



CREATING REPORTS YOUR CLIENTS WILL LOVE

Corbett Lunsford, Tech. Director, Green Dream Group
Developer, *APT (Automated Performance Testing) Reports*
Author, *Home Performance Diagnostics: the Guide to Advanced Testing*
Founder, Building Performance Workshop
HERS Rater/QAD & BPI Super Proctor
Exec. Dir., IL Assoc. of Energy Raters & Home Performance Professionals





MY TOOLS

APT REPORTS

BUILDING PERFORMANCE WORKSHOP
a division of Green Dream Group

CHICAGO HOME PERFORMANCE
a division of Green Dream Group

AIR LEAKAGE & PRESSURE TESTING

RECOMMENDATIONS

UTILITY BILL ANALYSIS

CONNECTION TO OUTDOORS

CUSTOMIZED SOFTWARE TOOL

HOME PERFORMANCE DIAGNOSTICS

the guide to advanced testing

by **Corbett Lunsford**

with a foreword by **John Straube of Building Science Corporation**



BUILDING PERFORMANCE WORKSHOP
a division of Green Dream Group



FIRST, THE MUSIC:

Home Performance Professionals must think on TWO TRACKS:

- Relationships
- Consequences



SMALL BUSINESS IS NOT ALL BUSINESS



- Write the way you talk
- Your personality is your most unique product
- You establish your own worth
(SO BE SEXY AS HELL)

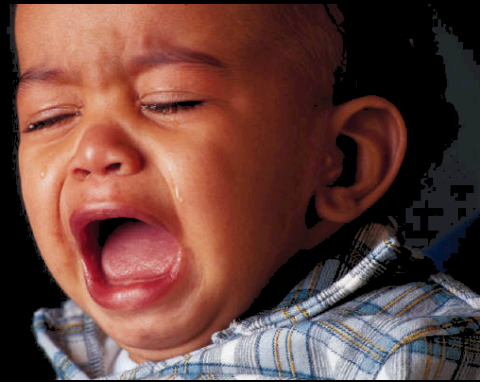
Treat your equipment and your people like a million bucks.



THE ANTI-K.I.S.S.

RULE #1:

- Don't Hurt Your Client's Feelings



RULE #2:

- Don't Hurt Your Competition's Feelings
(if you can possibly help it)

PRACTICE MAKES PERFECT



THE 3 STEPS

IN THE FIELD:

1. Inspection
2. Diagnostics
3. Recommendations

IN YOUR REPORT:

1. Recommendations
2. Diagnostics
3. Inspection



YOUR JOB

SOLVE THE CLIENT'S PAIN.

Home Inspectors inventory the ***static*** state

Home Performance Pros analyze ***dynamic*** states

The person with the data wins.



BOILING IT DOWN: THE SILVER BUCKSHOT

- Two Systems that Perform in the Home:
 - Envelope
 - HVAC
- Three Complex Recommendations:
 - Air Sealing
 - Insulation
 - HVAC



EVERY CLIENT IS UNIQUE

- Over 40 diagnostic techniques in the book
- Hundreds of possible recommendations
- Thousands of possible report formats



THE DESK JOB

- How much time do you spend in the field?
- How much time do you spend on reports?





MODULARITY

- How many different symptoms?
- How many different opportunities for improvement?
- How many competitors with an identical report template?

January 1, 2011

SAMPLE CLIENT
123 Chicago Ave.
Chicago, IL 60601



RECOMMENDATIONS

Prioritized by Importance and Sequence - TACKLE ITEMS IN ORDER

These suggestions for your home's improvement are cost-benefit-prioritized and based on our inspection and test results. We will encourage you to contact our affiliated contractors to complete these steps, though we do not warranty or guarantee their workmanship, or the results obtained by any other outside contractor. Please use this entire Home Performance Package to inform whichever contractor you do hire, and feel free to contact us for continued support and any other energy issues that may arise in the future. We will return one time at your request once the work recommended below has been completed, to perform combustion safety test and inspect the quality of the work.

**SP= Estimated Simple Payback, accounting for utility cost savings only. Remember that these improvements will also improve Comfort, Safety, Durability, and Home Resale Value.*

**Do-It-Yourself: If you have the time and energy to do any of this yourself, watch our DIY Videos at:
www.ChicagoHomePerformance.com/resources*

**ALL FINANCIAL INCENTIVES ARE LINKED FROM THE FRONT PAGE OF OUR WEBSITE:
www.ChicagoHomePerformance.com*

SUMMARY:

The good news is: your beautiful home already has some nice high performance features, and has some great opportunities for improvement. Airsealing is the single biggest investment you can make at the moment.

The **blower door test** demonstrates that your home is about **3** times as drafty as necessary to maintain air quality. Air sealing is a top priority for improving comfort, durability, and energy efficiency, and is part of several of the measures described below.

Simple Air Sealing:

These are steps that are possible to do yourself or through a handyman, and should be guided by the images in the *Infrared Inspection Report*. Use weatherstripping on moving parts (doors and windows), siliconized caulk on small gaps and cracks, canned spray foam on larger gaps/holes or around penetrations of pipes/cables, and rigid foam board insulation on big air pathways.

Using the *Infrared Inspection Report*, focus on:
Exterior and Basement penetrations
Windows and Doors

Natural Gas Leaks:

SAFETY ISSUE: Natural gas leaks were detected, tagged and photographed. Have a plumber or handyman seal these with joint compound, or replace valves or joints.

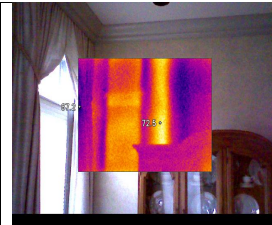
Combustion Gas Backdrafting:

SAFETY ISSUE: During testing of the combustion appliances under worst-case depressurization conditions, the combustion gases were sucked back down the exhaust flue into the house.

Provide adequate combustion air for the combustion appliances by installing **90** in² of vent to the house in the mechanical room wall, or by replacing the door with a louvered door.



IR003087.IS2
10/8/2009 3:15:52 PM
FL1: Duct/flue in exterior wall.



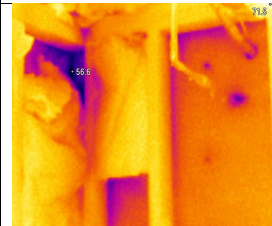
IR003089.IS2
10/8/2009 3:16:34 PM
FL1: Ductwork in exterior wall.



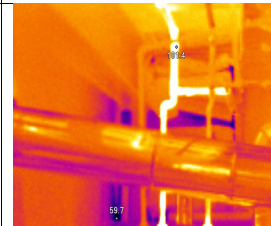
IR003092.IS2
10/8/2009 3:20:43 PM
FL2: Unsealed, uninsulated ductwork in bonus room.



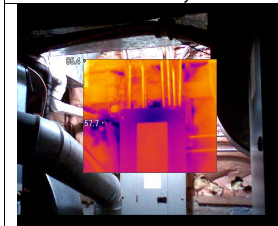
IR003094.IS2
10/8/2009 3:28:09 PM
BSMT: Frame wall above foundation- air leakage at rim joist, insulation discontinuity.



IR003098.IS2
10/8/2009 3:32:58 PM
BSMT: Pipe penetration air leakage, insulation discontinuities.



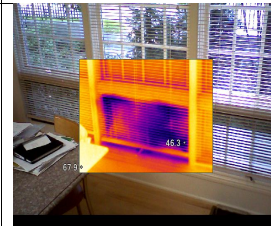
IR003099.IS2
10/8/2009 3:33:11 PM
BSMT: Pipes uninsulated, wall air leakage.



IR003101.IS2
10/8/2009 3:33:31 PM
BSMT: Electrical and pipe penetrations- air leakage.



IR003318.IS2
10/13/2009 10:15:03 AM
BSMT: Second egress window.



IR003322.IS2
10/13/2009 10:16:33 AM
FL1: Center window's gasket seems broken. Augment or replace.

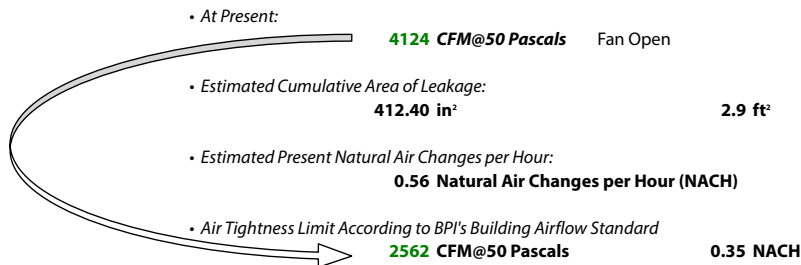


February 1, 2013

Sample Client
123 Chicago Ave.
Chicago, IL 60601

AIRFLOW & PRESSURE TESTING

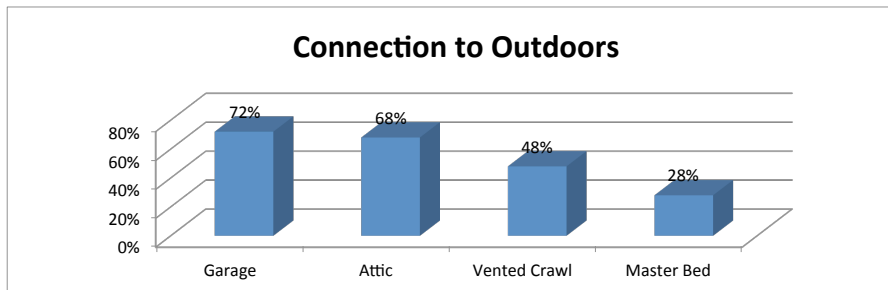
BLOWER DOOR TEST:



Presently, it appears to be that all the air in your home is replaced **every 107 minutes.**

Based on our diagnostics, we recommend making the home up to **57 % tighter** (before mechanical ventilation is required.)

Your home requires **61 CFM** minimum for ventilation (once mechanical ventilation is required.)



All areas should ideally show an airway connection of either 0% or 100% - completely inside or outside



February 1, 2013

Sample Client
123 Chicago Ave.
Chicago, IL 60601

HVAC ANALYSIS & SAFETY

WORST-CASE DEPRESSURIZATION TEST:

A '**worst-case**' scenario was created for your gas combustion appliances (furnace, boiler, water heater) with the home's own exhaust systems and air handler, and the results were compared with BPI standards for safety.

- Combustion Appliance Zone (CAZ) Baseline Pressure, and Worst Case Pressure

-3.1 Pascals	-8.5 Pascals
---------------------	---------------------
- Worst-Case Depressurization Test Results:
The main combustion appliance zone FAILED testing.
 See the Opportunities For Improvement report for more about this important safety issue.

CARBON MONOXIDE AND FLUE GAS SPILLAGE:

- Unsafe levels of Carbon Monoxide (CO) were emitted by the following:

Water Heater	143 ppm
Furnace	26 ppm
- **Spillage of combustion gas was detected during testing.**
 See the Opportunities For Improvement report for on more about this important safety issue.

COOKING SAFETY:

- SAFETY ISSUE: your kitchen's cooking range does NOT appear to be exhausted to outdoors. Have exhaust ventilation installed.
- **Steady state CO emissions from the oven exceeded 100ppm.**
 See the Opportunities For Improvement report for more about this important safety issue.

GAS LEAKS:

- **Combustible gas leaks were detected and tagged. See the Opportunities for Improvement report for more on this safety issue.**

COMBUSTION ANALYSIS:

Appliance	CO emission	Spillage	Draft Pressure (Pa)	Running °F	% Efficiency
Water Heater	143	fail	-2.1	512	79
Furnace	26	pass	-6	301	83



July 31, 2012

Sample Client
123 Chicago Ave.
Chicago, IL 60601

HVAC ANALYSIS

OVERALL SYSTEM AIRFLOW PERFORMANCE:

The static pressures, airflows, and configuration of your systems was investigated and performance tested, and the data is as follows:

Static Pressure	Nominal Airflow	Tested Airflow	Ideal Duct Leakage	Tested Leakage	Leakage as % of Total
supply .269", ret .705" TOTAL .974" w.c.	1200 CFM	1218 CFM	<6%, or 64 CFM	760 CFM@25	72%
		*Pitot tube		*ASTM Duct leakage test leakage to outside 49 CFM@25, which means the leakage is all indoors	

See the Recommendations Report for the solution to the red numbers

REGISTER AIRFLOWS:

<u>FL2</u>		<u>FL1</u>		<u>BSMT</u>	
Register	Tested Airflow	Register	Tested Airflow	Register	Tested Airflow
BATH +	52	FRONT HALL +	131	FRONT RM +	179
HALL +	100	BATH +	122	UTIL ROOM +	198
NW BED +	104	KITCHEN -	148	BATH +	47
NW BED -	138	KITCHEN +	80	BED +	34
NE BED +	126	DINING +	29	SUPPLY TOTAL	458 CFM
NE BED -	122	DINING -	35	RETURN TOTAL	0 CFM
MASTER +	65	LIV RM SE -	92		
MASTER -	105	LIV RM SW -	84		
SUPPLY TOTAL	447 CFM	LIV RM +	113	HOUSE TOTALS:	
RETURN TOTAL	366 CFM	SUPPLY TOTAL	474 CFM	SUPPLY TOTAL	1378 CFM
		RETURN TOTAL	459 CFM	RETURN TOTAL	824.8 CFM

"+" means supply, "-" means return

all airflow measurements in CFM, tested with a vane anemometer

EXHAUST SYSTEMS ANALYSIS:

Your dryer and other FL1 bath exhausts are all ducted together, which is a moisture and air quality problem. See the Recommendations report for more on this issue.

FAN	Ideal Airflow	Tested Airflow
FL2 BATH	50	29
BSMT BATH	50	16



February 1, 2013

Sample Client
123 Chicago Ave.
Chicago, IL 60601

UTILITY BILL ANALYSIS

HEATING UTILITY: _____	North Shore	ELECTRIC CO: _____	Ameren
FUEL TYPE: _____	natural gas	ANNUAL ELECTRIC USAGE: _____	12133
ANNUAL GAS COST: _____	\$2,198.42	ANNUAL ELECTRICITY COST: _____	\$1,033.00

SUMMER SAMPLES:	DATE	BILL DAYS	UNITS	UNITS/DAY
	Jun-13	28	29.13	1.04
	Jul-13	31	31.24	1.01
	AVG BASE LOAD/DAY			1.02
	AVG BASE LOAD MMBTU/DAY			0.10

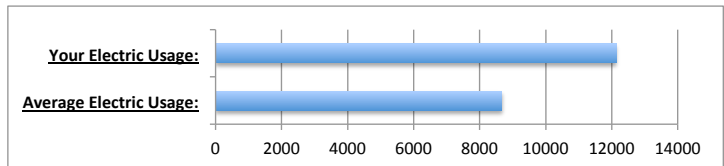
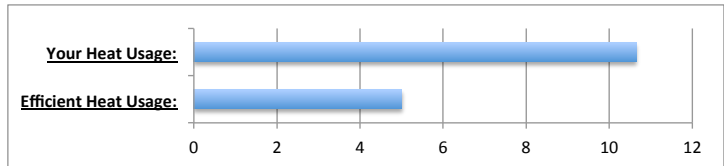
**Base Load consists of hot water, cooking, and clothes drying*

WINTER SAMPLES	DATE	BILL DAYS	UNITS	UNITS/DAY
	Dec-12	30	397.88	13.26
	Jan-13	30	451.25	15.04
	Feb-13	29	449.48	15.50
	SUM	89	1298.61	
	SPACE HEAT USAGE		1207.47	13.57

SPACE HEAT USAGE	1207.47
SQUARE FEET	3891
HEATING DEGREE DAYS	2913
HEAT USE (Btus/ft²/hdd)	10.65

BASE LOAD AVG.: .07-.1 BTU/DAY

HEAT USE AVG.: 5 = EFFICIENT
10 = INEFFICIENT
15 = VERY INEFFICIENT



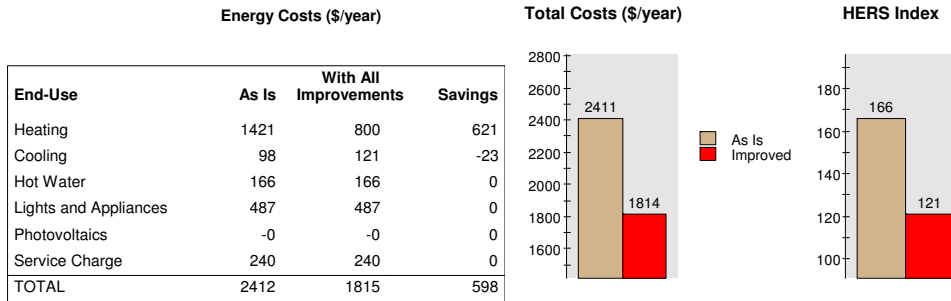


Energy Costs by End-Use

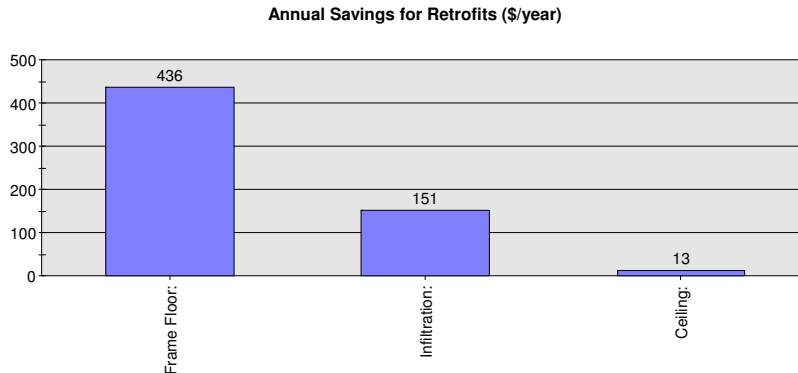
The Energy Costs table compares the "before" and "after" annual energy costs to show energy cost savings. It groups retrofits by "end-uses," which are broad categories of how energy is used (or generated) in a home. Note that Photovoltaic panels (PV) generate energy, so as a result this "end-use" shows negative costs, if present.

The Total Costs bar chart gives a visual sense of how the annual operating costs of your house could change by incorporating all the listed energy retrofits.

The HERS Index bar chart provides a snapshot of your home's energy efficiency before and after retrofits. The HERS Index shows the energy efficiency rating of your home, similar to the way a miles per gallon rating shows the efficiency for a car.



The bar chart below displays the annual energy cost savings (\$ per year) associated with the energy retrofits you choose. Some retrofits interact with one another, and the total savings offered by each can change if the package of combined retrofits changes. For example, if you increase the insulation of your home, the energy savings you can gain from installing a more efficient furnace will be less than if you only install the furnace. However, the total savings will be greater if you choose both retrofits.



WARNINGS

Moisture:	
CAZ:	
CO:	
Spillage:	
Draft:	
Gas Leaks:	



***ALL GRAY BOXES TO BE FILLED**

Date: _____

Homeowner: _____

Street Address: _____

City, State ZIP: _____ LBL Zone: _____

Expectations: _____

Renovations: _____

Temp Outside: _____ Year Built: _____ Floor Area: _____

Temp In: _____ Moved In: _____ Volume: _____

%RH In: _____ Bedrooms: _____ Shielding: _____

Wind: _____ People: _____ Facing: _____

Weather: _____ ASHRAE 62.2: _____ Stories: _____

N= #VALUE!

FEATURES

Foundation Type: _____

Insulation: _____

Wall Type: _____

Insulation: _____

Ceiling Type: _____

Insulation: _____

Ventilation: _____

COMBUSTION APPLIANCE

APPLIANCE	CO ppm	Spillage pass/fail	Draft Pa	Temp °F	Efficiency %

Draft Limit: _____

Recessed Lights? yes

2 problem?

3 problem?

4 problem?

1 opportunity?

2 opportunity?

3 opportunity?

4 opportunity?

WORST-CASE TEST

Baseline: _____

Worst Case: _____

Adjusted: _____

Low Limit: _____

Gas Oven: _____

Oven CO ppm: _____

Exhausted?

Gas Leaks?

FAN FLOWS

Fans: _____ CFM

_____ CFM

_____ CFM

_____ CFM

AIR LEAKAGE TEST

Building Airflow Standard:

Height Corrected N: #VALUE! BAS@nat: _____

BAS@50: #VALUE! BAS@50: #VALUE!

Blower Door:

CFM@50Pa: _____ Ring: _____

CRF: _____ Pa Reached: _____

Duct Leakage:

Total CFM@25Pa: _____ To Outside: _____

Duct PR PAN Criteria: _____

ZONAL PR w/ Blower Door w/r/t outside:

Zones:	_____ Pa
	_____ Pa
	_____ Pa
	_____ Pa
	_____ Pa
	_____ Pa
	_____ Pa

APPLIANCES

	Model, Fuel, and Type:	Input kBtuh:	Output kBtuh:	Stated Eff:	Year:
Furnace 1:					
Furnace 2:					
Boiler 1:					
Water Heater:					
A/C 1:					
A/C 2:					
Other:					

WHERE IT ALL BEGINS: THE INPUTS



CUSTOMIZATION

Programming teaches
us to think better

APT Reports
development process is
user-generated





NEED-TO-KNOW BASIS

- Collect as much data as you need
- Show your client as much as they need





RECOMMENDATIONS

What is the problem?

- Symptoms
- Causes

Why should they fix it?

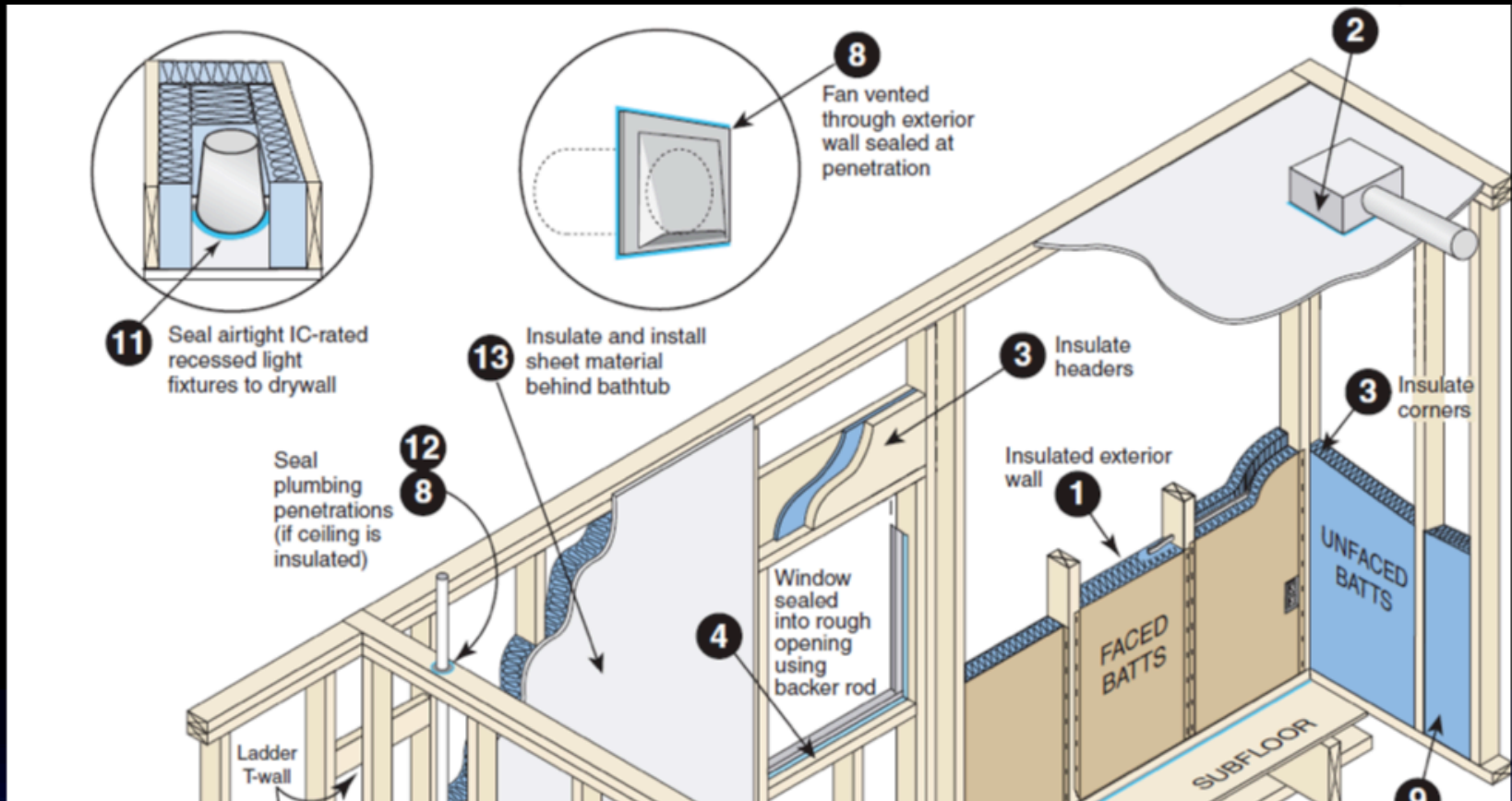
How best to do so?



Don't hassle with How-To

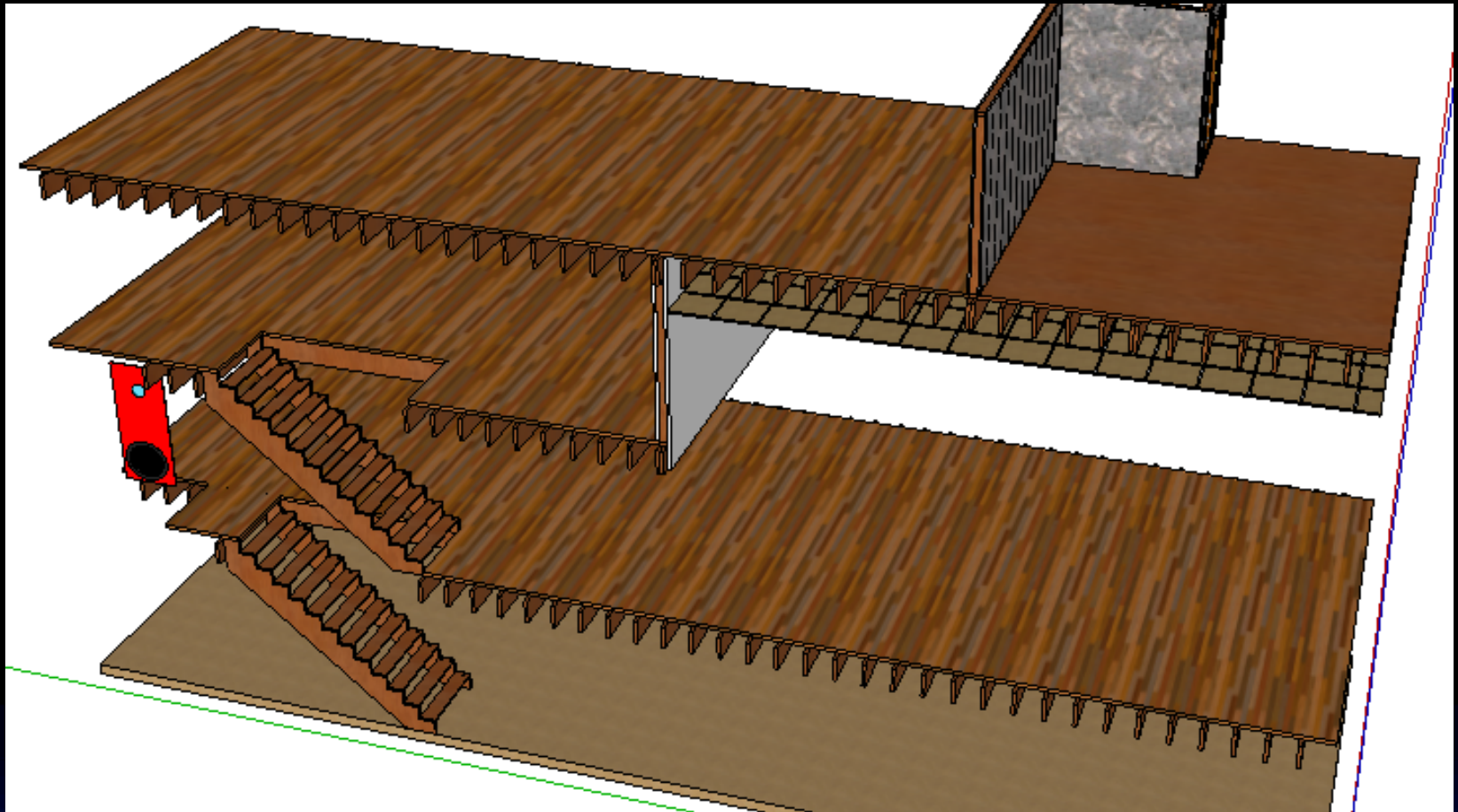


SHOW, DON'T TELL





SHOW, DON'T TELL





DEVELOP YOUR LIBRARY

- Airseal/Insulate
- HVAC
- Architectural/Structural
- Safety

AIRSEAL/INSULATE	WINDOWS	Window Sealing In Basement: There are a few windows down here that you said you'd rather not have. If you don't need the little bit of light coming through them, sealing and insulating them would be an excellent idea. Windows are the weakest link in the wall, and if they're not being looked out of, they're not doing you any good. Use 2" rigid foam board insulation to cover the entire window, and seal the edges with canned spray foam, to make it airtight.
ARCH	CHIMNEY	Chimney Liner and Cap: From the ground, it didn't appear to be that your chimney is capped, which means it might also not be lined. This makes it difficult to properly exhaust the combustion gases of the boiler and water heater, and may lead to degradation of the chimney. It should be verified.
ARCH	MOISTURE	Moisture Issues: See the Infrared Inspection Report for photos of all of the following:
ARCH	RENOVATION	Major Renovation Project: Feel free to call us again to be onsite consultants for you, or to verify your home achieves ENERGY STAR Home certification, when you begin this process. Or, just call us when you have specific questions. Essentially, you'll want your home to look like this when you're done: ROOF: The fewer gables, peaks and valleys you have, the easier the drainage and attic ventilation will be. Make sure if there are eave vents that there are soffit baffles installed inside the attic. Also, a light-colored roof will lower the surface heat in summer and extend the life of the shingles. CEILINGS: R-50 insulation in all attic floors or vaulted ceilings (this is 16" of the type of insulation you have now). All pipe/conduit/fixture penetrations should be airsealed prior to insulating. RECESSED CAN LIGHTING: We recommend poking zero holes in the ceiling plane, but if you must use recessed lighting, make triple sure it's ICAT (Insulation Contact, Air Tight) and not just IC. WALLS: R-25 insulation is achievable with continuous exterior insulation like XPS or Polyiso, or by using a staggered stud pattern. Exterior insulation should be sealed at every
ARCH	VENTILATION	Attic Ventilation: The rule of thumb is 1 sq. ft. of vent for every 300 sq. ft. of attic space. To go the extra mile and provide active ventilation over a certain temperature (like 95°F) with a solar attic fan would make good sense, as well.
ARCH	WATER	Water Drainage: Water drainage is a major concern for your home at present. Energy efficient improvements won't mean much if your house is deteriorating, and structural safety is obviously primary. Make sure there's enough drainage from the roof through gutters and downspouts to ensure that heavy precipitation is directed away from the house, either into the sewer or a rain collection



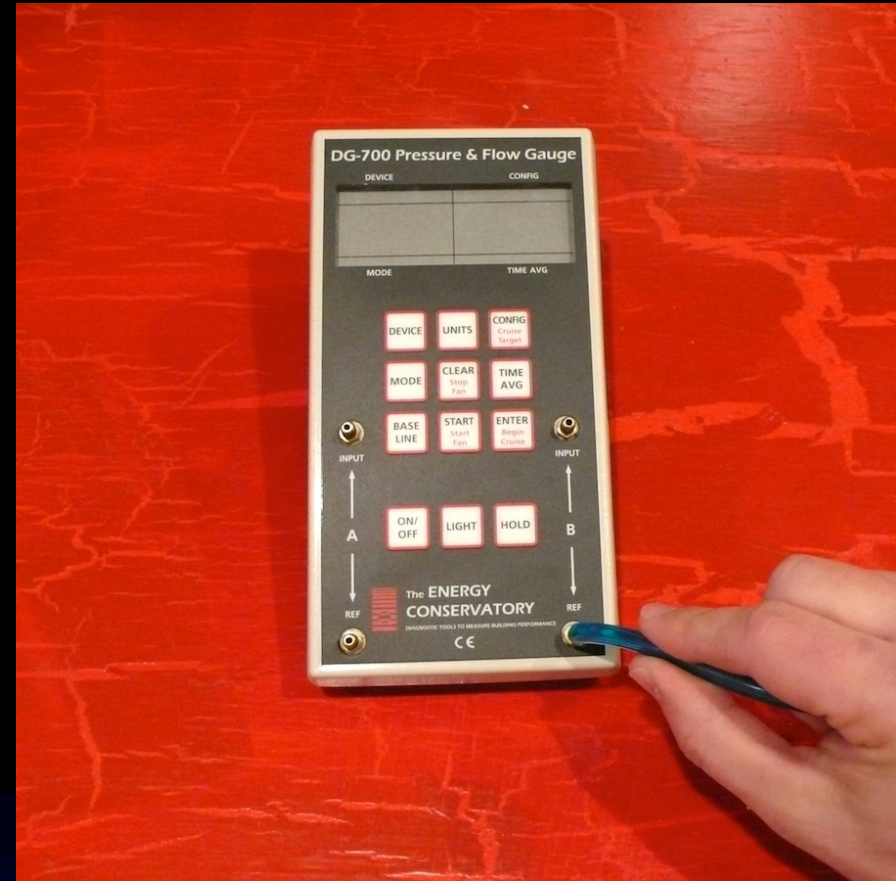
DIAGNOSTIC SEXINESS

ALWAYS:

- Blower Door
- 5-Point Combustion

WHEN CALLED FOR:

- Advanced Envelope
- Advanced HVAC





BLOWER DOOR SEXINESS

TAILOR THE MESSAGE TO YOUR CLIENT!

- Illustrations
- Graphs
- Analogies



**CHICAGO HOME
PERFORMANCE**
a division of Green Dream Group



EXPLANATION OF BLOWER DOOR TESTING

DEFINITION:

The blower door is a scientific device that tests the airtightness of a home. There are two key systems in any home that are most important for control of home performance: the **Envelope** (air sealing and insulation) and the **HVAC System** (heating, cooling and ventilation).

The Envelope is the more critical of these two systems, since air leakage and insulation deficiencies can defeat the performance of the HVAC System. Air tightness is, in fact, the single most important feature of any home- this is why the blower door test is important.



HOW IT WORKS:

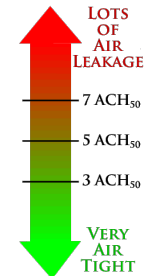
The blower door is used to blow air out of the house, and since the fan is finely calibrated, it can be hooked up to a digital gauge to determine exactly how much air is moving through the fan, in Cubic Feet per Minute (CFM).

Since it's not possible to create a vacuum inside the home, the same amount of air that's blowing through the fan out of the home must be also coming into the home through holes in the home's Envelope. Every home's blower door CFM is measured at the same pressure (50 Pascals), which is roughly the same amount as a 20 mph wind on every side of the home.

INTERPRETATION:

We can compare your home's *tested* airtightness to its *ideal* airtightness using the metric of Air Changes per Hour (ACH). Your home's air is completely replaced by outdoor air a certain number of times per hour under everyday conditions ($ACH_{natural}$) and during the blower door test, the replacement is accelerated by the fan (ACH_{50}).

The building code in Illinois prior to January 1, 2013 requires that any new home be more airtight than 7 ACH_{50} , and the code thereafter requires a tightness below 5 ACH_{50} . Airtightness is critical for control of home performance, so lower ACH numbers are *always* better. These numbers can be used in the MLS around Chicago to help sell homes faster or for a higher price!

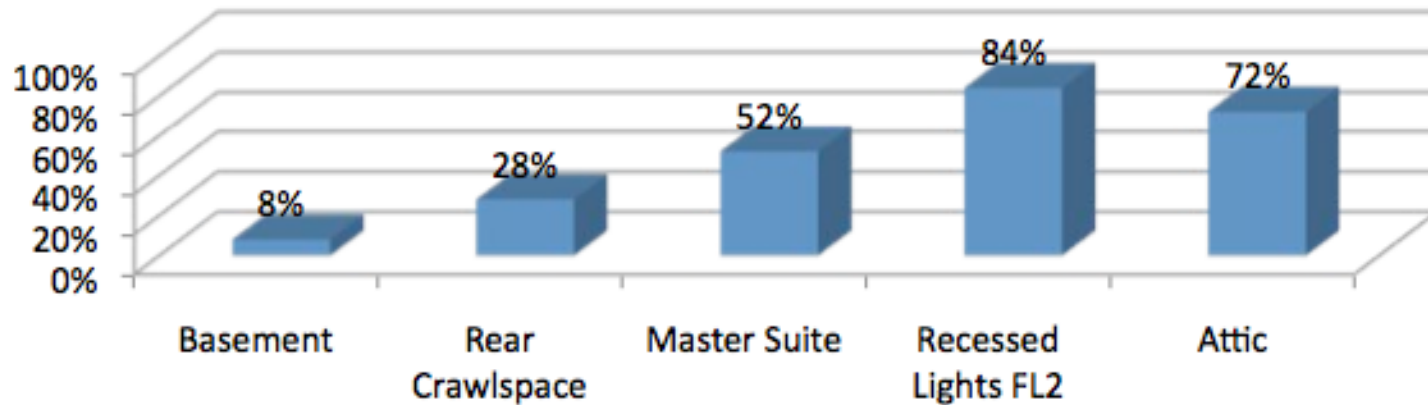




ZONAL PRESSURES (SEXY)

GET AS TECHNICAL AS YOUR CLIENT ENJOYS

Connection to Outdoors



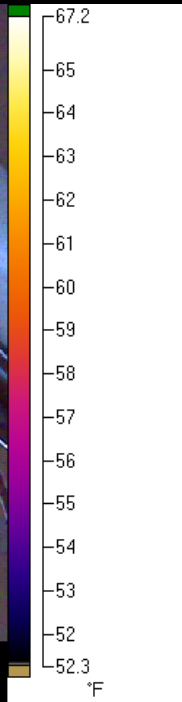
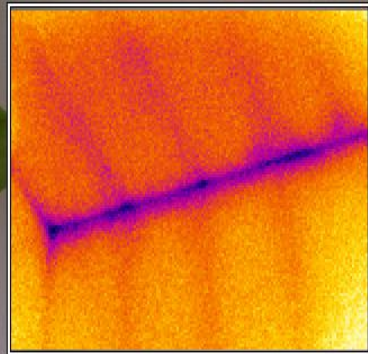


INFRARED SEXINESS

YOURS.

The Competition's.

Max = 73.6
Avg = 71.2
Min = 67.6

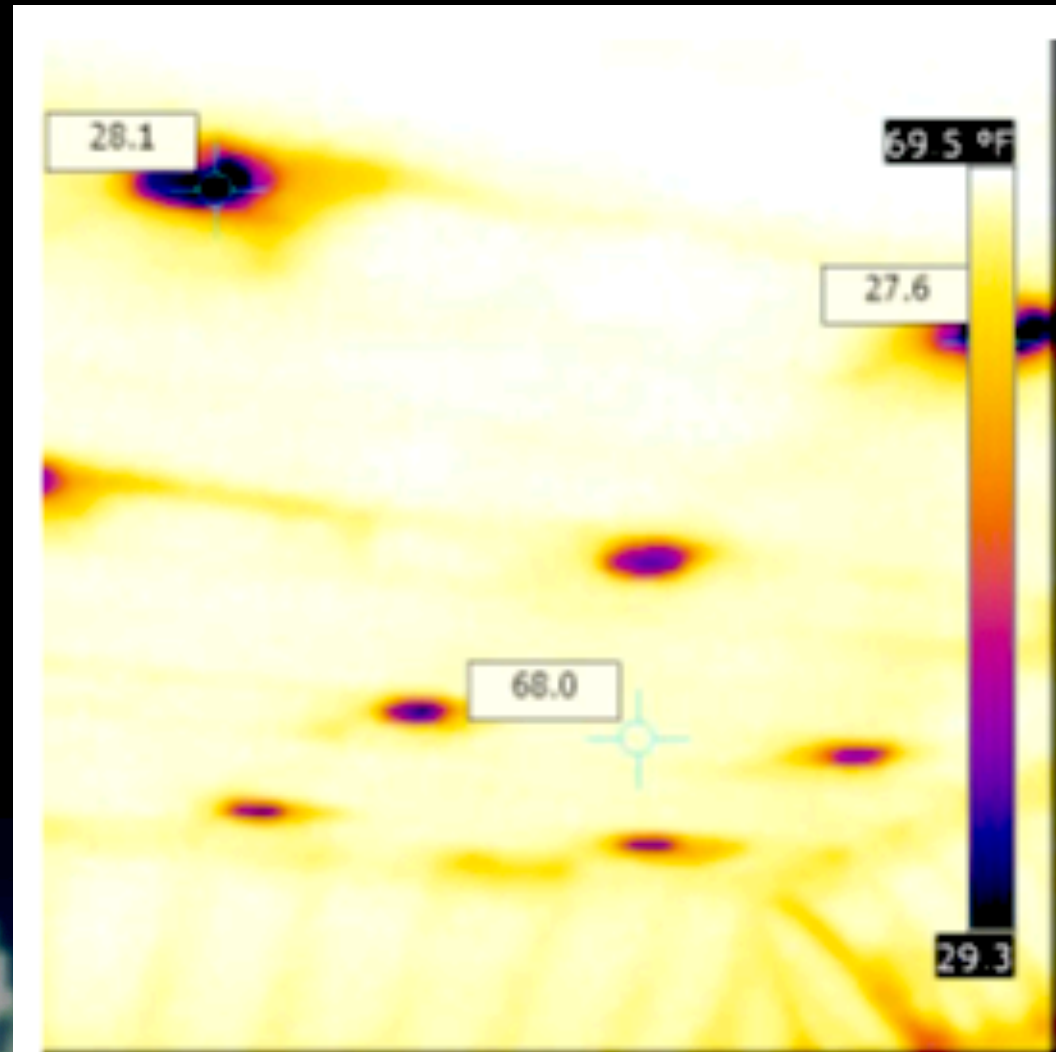




SHOW, DON'T TELL

Sexy colors
Good framing
Dynamic angles

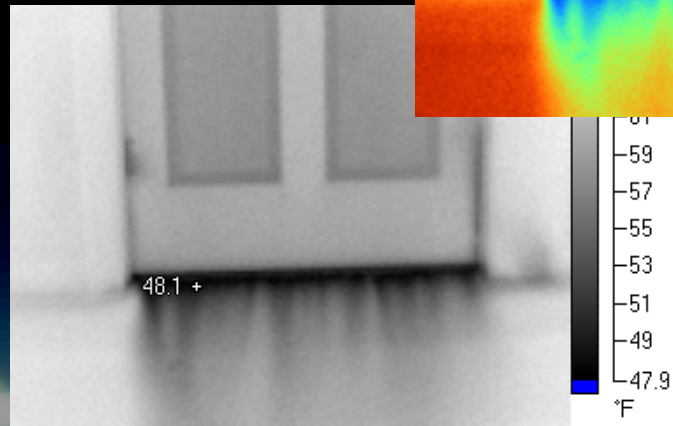
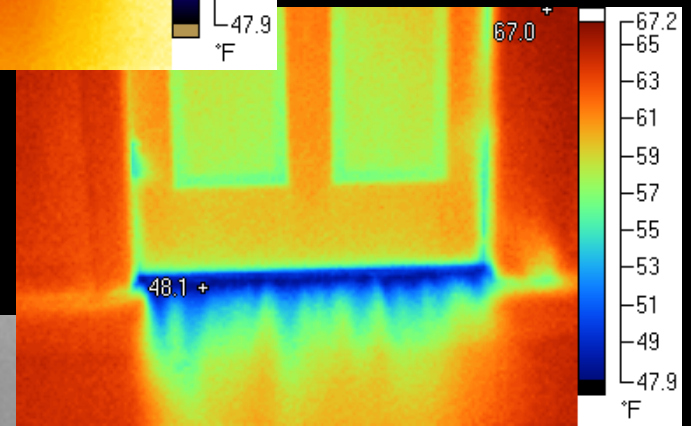
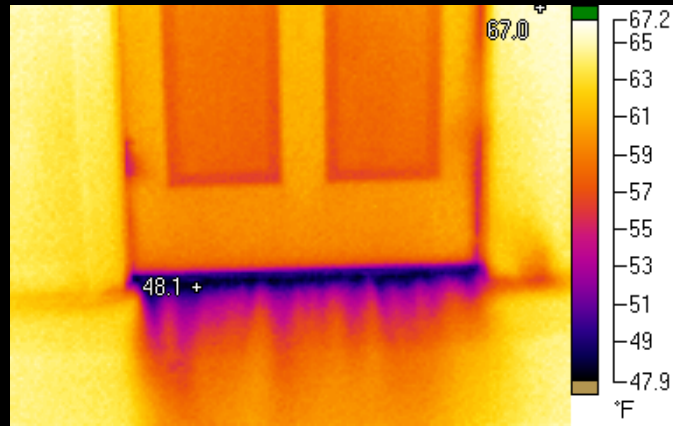
+ ACTUAL
SCIENTIFIC
DATA





CHOOSING A PALETTE

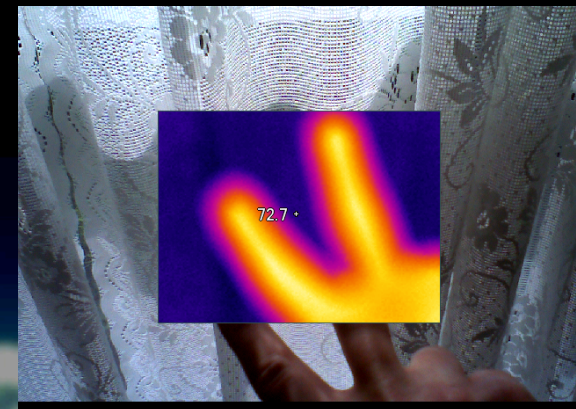
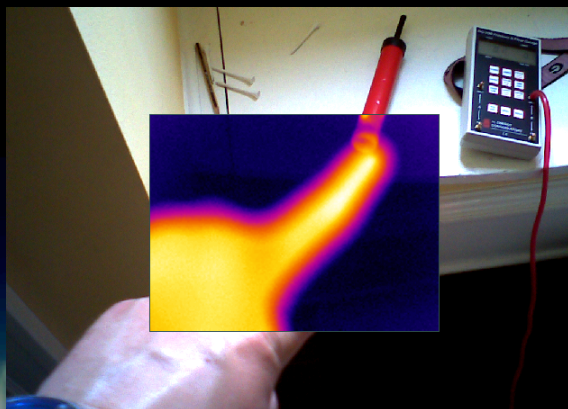
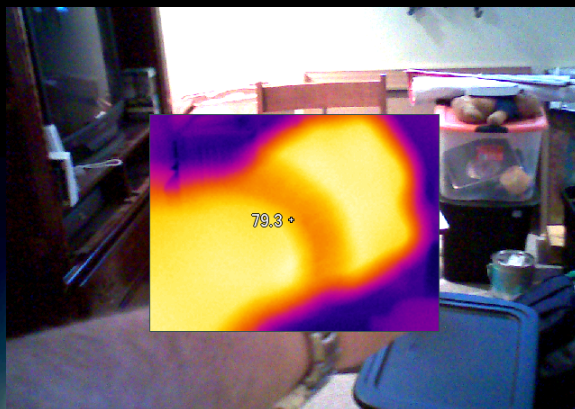
- Perception-Relative
- Spectrum-Relative
- Grayscale





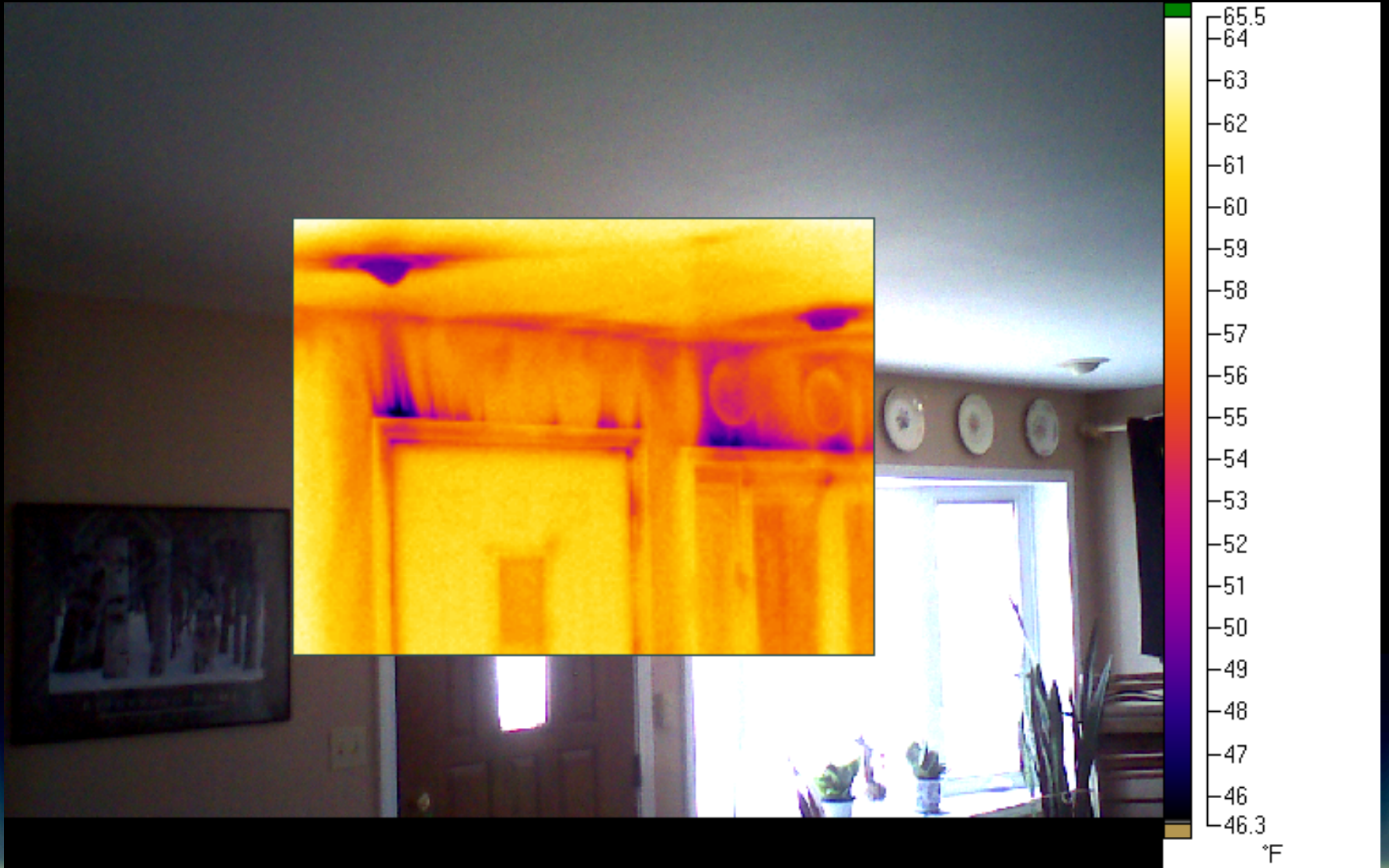
USE A PROTOCOL

- Start at lowest-pressure level
- Start at front door on each level
- Move clockwise
- Use hand signals





THINK AHEAD TO REPORTING





DEVELOP YOUR LIBRARY

- “Air leakage”
- “Insulation discontinuity or deficiency”
- “Moisture issue”
- “Air quality issue”

Prefix: BSMT, FL1, FL2

EXT: Structural issue.			
EXT: Potential drainage issue.			
EXT: Air leakage site.			
EXT: Heat loss from home.			
ATTIC: Air leakage site.			
ATTIC: Insulation discontinuity/deficiency.			
ATTIC: Moisture issue.			
ATTIC: Air leakage and insulation discontinuity/deficiency.			
BSMT: Gas leak detected and tagged.			
BSMT: Hot pipes uninsulated.			
BSMT: Moisture issue.			
BSMT: Insulation discontinuity/deficiency.			
BSMT: Air leakage.			
BSMT: Air leakage and insulation discontinuity/deficiency.			
FL1: Gas leak detected and tagged.			
FL1: Moisture issue.			
FL1: Insulation discontinuity/deficiency.			
FL1: Air leakage.			
FL1: Air leakage from attic, down through top plate of wall.			
FL1: Air leakage and insulation discontinuity/deficiency.			
FL2: Gas leak detected and tagged.			
FL2: Moisture issue.			
FL2: Insulation discontinuity/deficiency.			
FL2: Air leakage.			
FL2: Air leakage from attic, down through top plate of wall.			
FL2: Air leakage and insulation discontinuity/deficiency.			
FL3: Gas leak detected and tagged.			
FL3: Moisture issue.			
FL3: Insulation discontinuity/deficiency.			
FL3: Air leakage.			
FL3: Air leakage from attic, down through top plate of wall.			
FL3: Air leakage and insulation discontinuity/deficiency.			
Dryer duct crushed.			
Hot air exhaust inhibited.			
Fan flow inhibited.			
It appears to be that the exterior wall is NOT adequately insulated.			
It appears to be that the exterior wall IS adequately insulated.			
Ductwork in exterior wall.			
Indoor Air Quality Issue.			
Standby electrical losses.			
Indication of Duct Leakage.			



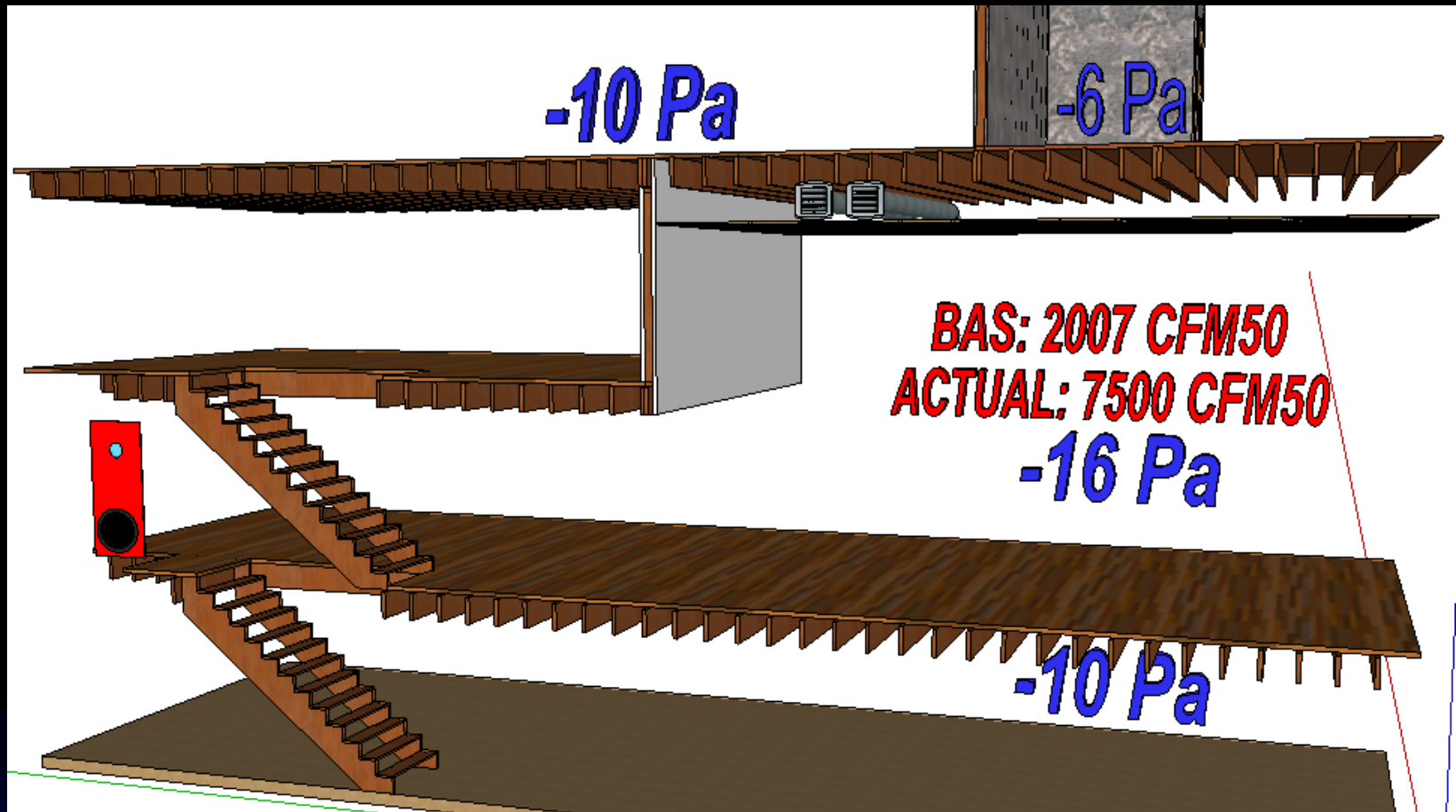
DIAGNOSTIC REPORTING

DO NOT BOG DOWN.

- Choose your ***standard*** and stick to it
- Can & should be entirely ***automated***
- ***Refer*** to your Recommendations report
- Safety First, and C.Y.A.



SHOW, DON'T TELL





UTILITY ANALYSIS

2 baseline samples

3 heating samples

Subtract baseline from heating

Convert to $\text{Btu}/\text{ft}^2/\text{HDD}$



INFLUENCING BEHAVIOR

Behavior = least controllable element

What's your parenting style?

- Thinking before speaking
- Awareness will self-correct behavior



THE FUTURE REPORT

- 3D, Interactive Modeling
- Online access
- Real-time updates
- Online bidding/proposals





THANKS FOR ATTENDING!

QUESTIONS?

COMMENTS?

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www.BuildingPerformanceWorkshop.com

Your presenter was:
Corbett Lunsford