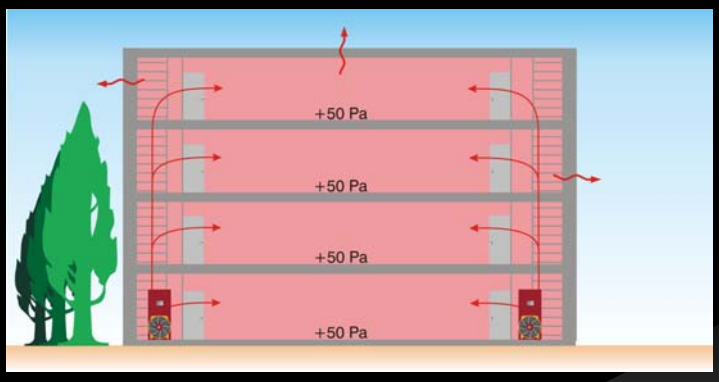
Measure Entire Envelope



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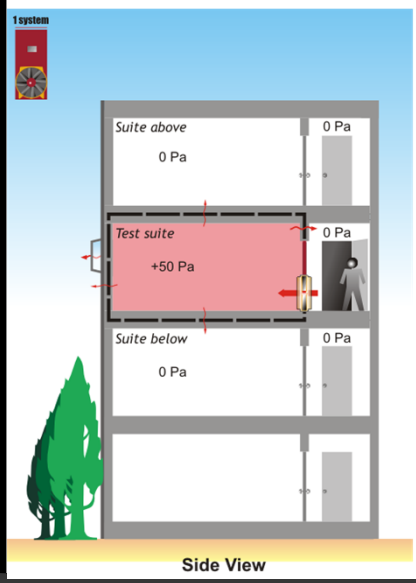
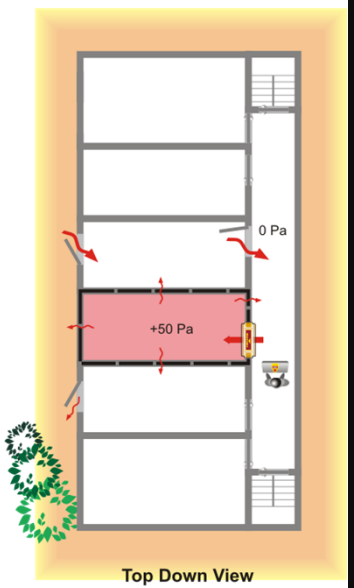
Total Unit Leakage - All 6 Sides, 1 Door Fan



Side View



Top Down View

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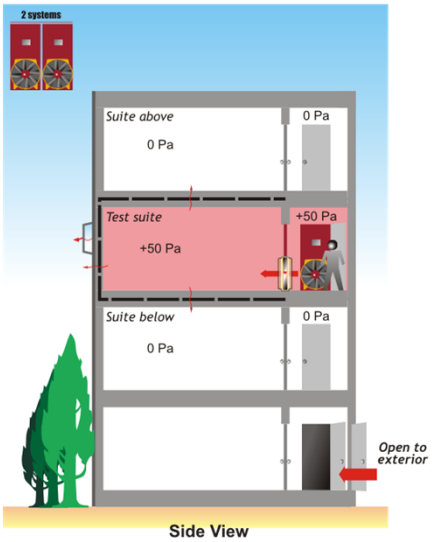
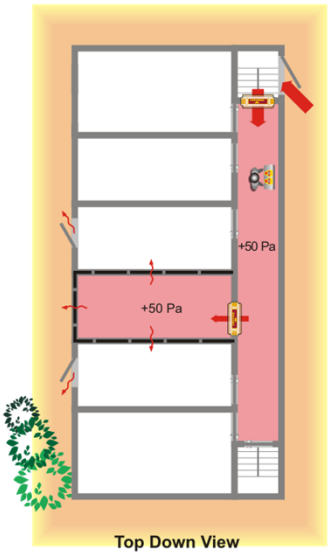
Leakage from Apartment to Hallway



Side View



Top Down View

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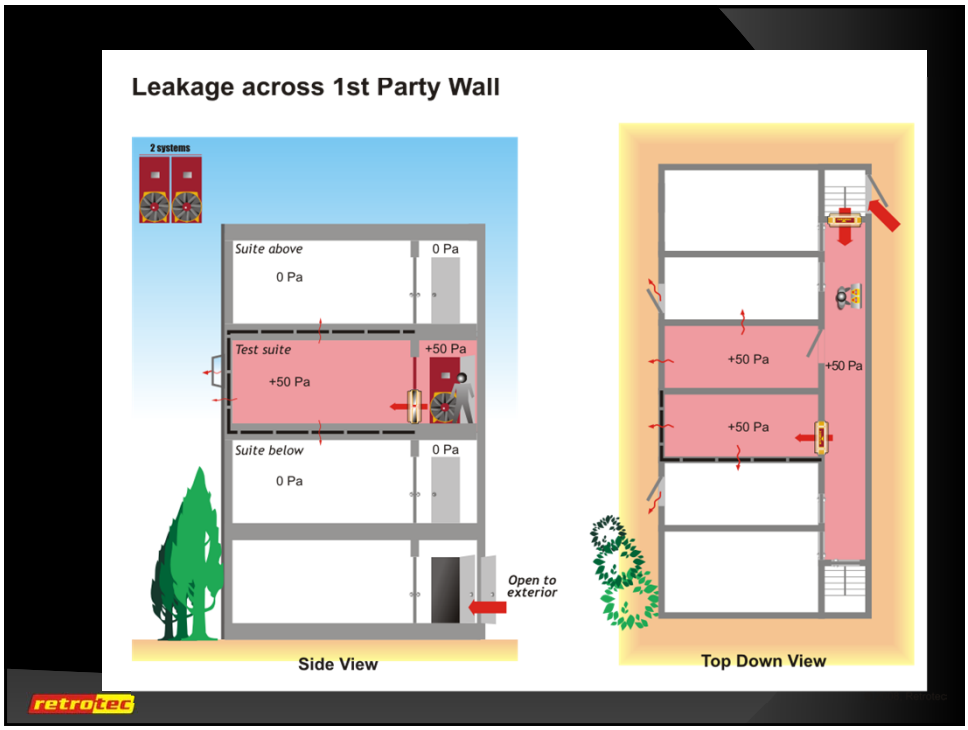
Leakage across 1st Party Wall
2 systems
Suite above
0 Pa
0 Pa
Test suite
+50 Pa
+50 Pa
Suite below
0 Pa
0 Pa
Open to exterior
Side View
+50 Pa
+50 Pa
+50 Pa
Top Down View
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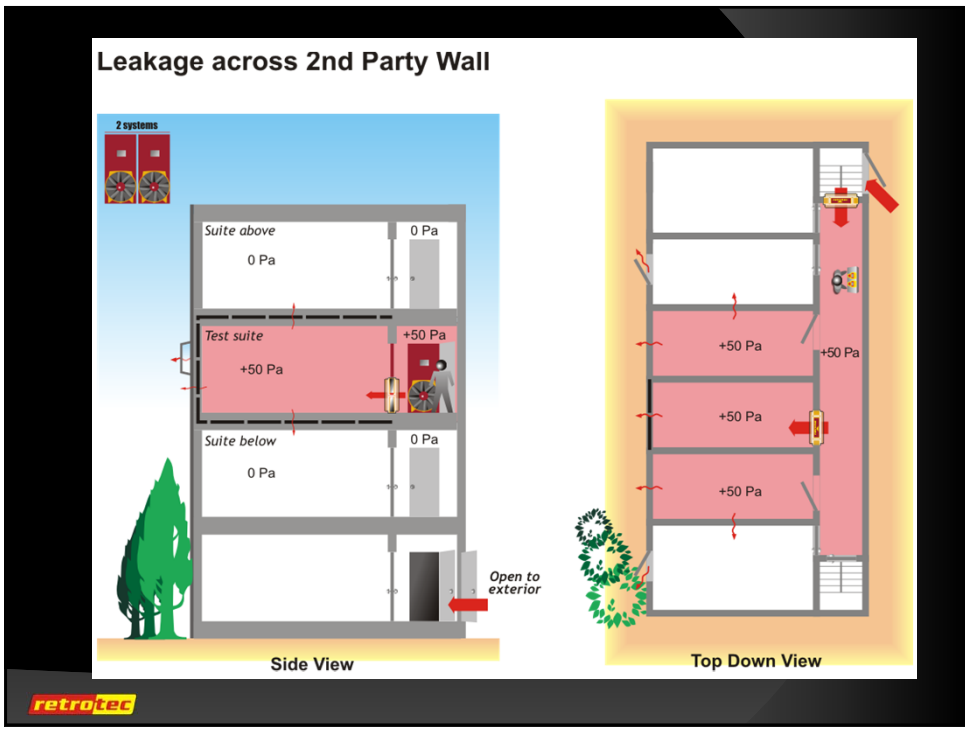
Leakage across 2nd Party Wall
2 systems
Suite above
0 Pa
0 Pa
Test suite
+50 Pa
+50 Pa
Suite below
0 Pa
0 Pa
Open to exterior
Side View
+50 Pa
+50 Pa
+50 Pa
+50 Pa
Top Down View
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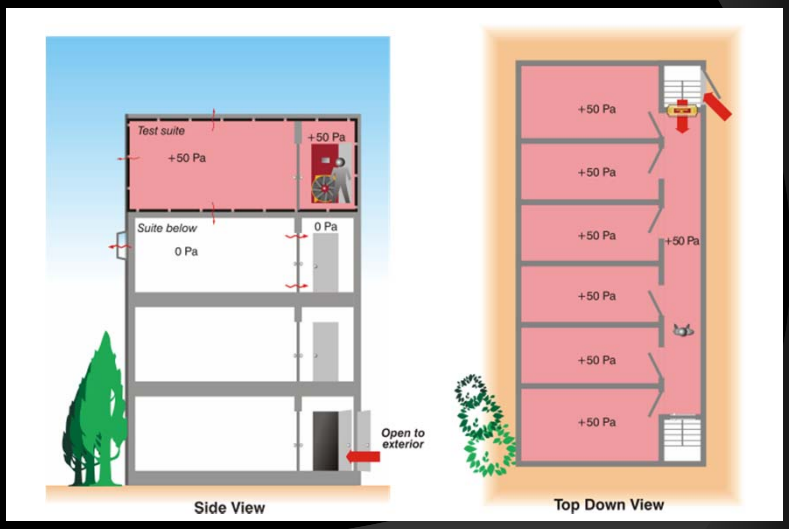
Slab leakage – total floor leakage



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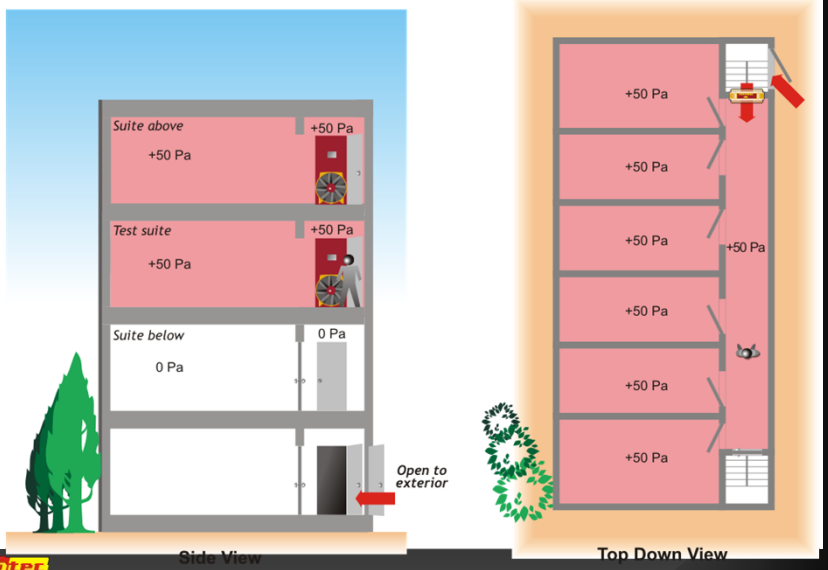
Pressurizing the Floor Above



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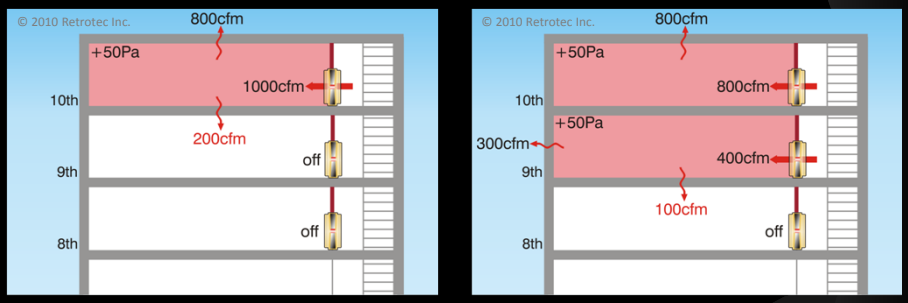
Floor to floor leakage can be measured



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Standard Test Method - large building

Canada
CGSB 149.10

UK
TS-L1/TS-L2

Europe
EN13829

USA
USACE Air Leakage Protocol

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Results expressed in many ways

Standard	ASTM	CGSB	EN13829 ATTMA	USACE	LEED	IECC
Origin	USA	Canada	Europe	USA WA State	North America	
Results	EfLA $_4$ ACH_{50} CFM_{50}	$EqLA_{10}$ ACH_{50}	$m^3/h_{50}/m^2$ $m^3/h_4/m^2$ ACH_{50}	CFM_{75}/ft^2	EfLA $_4$ /100 ft^2	ACH_{50} $CFM_{25}/100\ ft^2$

Suggest using only:
ACH50
EqLA 50/Floor area x 1,000,000

- Unitless
- Always whole number
- Calibrate against holes of known sizes
- Always reference results to 50 Pa

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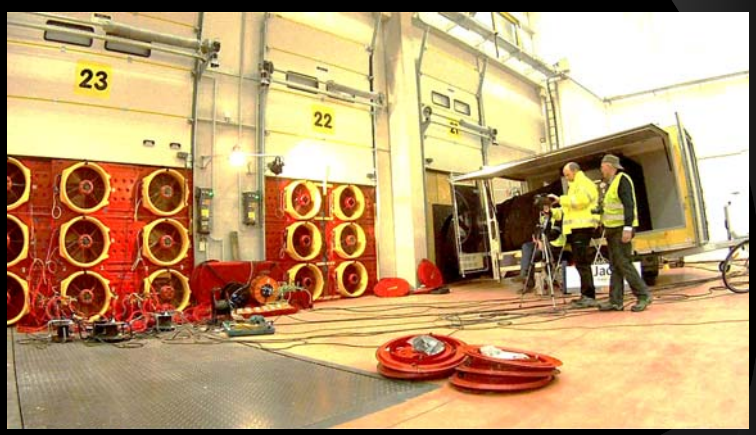
Case Study - Germany



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15,000,000 cubic feet

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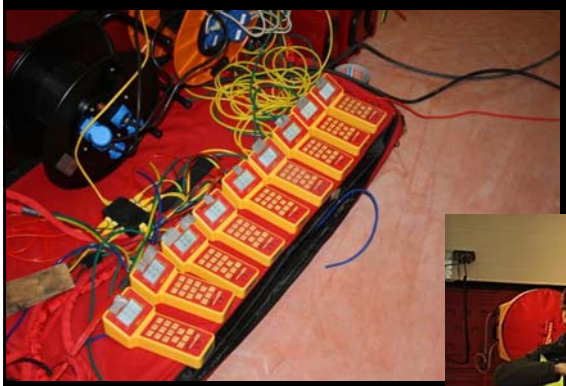

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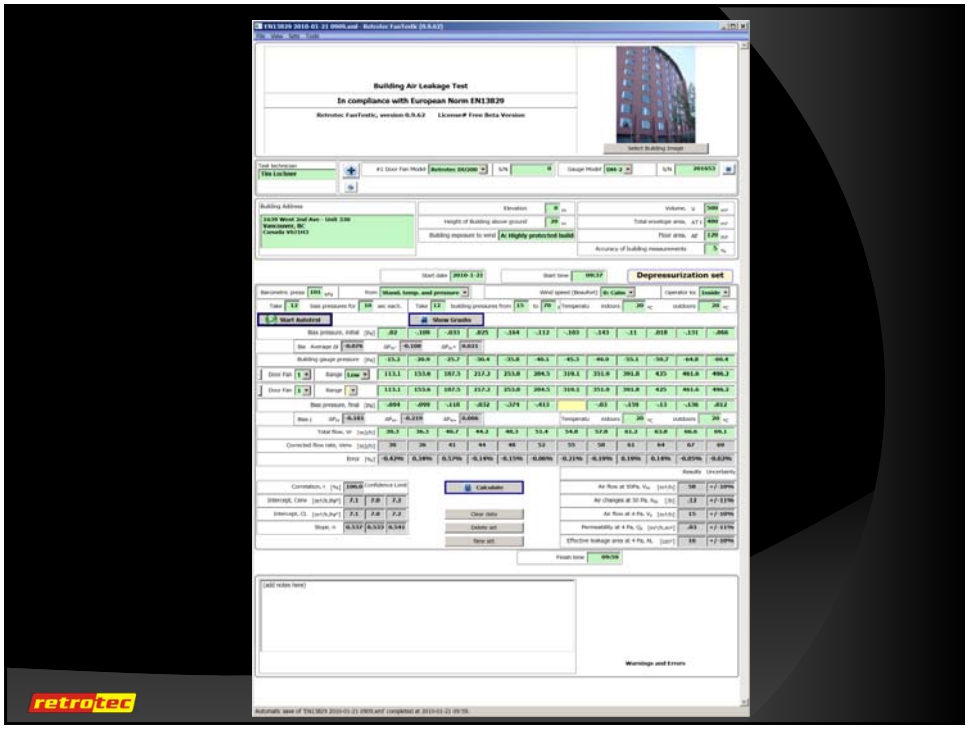
Building Air Leakage Test
In compliance with European Norm EN13829
Depressurization set
Warnings and Errors
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AutoTest
1 DM2 gauge found. Gauge #201653 on Retrotec DU200, Range Low.
Static Bias Pressure (Pre)
Building gauge pressure
Static Bias Pressure (Post)
Building Gauge Pressure vs. Flow Pressure
Start Test
Stop Test
Change Range
Clear data
Auto test completed.
Cover fans before taking bias readings? Yes No
Previous step:
Step 2: Flow pressure at 12 points, -15 Pa, -20 Pa, -25 Pa, -30 Pa, -35 Pa, -40 Pa, -45 Pa, -50 Pa, -55 Pa, -60 Pa, -65 Pa, -70 Pa, each point collected for 20 seconds (minimum 20 readings).
Current step:
Step 3: Bias Pressure. 12 points, averaged from data collected over 10 seconds (minimum 10 readings)
Next step:
1 DM2 gauge found. Gauge #201653 on Retrotec DU200, Range Low. Gauges ready. Click start when read to start autotest.
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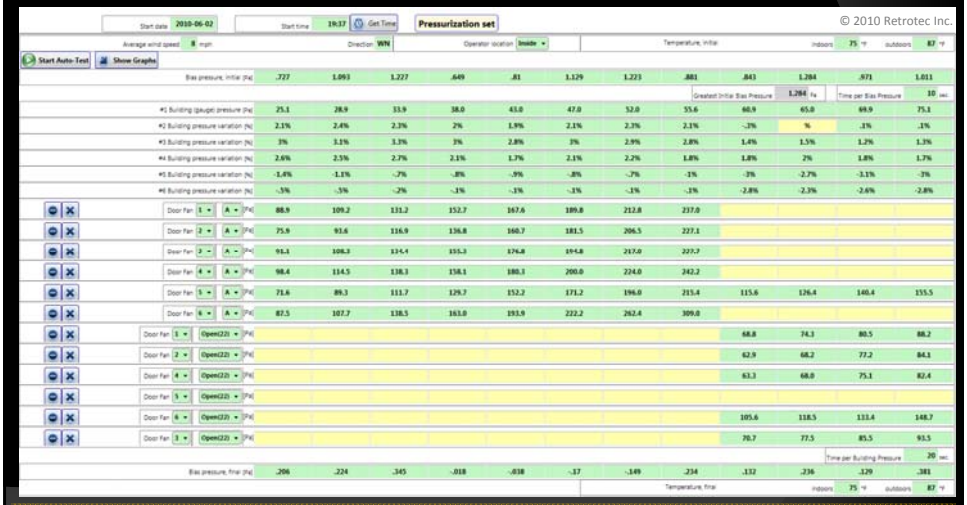
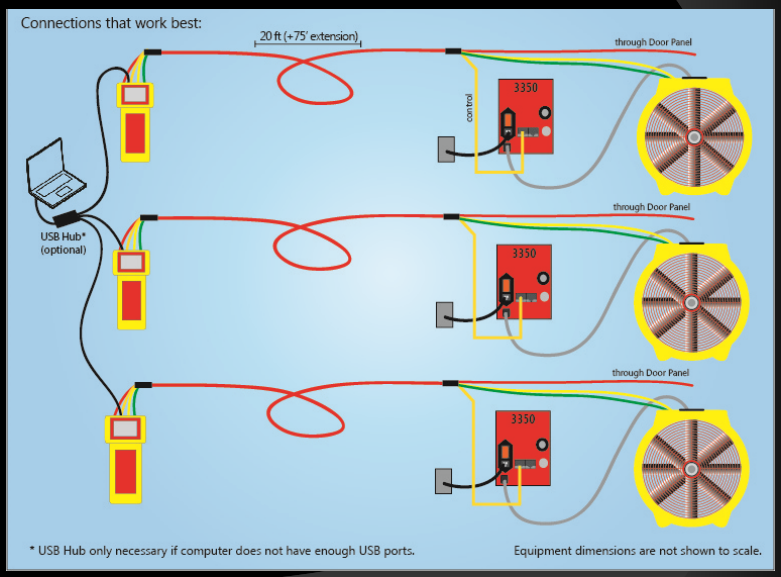
Automatic vs. manual data collection



Types of door fan tests 3

Lots of cable & tubing



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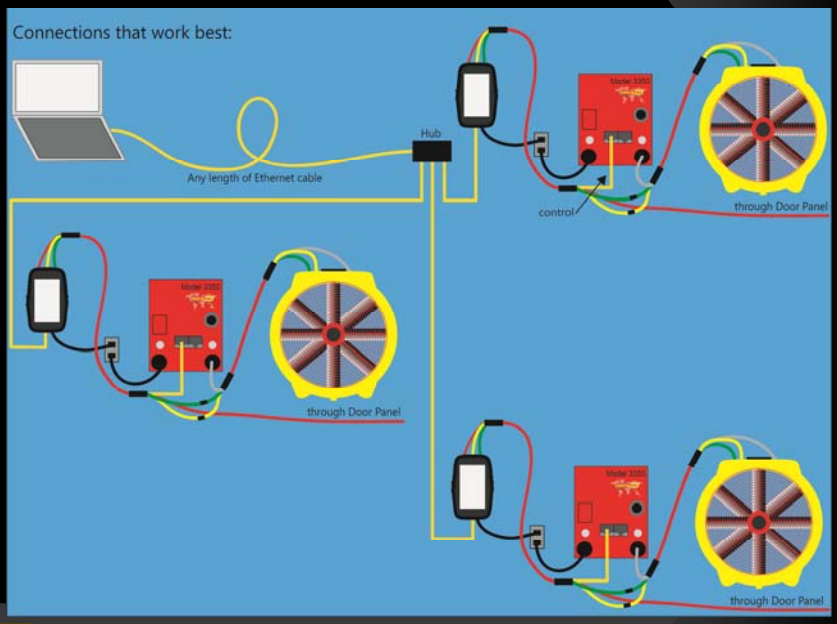

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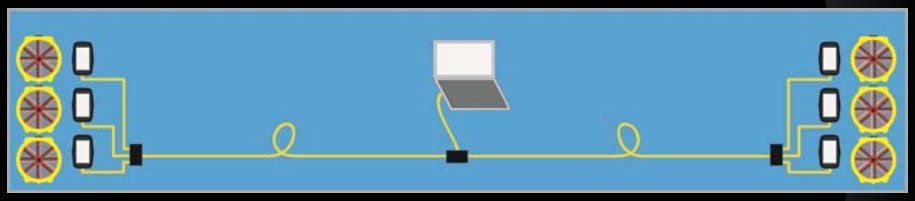
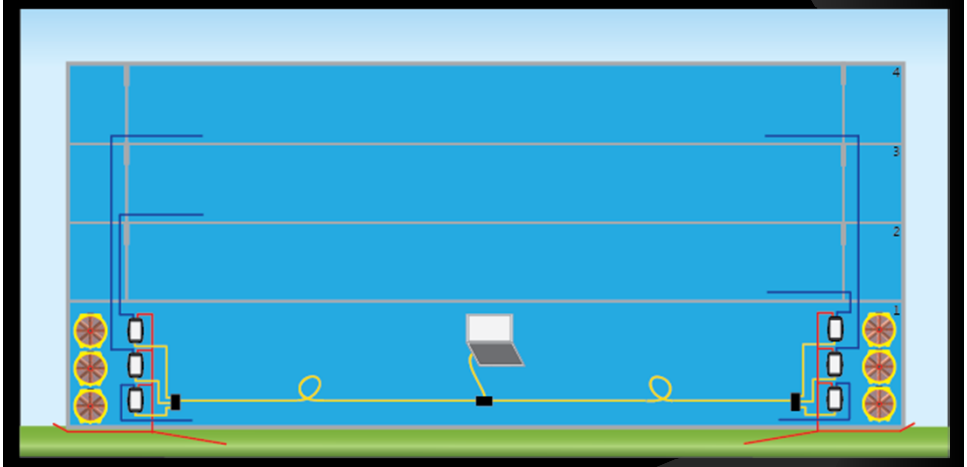
Easier connections





Conclusions

- Virtually any component of a building can be tested
- Running tubing and speed control cables long distances is cumbersome
- New technology eases setup & allows testers to take advantage of existing networks
- Software is needed for large tests with many fans

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Questions?
Comments?
Angry rants?

Denali Jones
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