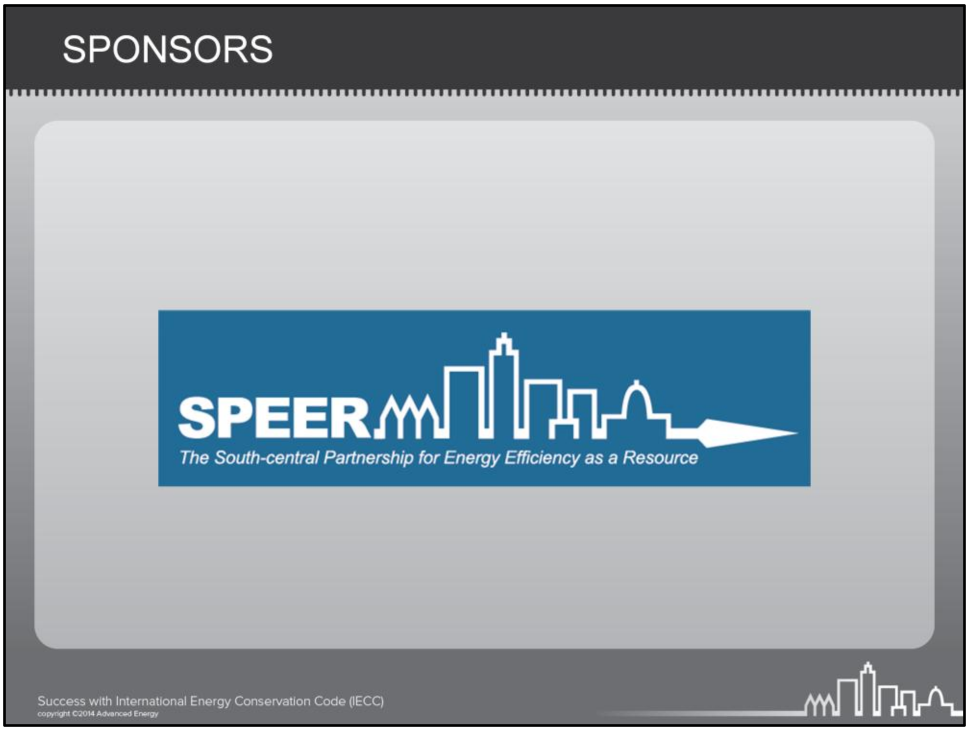
This is a cover slide to display as people gather for the training. Feel free to add your name, the date and class location if you like.

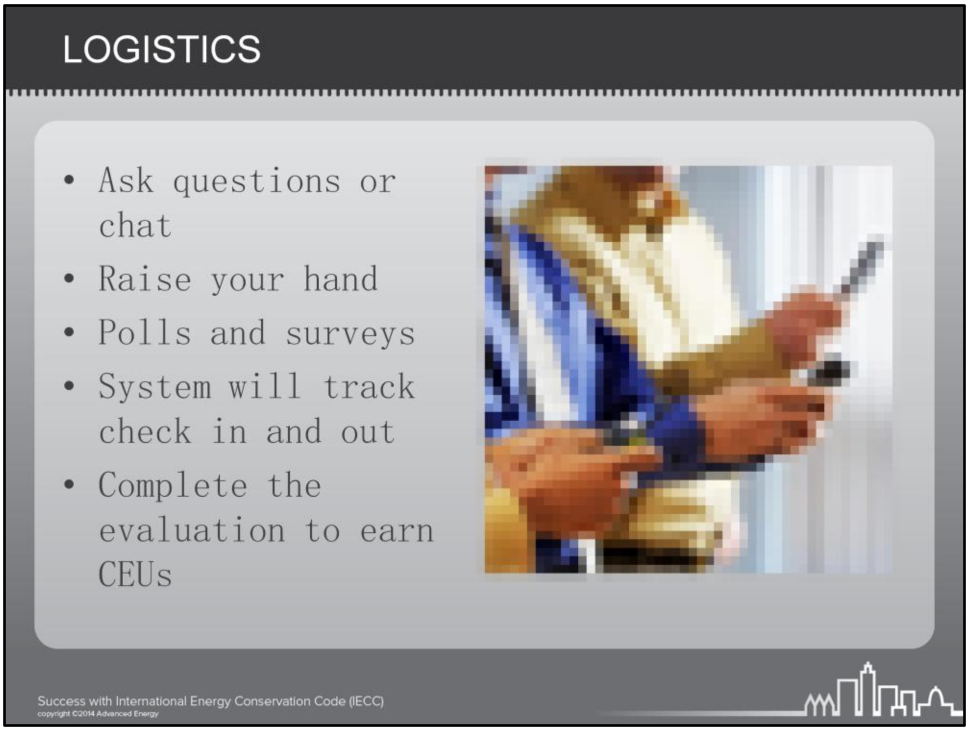
Narrative: Welcome to this SUCCESS with International Energy Conservation Code class. The SUCCESS with IECC class focuses on the requirements and desired outcomes of the energy code from the perspective of professionals – builders, trades, engineers and code officials – working to implement the code out in the field. The SUCCESS class places a focus on applied building science concepts and proven construction techniques that assist in achieving code compliance while delivering a home that is healthy, safe, comfortable, durable, energy efficient and affordable to own and operate.

Today's session will focus on lighting and HVAC installation critical details that, when done correctly, will assist builders in meeting the intent of the code and code officials in verifying compliance. The 2009 IECC and 2012 IECC have established standards that will save 15% and 30% energy, respectively, against a baseline 2006 IECC home. The 2015 IECC will save about 1% more energy than the 2012. This savings is, in part, achieved through more stringent lighting and HVAC systems requirements. But, to achieve those savings the details of the HVAC design and installation have to be done right. This session will help explain what right means in the case of HVAC systems and lighting.



Narrative: This course was developed by the South-central Partnership for Energy Efficiency as a Resource (SPEER) with the assistance of Advanced Energy, a nationally recognized building science training organization.

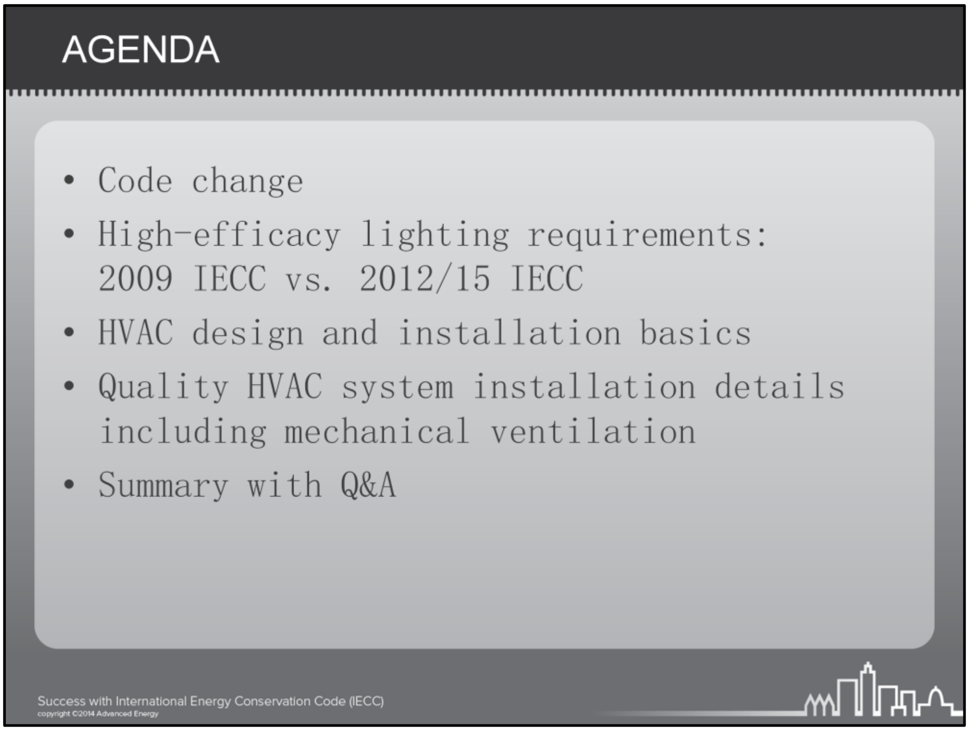
Point of Slide: Provide background on who developed these materials and the wide range of experience and knowledge leveraged to create the slides and book.



Narrative: Let’s take a moment to cover some logistics for the day:

- Share with the group where bathrooms are located
- Ask everyone to either turn off their cell phones or put their cell phones on vibrate
- Make sure everyone signs in and signs out as necessary (for either continuing education units or for internal reporting purposes)
- Clarify that there will be an evaluation that you would like everyone to complete at the end of the session
- *Be sure to mention breaks if you will be taking any*
- *Be sure to mention the time and location of breakfast or lunch if you are providing one or both.*

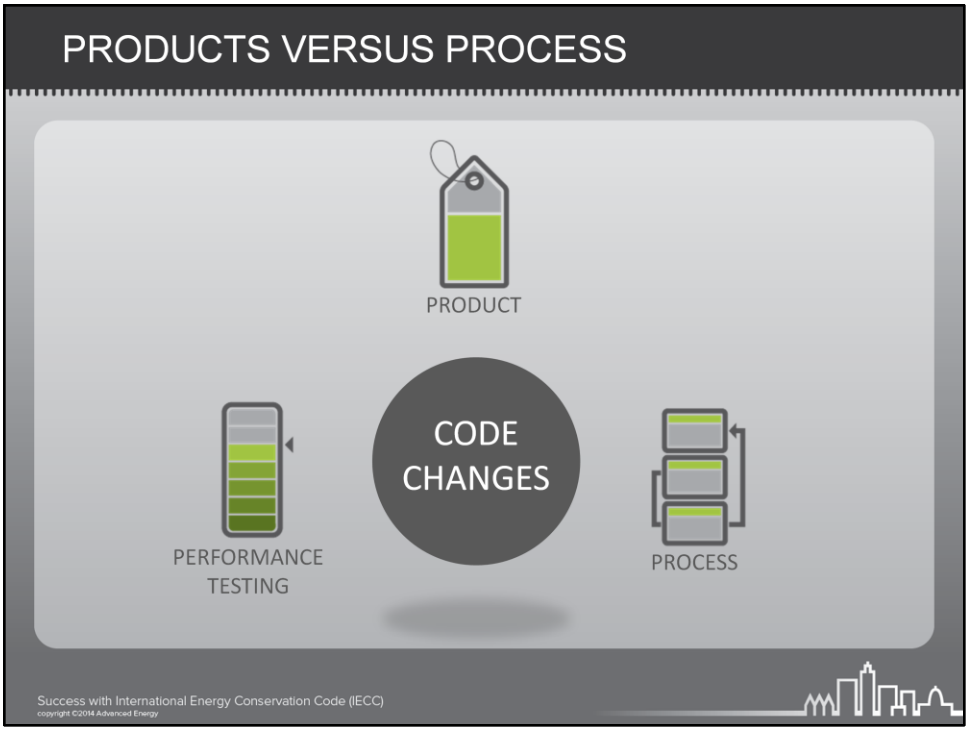
Point of Slide: Establishing logistics puts people at ease and helps the class run smoother.



Narrative: This agenda reflects the major topics we will be covering today and the order of the slides:

- We will start with a brief discussion of code changes, with special focus on the importance of having a clear process of meeting new requirements
- Before we get into HVAC design basics and installation details, which make up the bulk of this session, we will cover some lighting terms and requirements
- A brief introduction will be given introducing HVAC design requirements established by the International Mechanical Code, as well as a summary of common HVAC design and installation issues seen in practice
- The majority of the slides will cover requirements relating to duct insulation, installation and sealing, while also addressing ventilation installation details and new mandatory HVAC installation and testing requirements
- We will close with a summary of the days details and leave time for any final questions that we didn’t answer during the session

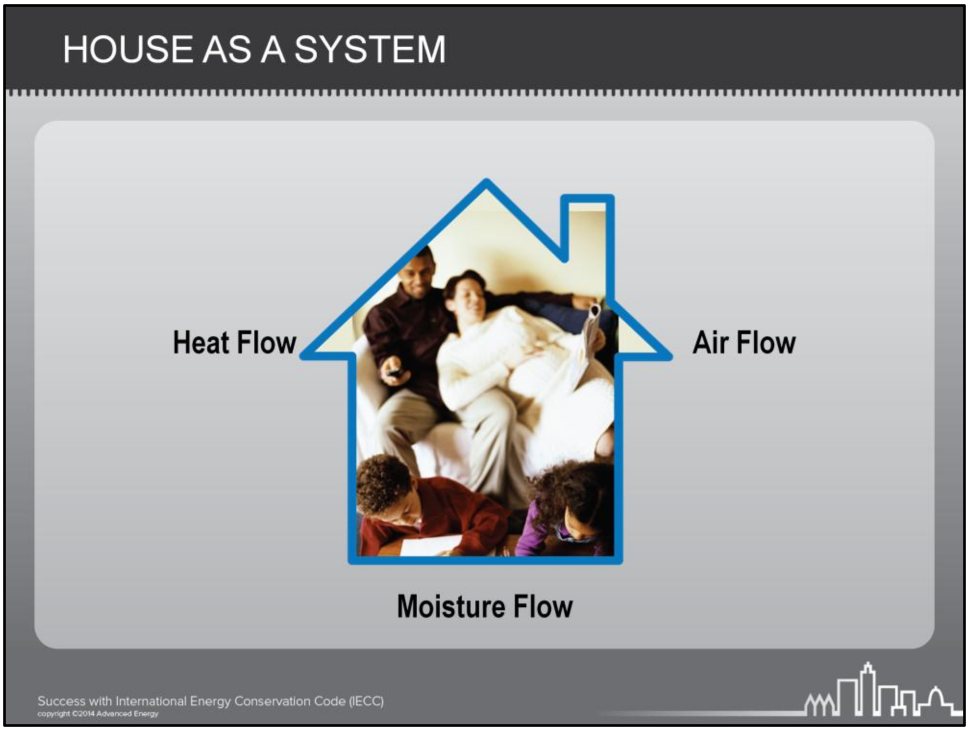
Point of Slide: This agenda describes the main sections of the training. It tells folks what they will learn, helps prepare them and allows them an opportunity to establish some initial questions.



This is an animated slide. Please be sure to note the order of the animation.

Narrative: The application of the code involves the products required, the process to install them and how they might be tested to ensure they work properly. The 2009 IECC is unique in that it was the first energy code to establish standards for field inspections and performance testing. The 2012 and ‘15 IECC go even further by having more detailed field inspection requirements and more stringent performance testing targets. But regardless of the individual code, all of the code requirements work together to increase the performance of the house, and all fall into one of these categories.

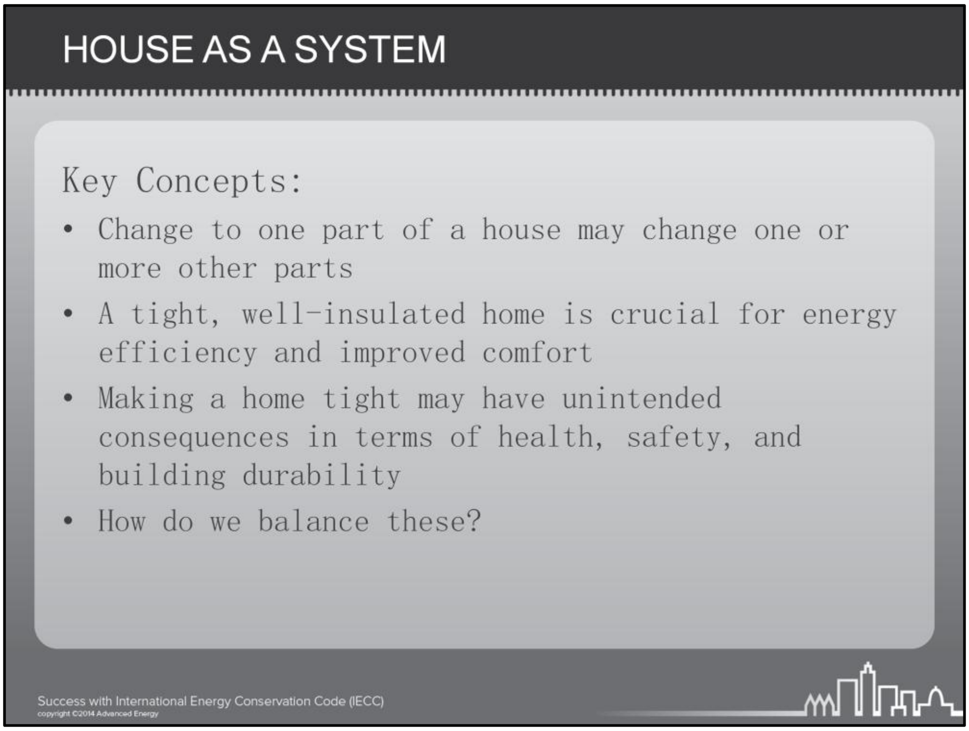
Point of Slide: It is important to understand the differences between code requirements, because they each have their own challenges and obstacles.



This is an animated slide. Please be sure to note the order of the animation.

Narrative: Just as different building professionals work together to meet code requirements, the different parts of the house interact with one another to form a functioning system that offers a safe, comfortable environment for occupants. One way to look at a house: **(click to animate text)** It's there to control air flow in and out; heat flow in and out; and moisture flow in and out. If we change one of these, it will have an impact on the others, and on the people in the house. **Click to animate image.**

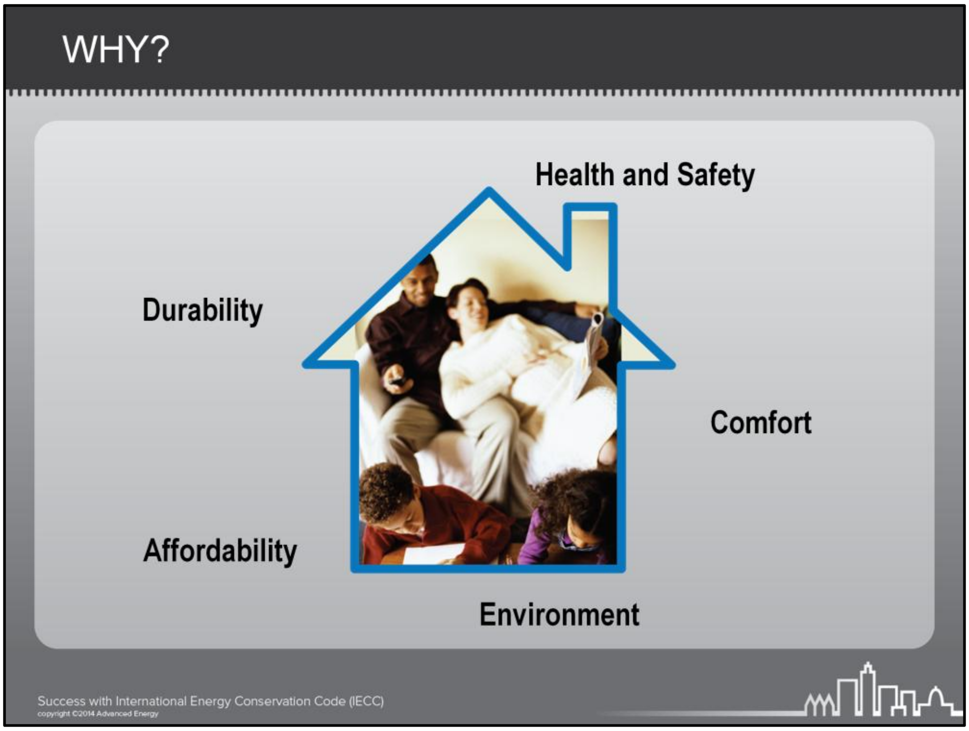
Point of Slide: New energy codes – and the people designing and constructing buildings – are now doing their best to take a systems approach and manage heat, air and moisture flow. For the next few slides will we focus on the basics of heat flow.



This is an animated slide. Please be sure to note the order of the animation.

Narrative: In building science, we always think of a house as a system. It is important that we consider all of these points as we make changes to a home. If we only concentrate on energy efficient materials or performance testing standards without considering the potential impacts on indoor air quality or durability, we can do harm to both the building and the occupants!

Point of Slide: Always be aware that changes to a part of a home can affect the whole home as a system.



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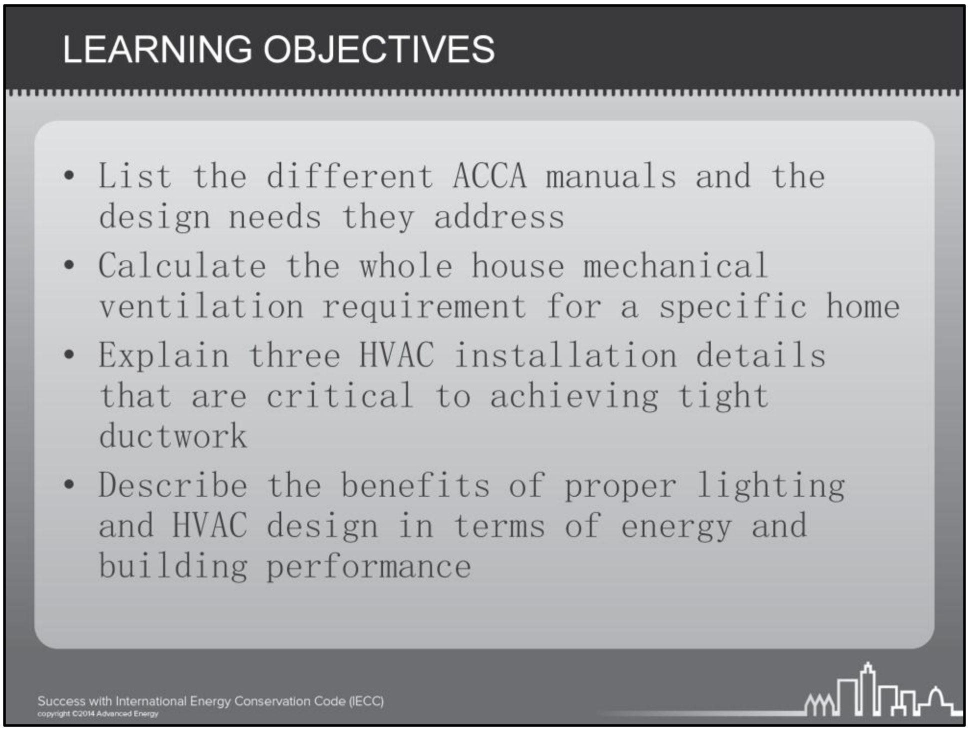
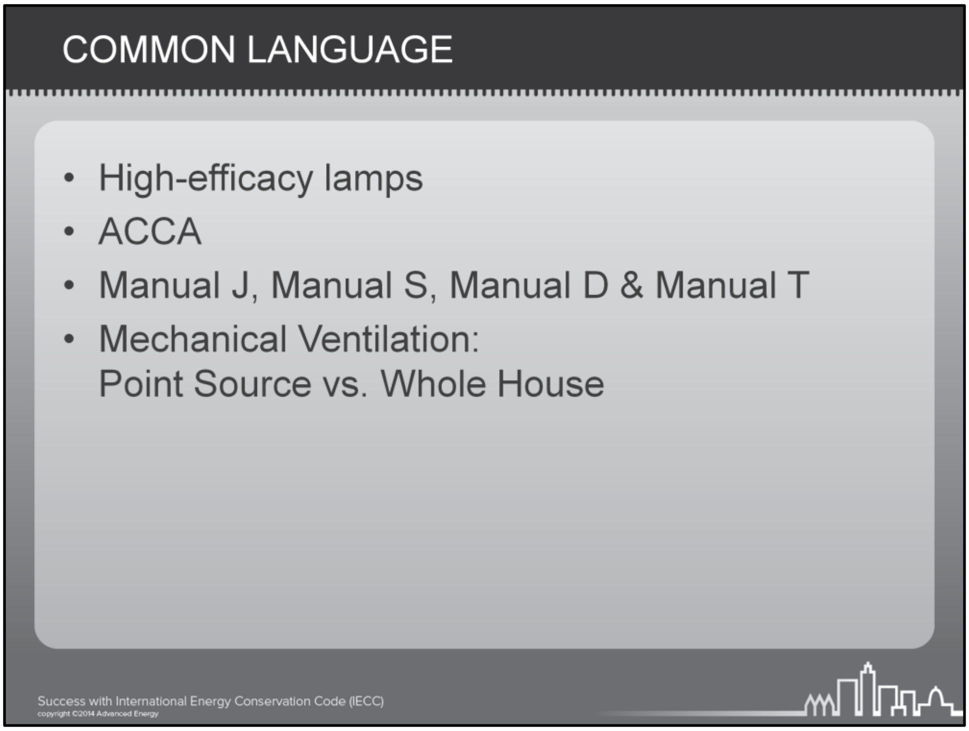
Narrative:
The ultimate point of the house as a system is to create a better home for the families living in them. Houses built to the new code are much better than houses built 10-20 years ago, not only because they are more energy efficient **(click to animate text)**, but because they are more durable, comfortable and healthy for the people living in them. The 2009 IECC and 2012 IECC and now the 2015 have incorporated specific HVAC and Lighting requirements because they were written with a systems approach. **Click to animate image.**

Point of Slide:
All of these factors are constantly interacting with each other and with the people. If we do something to impact one of these, we will most likely also impact other factors.



Narrative: A couple of points about these learning objectives: It starts with the simplest to achieve and moves to the most difficult. In addition, it follows the agenda. You can expect to accomplish the last learning objective at the end of the day. Lastly, these learning objectives provide a way to evaluate the course. By checking for understanding during the presentation, after activities and through the survey, you can gain quick insight if the learning objectives are being met.

Point of Slide: Learning objectives are what we hope to have all (willing) participants to achieve. It is important to know the participants goals of this training – and they had an opportunity to state them in their introduction when asked about concerns.



Ideally the instructor can bring samples of different bulbs and fixtures that can be passed around the room. Examples include CFL's, pin based bulbs, pin-based adapters and LED bulbs. Another idea is to bring a physical copy of any of the ACCA manuals if you have one handy.

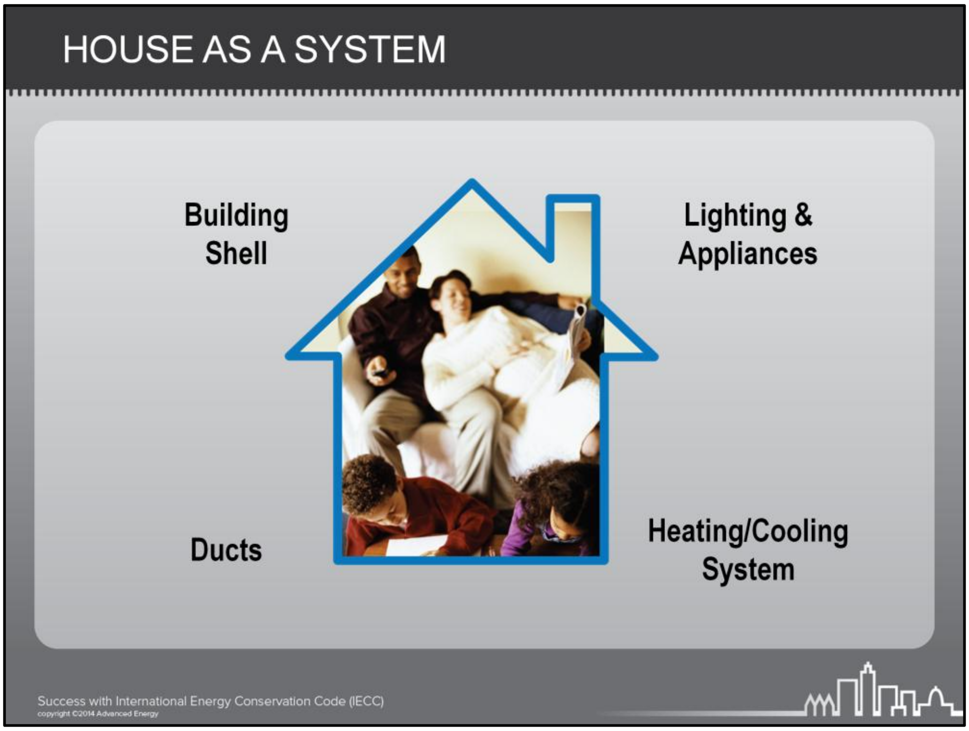
Narrative: Before we get into lighting and HVAC installation details, it is important to establish a common language so we are all using the same terms and you all understand the concepts to be covered.

Ask the class the following questions. Give them a few seconds to answer; if no one answers, ask someone to give a definition:

- "What do we mean by the term high-efficacy lamp?" For all practical purposes high efficacy lamps are compact fluorescent lamps, T-8 or smaller fluorescent tubes, or lamps with a minimum efficacy of 60 lumens per watt for lamps over 40 watts. Other examples include LED's, although they are not as common as CFL's in residential construction.

- "What does ACCA stand for?" Air Conditioning Contractors of America. ACCA is a non-profit association of heating, cooling, ventilation and indoor environment professionals serving all markets: residential, commercial, industrial, agriculture, etc.

- Tell the class that ACCA produces manuals that assist contractors in the proper design of HVAC systems. Ask the class if anyone can tell you what each of these manuals address:



This is an animated slide. Please be sure to note the order of the animation.

Narrative: The new codes take a comprehensive systems approach to energy savings. One way to think about a house is that it consists of the building shell, mechanical systems, and, usually, an air distribution system. Each of these interact with each other, and with the people in the house. Change one of them, and it may have an impact on one or more of the others and on the people.

Point of Slide: System thinking is critical to implementing the codes effectively and efficiently. By doing so we will not compromise the quality of life of the people living in the home.

HIGH EFFICACY LIGHTING REQUIREMENTS

	2009 IECC 404.1	2012/15 IECC R404.1
Lighting Equipment (MANDATORY)	A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps	A minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or a minimum of 75 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

Success with International Energy Conservation Code (IECC)
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Narrative: The mandatory requirements for high efficacy lighting have increased for the 2012 IECC. Now a minimum of 75% of the lamps used in permanently installed fixtures shall be high-efficacy lamps. Those building to the 2009 IECC shall ensure that a minimum of 50% of the lamps used in permanently installed fixtures shall be high-efficacy lamps.

Another option is to make sure that at a minimum of 75% of all permanently installed lighting fixtures shall contain only high-efficacy lamps.

Point of Slide: The 2009 IECC requires at a minimum 50% of all installed lamps to be high efficacy, while the 2012 IECC requires at a minimum 75% of all installed lamps to be high efficacy.

High Efficacy Lighting Defined

High-Efficacy Lamps are compact fluorescent lamps,
T-8 or smaller diameter linear fluorescent lamps,
or lamps with minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts
2. 50 lumens per watt for lamps over 15 up to 40 watts
3. 40 lumens per watt for lamps 15 watts or less

2012 IECC definitions

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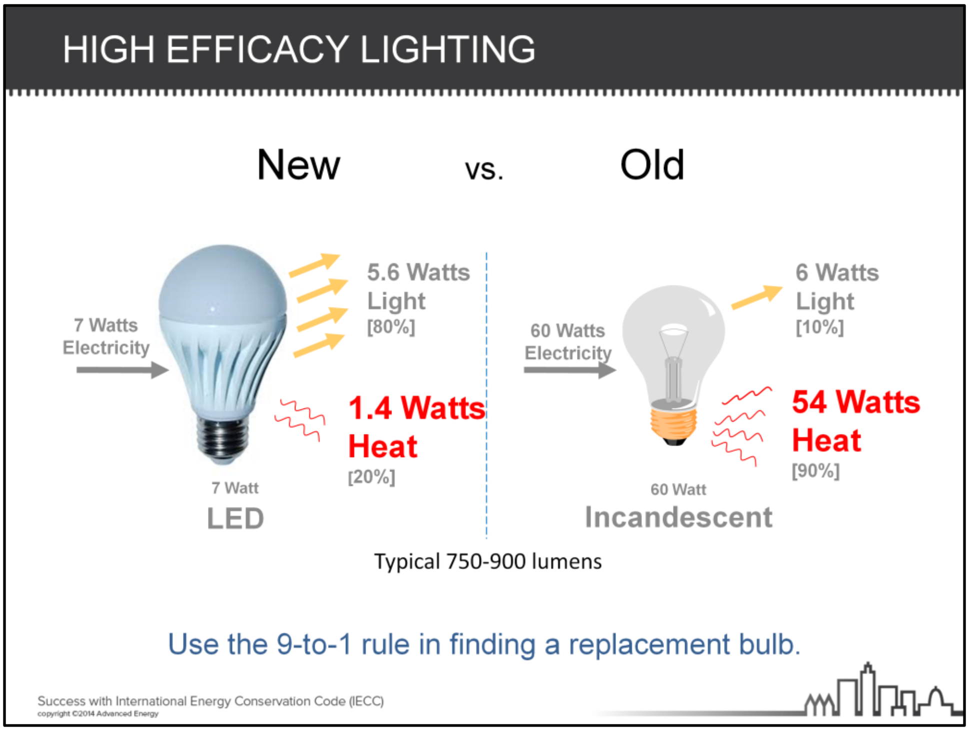

Narrative: 90% of the energy consumed by a incandescent bulb is given off in the form of heat.

The average CFL uses 75% less energy than a comparable incandescent light.

But LEDs use only about 10% as much energy as an incandescent and emit almost no heat.

Point of Slide:

HIGH EFFICACY LIGHTING

ENERGY EFFICIENCY & ENERGY COSTS	Light Emitting Diodes (LED)	Incandescent Light Bulbs	Compact Fluorescents (CFL)
Life Span (average)	50,000 hours	1,200 hours	8,000 hours
Watts of Electricity Used (Equivalent to 60 watt bulb)	6-8 watts	60 watts	13-15 watts
Kilowatts of Electricity used	329 KWh/y	3285 KWh/y	767 KWh/y
Annual Operating Cost	$32.85/year	$328.59/year	$76.65/year
ENVIRONMENTAL IMPACT	**Light Emitting Diodes (LED)**	**Incandescent Light Bulbs**	**Compact Fluorescents (CFL)**
Contains toxic mercury	No	No	Yes
RoHS Compliant	Yes	Yes	No
Carbon Dioxide Emissions	451 pounds/year	4500 pounds/year	1051 pounds/year
LIGHT OUTPUT	**Light Emitting Diodes (LED)**	**Incandescent Light Bulbs**	**Compact Fluorescents (CFL)**
Lumens	Watts	Watts	Watts
450	4-5	40	9-13
800	6-8	60	13-15
1,100	9-13	75	18-25
1,600	16-20	100	23-30
2,600	25-28	150	30-55

Success with International Energy Conservation Code (IECC)

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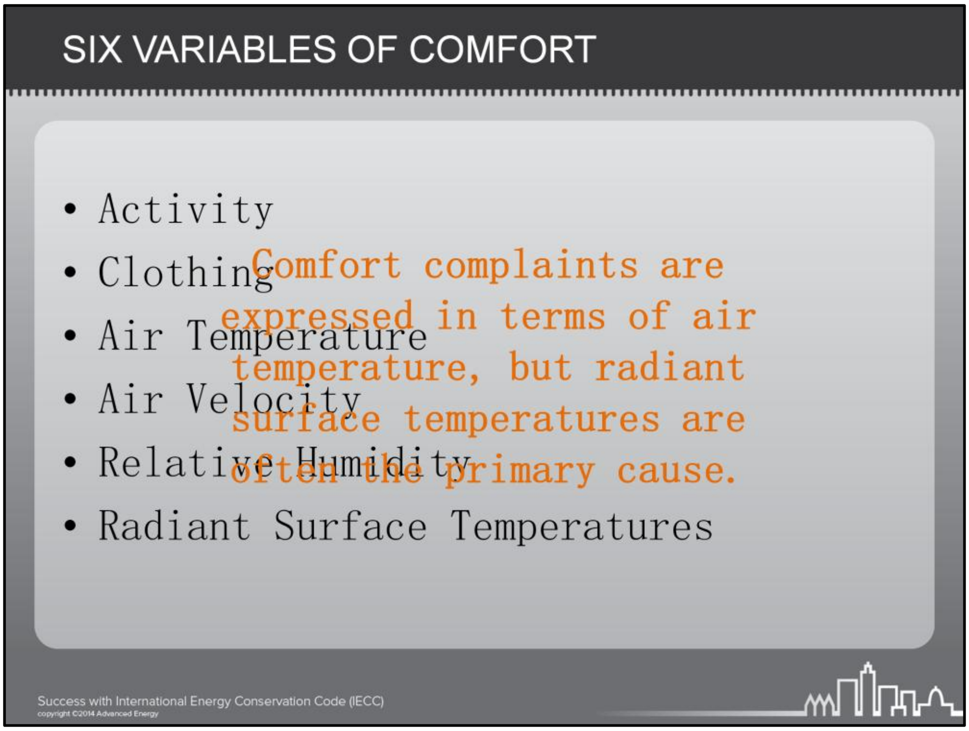
Narrative: 90% of the energy consumed by a incandescent bulb is given off in the form of heat.
A fun fact: if you assume a bulb burns 4 hours a day, an incandescent bulb will last about 10 months, a CFL will last 67 months or 5 and ½ years, and an LED will last 417 months or 35 years.

The average CFL uses 75% less energy than a comparable incandescent light.
When purchasing CFLs to replace an incandescent bulb, use the 4-to-1 rule.
Purchase a CFL that uses a quarter of the watts of the traditional bulb you are replacing.
So if replacing a 60 what bulb you would use a 13 watt bulb, as in the example on this slide.

Point of Slide:

Narrative: The main purpose of the heating, ventilating, and air conditioning (HVAC) system is to provide the people inside buildings with conditioned air so that they will have a comfortable and safe environment in which to live, work and play. "Conditioned" air means air treated to control its temperature, relative humidity or quality. Presumably this means air that is clean and odor-free, and the temperature, humidity, and movement of the air are within certain comfort ranges. The most common range measured against is the temperature range established in the definition for “conditioned area.” The conditioned area is the portion of the building served by the heating and/or cooling systems or *appliances* and which is capable of maintaining, through design or heat loss/gain, 68°F (20°C) during the heating season and/or 80°F (27°C) during the cooling season.

Point of Slide: We need to realize that an HVAC system is a system that can be made to be very complex. But in practical terms, when we judge if an HVAC system is doing it’s job it comes down to the occupants perception of what is comfortable and what they can reasonably expect in terms of temperature, humidity control and clean air.



This is an animated slide. Please be sure to note the order of the animation.

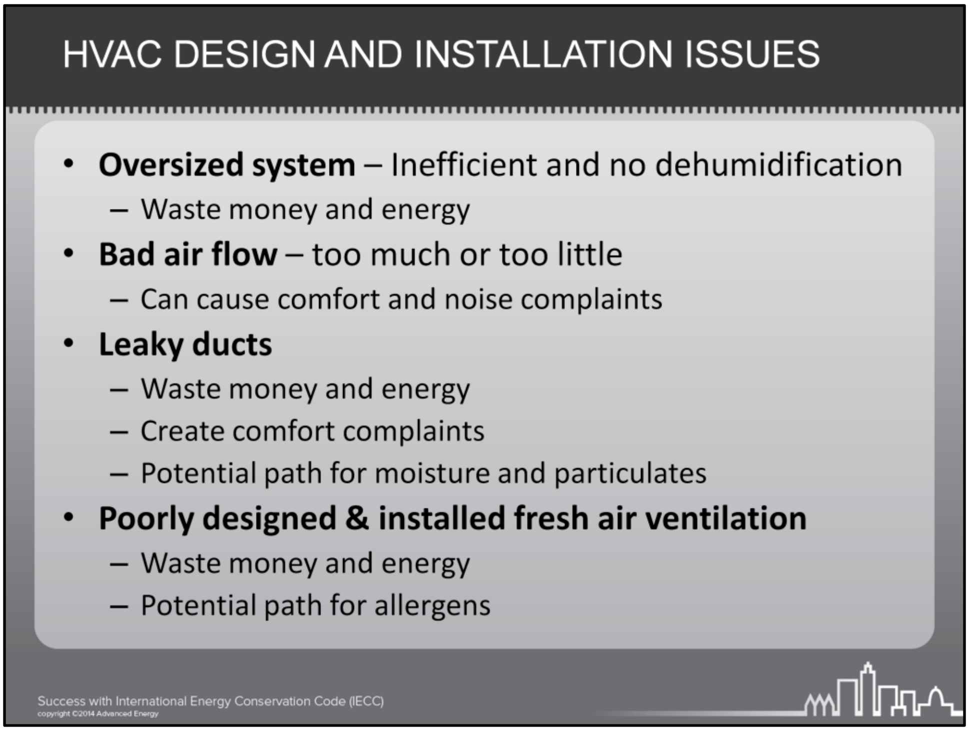
Narrative: Each of these has been shown to impact thermal comfort. Activity and clothing are totally customer-driven. As building professionals, we can't control whether people are doing aerobic dancing or sitting in their La-Z-Boy, nor can we control whether they are wearing a sweater and wool pants or absolutely nothing. We do know that our customers expect a home where they can be comfortable regardless.

Air temperature is what most people think of first. When they are uncomfortable, what do most people do? They turn the thermostat up or down, to adjust the air temperature. This is important, but not the most important factor in determining comfort.

How fast the air is moving is also important. The faster air moves over your body, the more moisture evaporates, carrying heat away, making you feel cooler. If air is blowing directly on you, it will cool you off, which is why ceiling fans work well in the summer but not in the winter.

Relative humidity is very important, especially in the south and Midwest. If the humidity in the house is high—even if it's cool inside—people won't be comfortable. But this still isn't the most important determinant of comfort.

According to the American Society of Heating, Refrigeration, and Air Conditioning Engineers) (ASHRAE) most comfort complaints are caused by radiant surface temperatures that are too hot or too cold. **Click to animate**



Narrative: We have stressed the importance of a system design that will deliver high performance and customer satisfaction. Getting that system designed and installed right—according to manufacturers specifications—is a much bigger challenge than you might think. Several studies, which looked at actual field installations in new construction, concluded that heat pumps and central air conditioning systems are installed right about 10% of the time.

Here is a list of some of the issues we see in the design and installation of residential HVAC system.

The ultimate goal of a comprehensive approach to the HVAC system:

- Sized to deliver the necessary heating and cooling to each room so that all rooms are within a few degrees of the thermostat temp.
- Sized to run consistently, maximizing efficiency and removing summertime moisture.
- Ducts designed to deliver the load required by each room, in a quiet manner.
- Installed without leaks in the system, and without bends and turns that increase static pressure and reduce flow.
- Quiet so that people don't notice the system is running.
- Installed with controls homeowners can understand and utilize.

Throughout the remainder of the day we will discuss these topics and discuss strategies to achieve them.

Point of Slide: Ensuring an HVAC system is designed and installed right—according to

Narrative: Ask the class the following:

There is only 1 trade whose 1-800 number is left with the homeowner. Can you guess who?

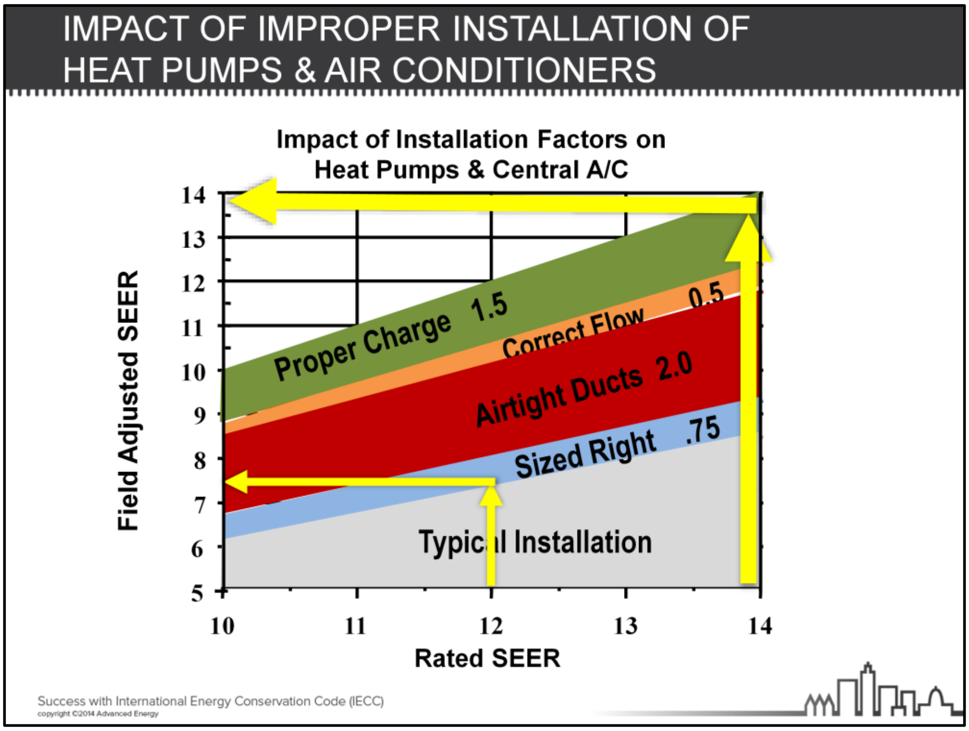
Answer: The HVAC contractor!

Therefore HVAC companies have always designed with the mantra bigger is better, because they believe bigger systems prevent the telephone from ringing. That may have been the case when ducts were leaky, and houses were just as leaky, with little to no insulation that was installed incorrectly and not protected with good framing and blocking.

But those days are gone. The new energy codes require framing and insulation critical details, performance testing and field inspections that result in a superior shell. This requires a properly sized, designed and installed HVAC system to deliver comfort.

An over-sized system will short cycle, reducing the ability of the HVAC system to remove moisture from indoor air. Over-sizing also causes noise complaints, uses more energy and reduces the life of equipment. With new codes HVAC designers can trust that the shell will perform, so they can save builders money with smaller systems while delivering homeowners optimal comfort and energy performance.

Point of Slide: The new energy codes require framing and insulation critical details, performance testing and field inspections that result in a superior shell. This requires



This is an animated slide. Please be sure to note the order of the animation.

Narrative: This chart summarizes the findings of a project several years ago, where Advanced Energy looked at every study that had ever been published that actually included measured performance data on HVAC systems.

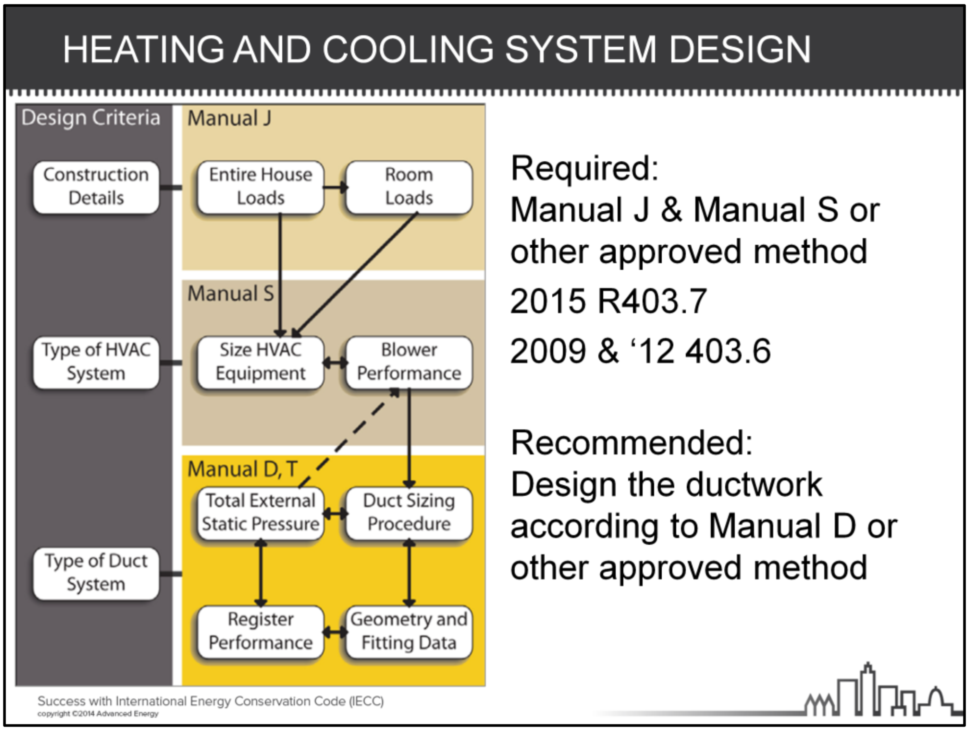
Based on the data, a SEER 12 heat pump or air conditioner **(click to animate small vertical arrow**) installed in a "typical" manner **(click to animate small horizontal arrow)** performed at a SEER 7.5 level. You're paying for a SEER 12, but getting a SEER 7.5!

The main problems are:

Click to animate the blue section. Over-sized systems: Reduces efficiency by ¾ of a SEER point.
Click to animate the red section. Leaky ducts: Reduces efficiency by 2 SEER points.
Click to animate the orange section. Improper air flow: Reduces efficiency by ½ of a SEER point.
Click to animate the green section. Improper charge, i.e. having the right amount of refrigerant in the system: Reduces efficiency by 1.5 SEER points

Click to animate large vertical arrow. If all of these installation details were done right—that is, to manufacturers' specs—the SEER 12 you paid **(click to animate large horizontal arrow)** for will effectively deliver SEER 12 performance.

Point of Slide: Based on the data, a SEER 12 heat pump or air conditioner installed in

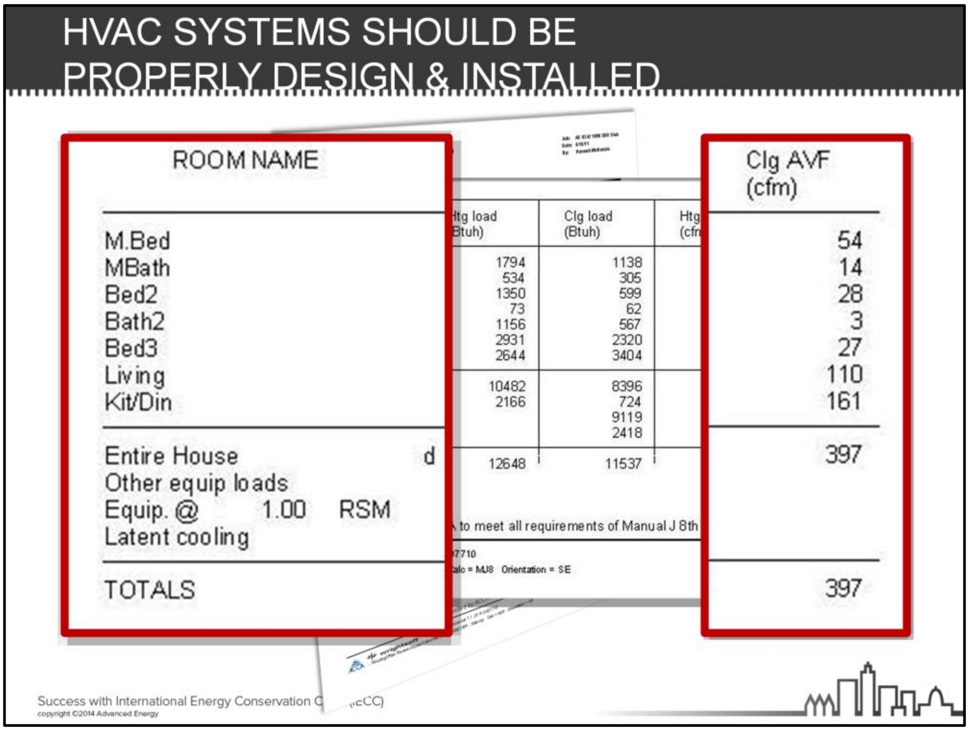


Narrative: Like a house, the HVAC system involves many different parts that have to work together to work well. We usually think of Heating and Cooling System Design as *"load calculation"* or a *"sizing,"* but the reality is that a properly designed HVAC system involves these things and much more. Proper system involves room by room loads, equipment sizing and selection, duct design and installation critical details.

In terms of codes, the IRC states that heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies. The Telephone Method is not one of the "other approved calculation methods!"

While a Manual D or T is not required for designing the duct work, it is generally recommended to assure a properly sized duct system is installed with optimal airflow.

Point of Slide: A properly designed HVAC system involves room by room loads, equipment sizing and selection, duct design and attention to installation critical details.



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Narrative:

This is a short form report from a Manual J calculation done with wrightsoft®, one of the most popular software programs used to complete HVAC designs. (There are other such as Elite®, and any approved by ACCA are acceptable) The Manual J process takes into account building orientation, glazing, room size, number of people in the house, etc…

Click to animate room-by-room section. This software assists you in determining the room-by-room load, telling you how much air the system should supply into each room to meet the heating or cooling load. **Click again to animate the zoomed in room names and cooling airflows.** Looking this over, we can see it is a small home with low loads – because it has been built with high efficiency in mind. In mixed climates, we always install the ducts and balance room-by-room airflows according to the cooling design.

Otherwise, you're just guessing. And you can't design a proper duct system without knowing how much air needs to be in each room.

COMPLIANCE WITH DUCT LEAKAGE TESTING STANDARDS

DUCT LEAKAGE TESTING REQUIREMENTS *If ALL ductwork and equipment are inside the thermal envelope duct testing is not required		
	2009 IECC 403.2.2	2012/15 IECC R403.2.2/R403.3.2
*Rough-in Total Duct Leakage	≤ 6 CFM/100 ft² @ 25 Pa (w/ air handler in place)	≤ 4 CFM/100 ft² @ 25 Pa (w/ air handler in place)
*Finished Total Duct Leakage	≤ 12 CFM/100 ft² @ 25 Pa	≤ 4 CFM/100 ft² @ 25 Pa

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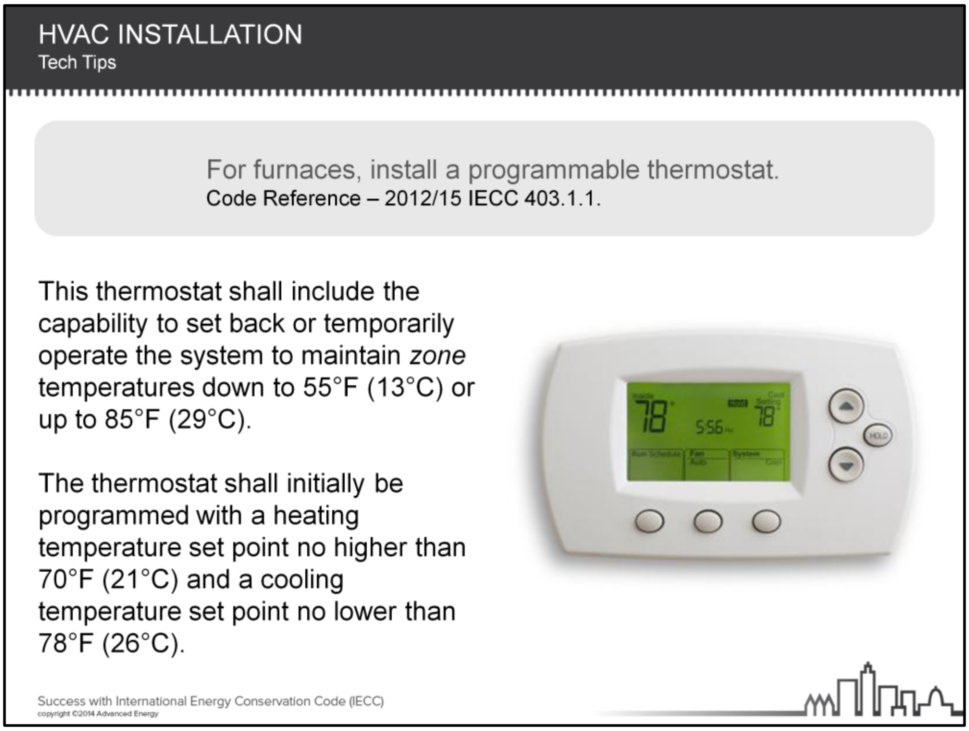
Narrative: This table outlines the duct leakage testing requirements of the 2009 IECC and 2012 IECC.

Note that the standards have gotten more stringent with the 2012 IECC when the ducts are tested at rough-in with the air handler in place or at the finished stage.

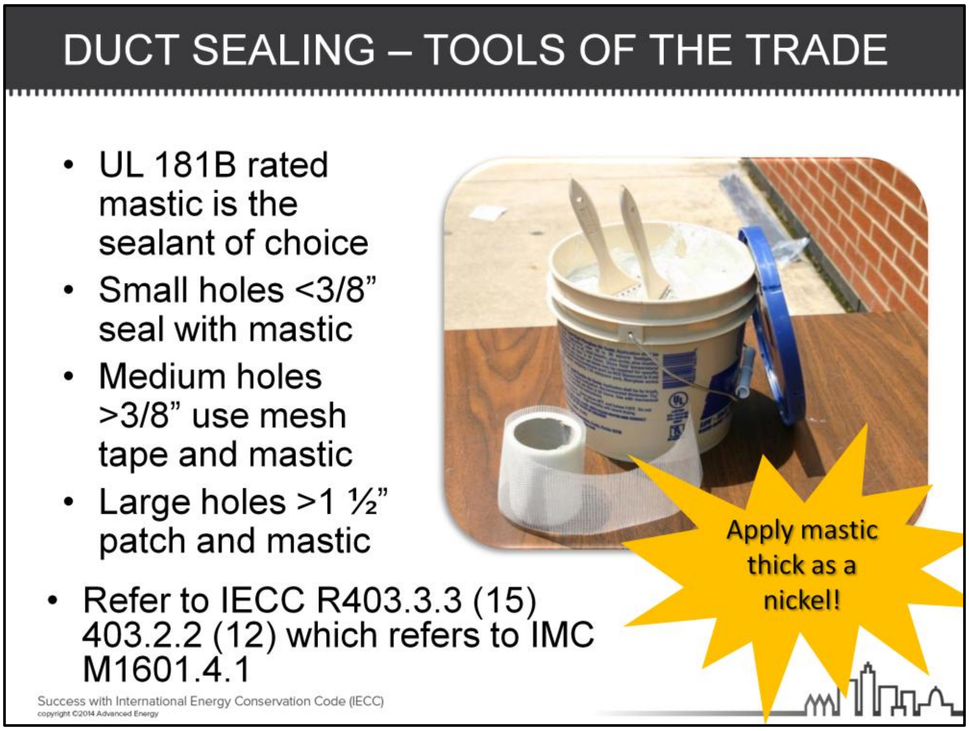
Achieving ≤ 4 CFM/100 ft² @ 25 Pa can prove challenging even for experienced HVAC contractors, requiring attention to detail and comprehensive training and support of every installation crew.

Point of Slide: The 2009 and 2012 IECC each establish clear requirements for duct leakage testing. The duct sealing details we will be covering in the remaining slides are critical to passing the duct blaster test.



Narrative: Where the primary heating system is a forced-air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

Point of Slide: The 2009 and 2012 IECC state that where the primary heating system is a forced-air furnace, at least one programmable thermostat per dwelling unit shall be installed.

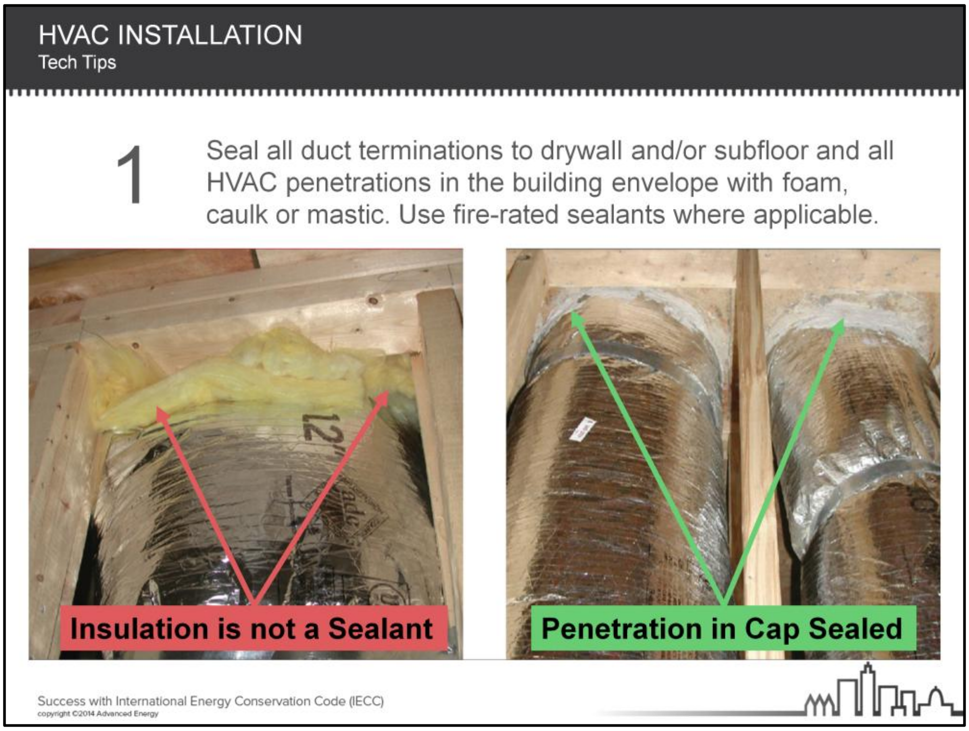


This is an animated slide. Please be sure to note the order of the animation.

Narrative: There are numerous duct mastic products on the market, as well as an endless array of tapes and gasket materials.

However, the IRC requires UL 181B rated sealants and closure systems. The water-based ones are probably less hazardous to the workers and to any chemically sensitive clients. Tape is allowed as long as it is UL 181B listed and installed according to manufacturer's specifications. But because tapes are more difficult and time consuming to install that bucket mastic, we do not recommend tape.

Point of Slide: UL 181B rated bucket mastic, applied with a brush or mesh glove, is the sealant of choice to meet the duct testing targets of the 2009 and 2012 IECC.



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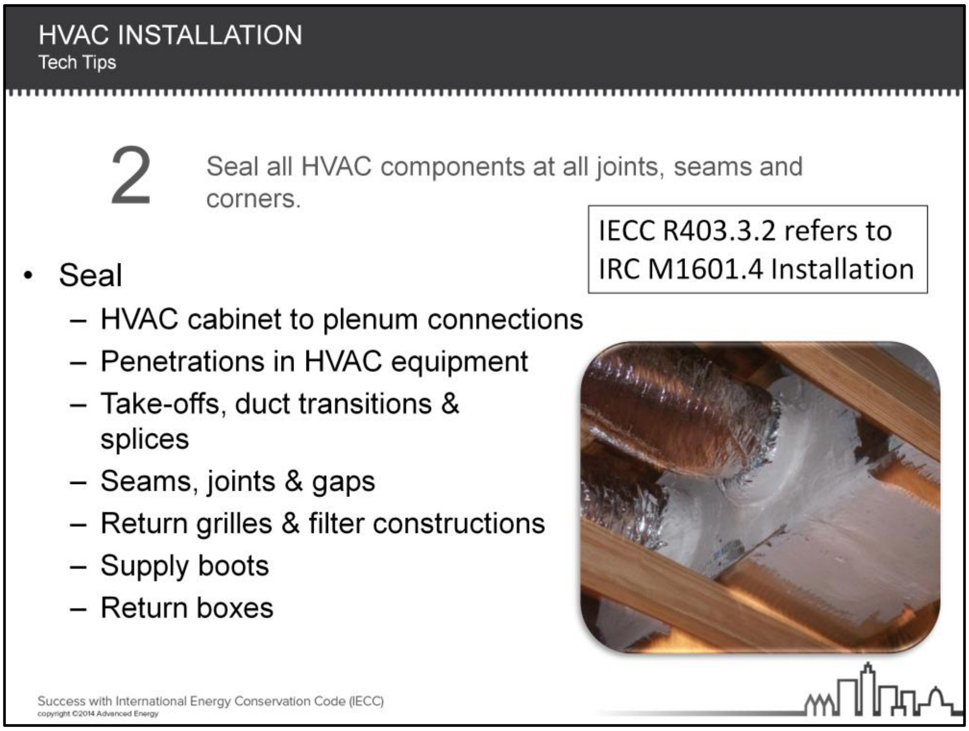

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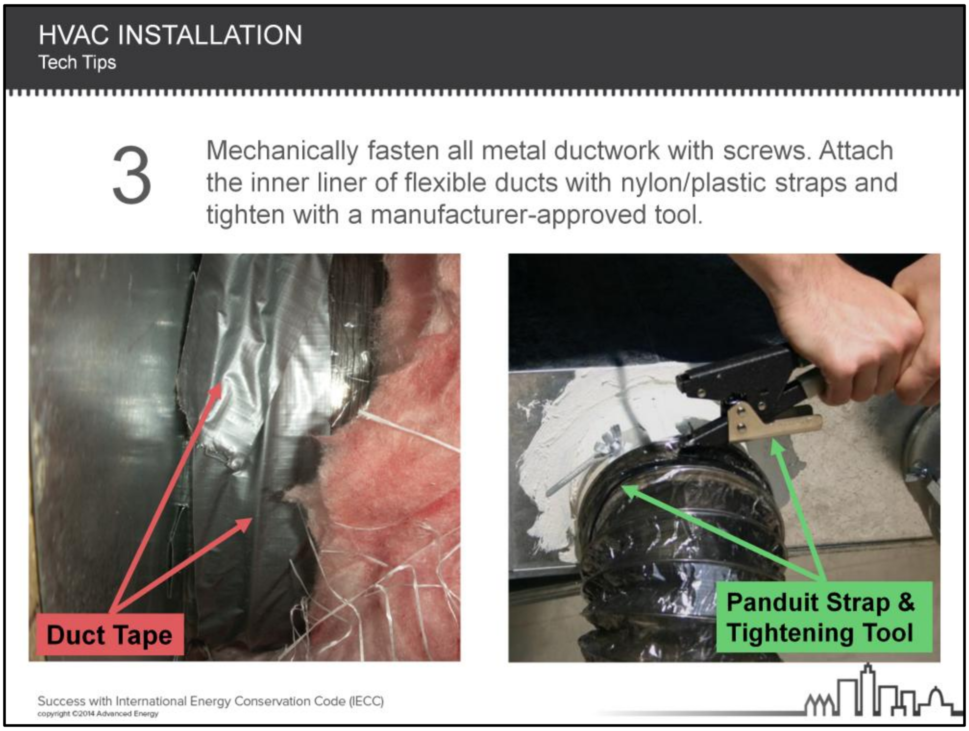

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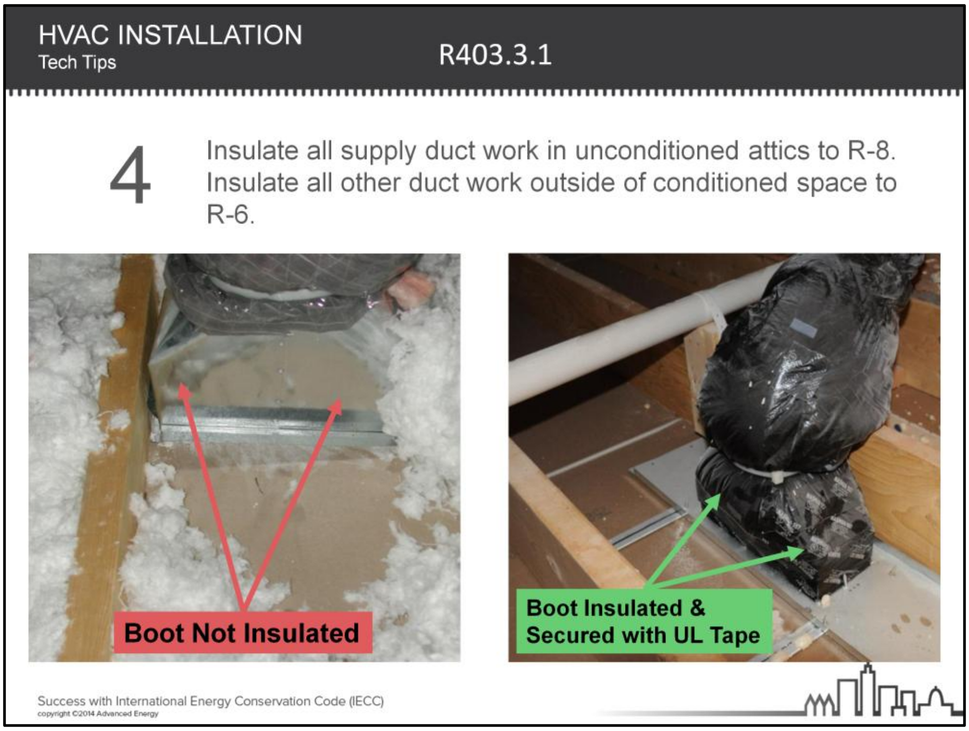

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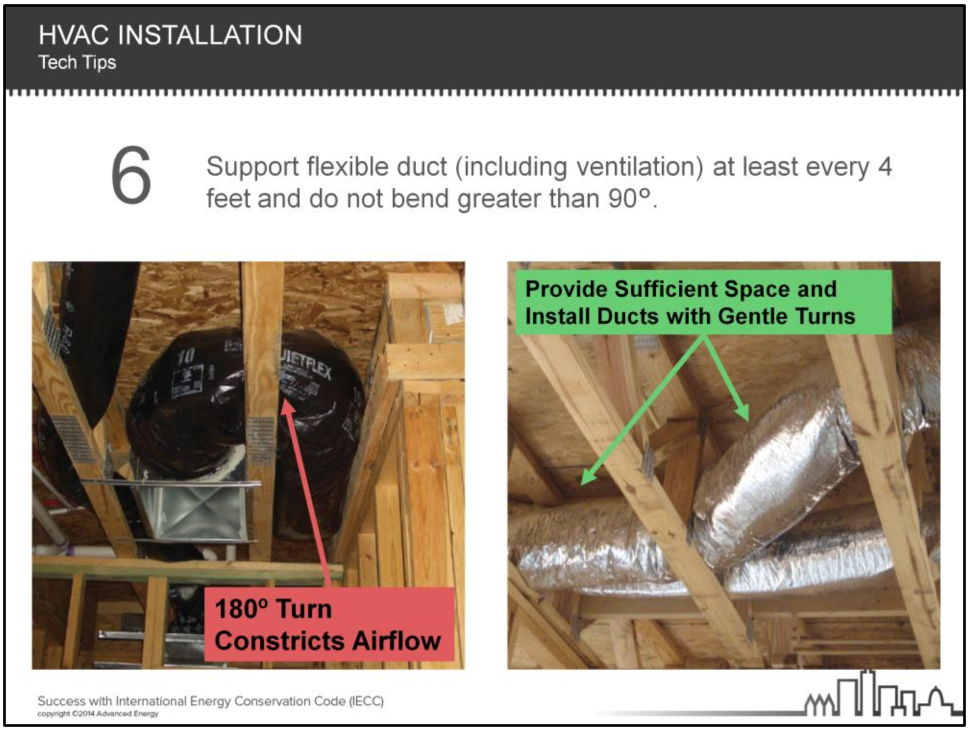

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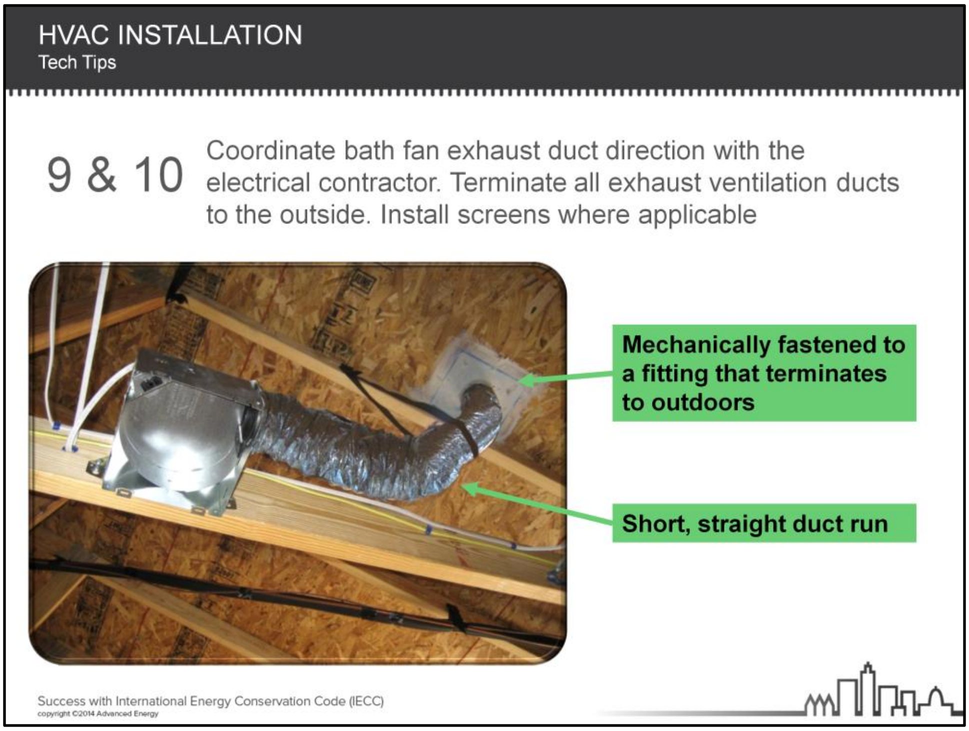
What went wrong here?



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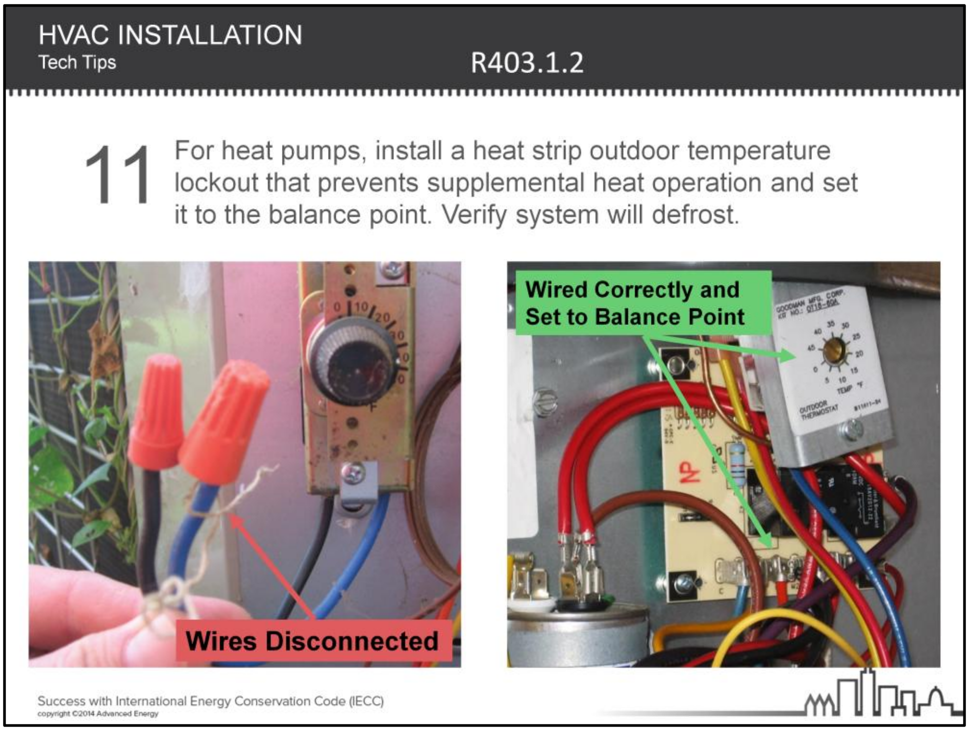

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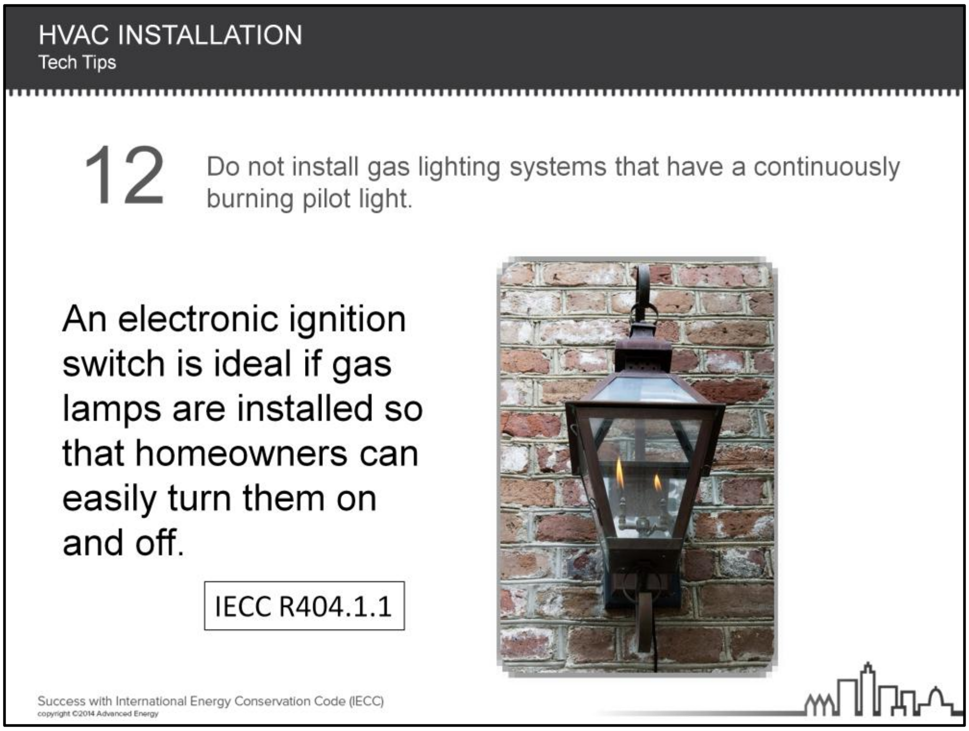

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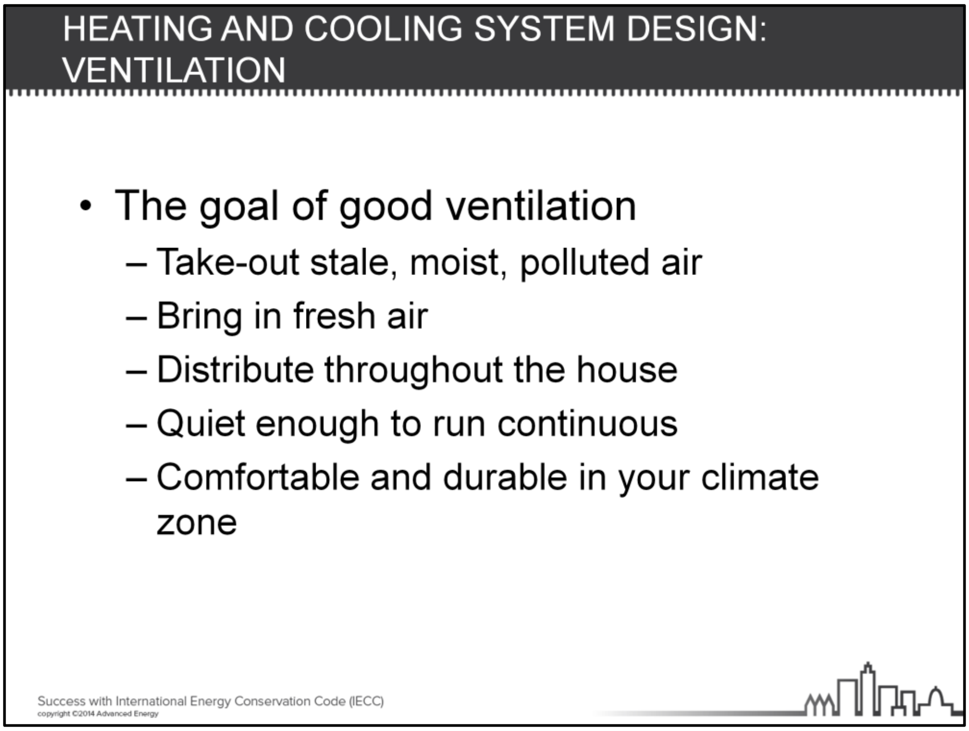


Narrative: Ventilation is often the most misunderstood standard in the HVAC world. Why do we spend all this time, effort and money tightening up a home, only to intentionally add outside air?

Well the primary reason is that the V in HVAC stands for Ventilation, so we should be designing heating and cooling systems with ventilation in mind because all occupants need fresh air to breathe. Ventilation has many benefits and goals, as outlined on this slide.

Homes have been getting tighter for the last 5 decades as we use more and more sheet products and try to address some and draft through codes. And now we have defined the need to tighten a home for purposes of energy efficiency, insulation performance, comfort, pest management, etc.

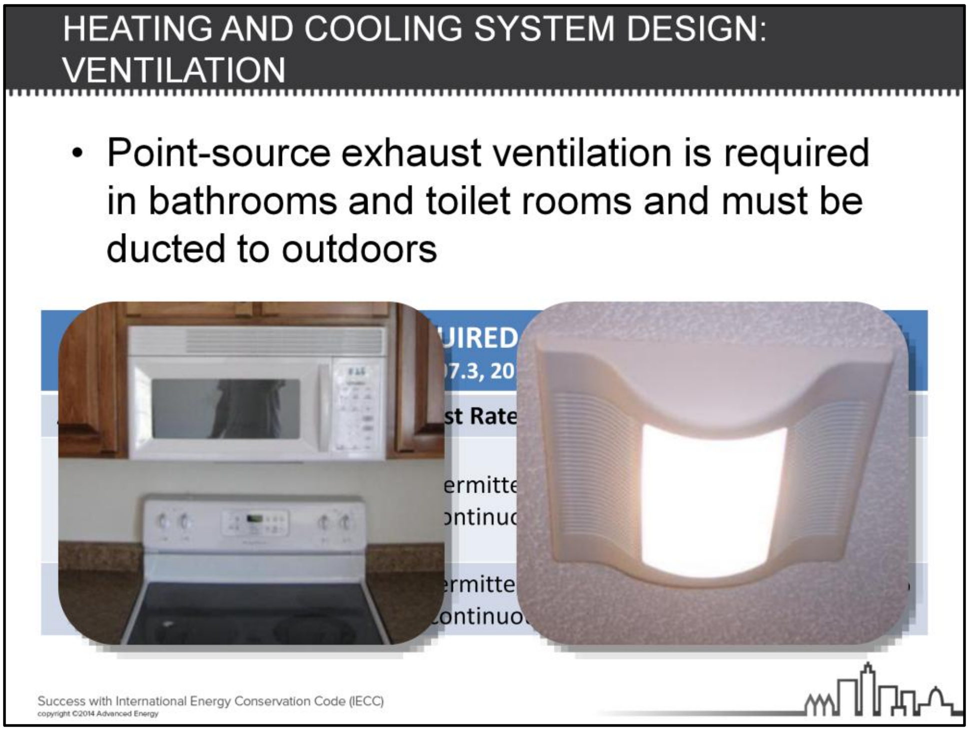
Ask the class: Can we ever have a home that’s too tight?

Make sure to let people share some answers. Don’t be afraid to repeat the question, drawing out more answers. Then give the following answer if no one has said it:

We can’t build a house too tight, but we can under ventilate it. Or simply provide no ventilation at all!

Let’s accept that all people need fresh air to breathe, and move on to strategies to get good ventilation installed…

Point of Slide: The V in HVAC stands for Ventilation, so we should be designing



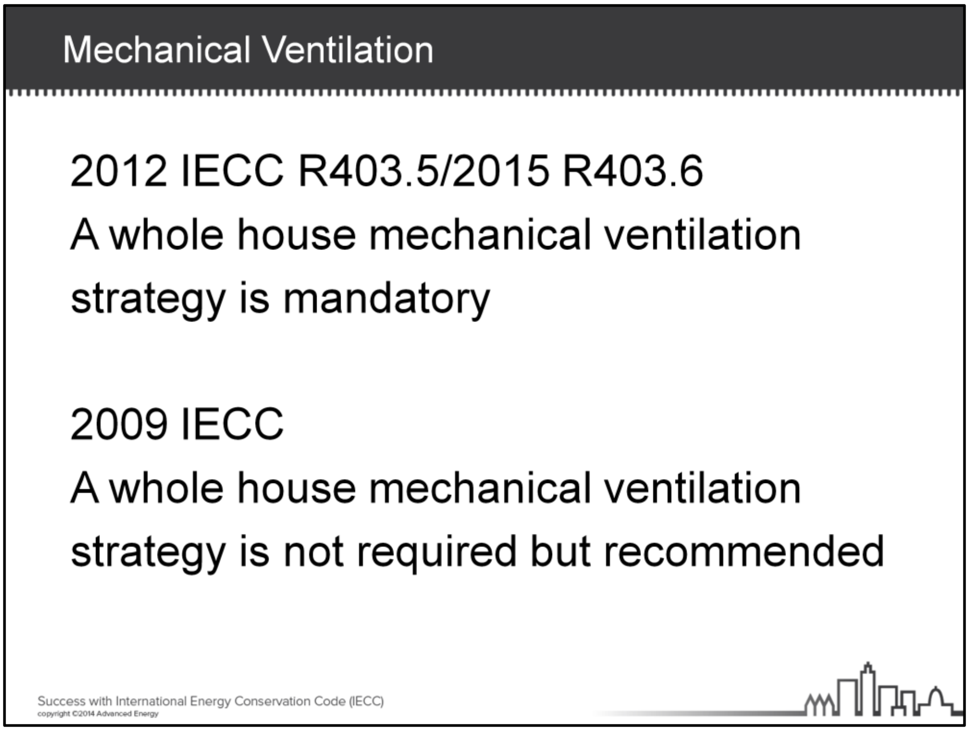
This is an animated slide. Please be sure to note the order of the animation.

Narrative: As we discussed, there are two types of mechanical ventilation: Local ventilation and whole house ventilation.

Local, or spot, ventilation is used to exhaust contaminants, odors, and moisture from a specific location. These are usually exhaust fans, mostly used in bathrooms and kitchens.

This table highlights the exhaust ventilation requirements of the 2009 IRC and 2012 IRC. Note that they are the same. And while only bathrooms are required to exhaust directly to outdoors, at this stage of the game, I think it is safe to say we should be venting all kitchen exhaust hoods to outdoors where grease, odors and cooking smoke belong. Hopefully your code jurisdiction does not allow recirculating fans in kitchens.

Point of Slide: Point-source exhaust ventilation is required in bathrooms and toilet rooms and must be ducted to outdoors.



Narrative: Over the past several code cycles, as residential building tightness standards have become more stringent, mechanical ventilation requirements have been added to ensure adequate outside air is provided for ventilation whenever residences are occupied.

The 2012 IECC requires a whole house mechanical ventilation strategy, installed in accordance with the ventilation requirements found in the International Residential Code (IRC) or the International Mechanical Code (IMC). However, it is recommended that all homes incorporate a whole house ventilation strategy because most homes built today are under the 5 ACH threshold set by the ICC and most indoor air quality experts feel this is the point at which all homes need whole house ventilation.

Builders and their HVAC contractor have the flexibility to choose how to meet this requirement – exhaust, supply and balanced ventilation are all allowable methods – although there may be some fan efficiency requirements, as well as specific design and installation requirements, depending on the method used to ventilate.

Point of Slide: The 2012 IECC requires a whole house mechanical ventilation strategy. Homes built under the 2009 IECC are not required to have whole house ventilation but it is recommended.

Code Reference - 2012 IRC M1401.3, 2012 IRC M1403.6, 2012 IMC M1507.3, 2012 IECC 403.5, 2012 IRC R303.4

REQUIRED MECHANICAL VENTILATION RATES AND RUN-TIME MULTIPLICATION FACTORS

Continuous Ventilation Airflow Requirements

Dwelling unit Floor Area (sq^{ft})	NUMBER OF BEDROOMS				
	0 - 1	2 - 3	4 - 5	6 - 7	> 7
	AIRFLOW IN CFM				
< 1,500	30	45	60	75	90
1,501 - 3,000	45	60	75	90	105
3,001 - 4,500	60	75	90	105	120
4,501 - 6,000	75	90	105	120	135
6,001 - 7,500	90	105	120	135	150
> 7,501	105	120	135	150	165

Table M1507.3.3(1): Continuous Whole-House Mechanical Ventilation System Airflow Rate Requirements
For SI: 1 square foot = 0.0929 m^2, 1 cubic foot per minute = 0.0004719 m^3/S.

Table M1507.3.3(1)
2015 IRC

Intermittent Run-Time Multiplication Factors

Run- Time Percentage in Each 4-Hour Segment	25%	33%	50%	66%	75%	100%
Factor[a]	4	3	2	1.5	1.3	1.0

Table M1507.3.3(2): Intermittent Whole-House Mechanical Ventilation Rate Factors[a, b]
[a] For ventilation system run time values between those given, the factors are permitted to be determined by interpolation.
[b] Extrapolation beyond the table is prohibited.

Table M1507.3.3(2)
2015 IRC

Success with International Energy Conservation Code (IECC)
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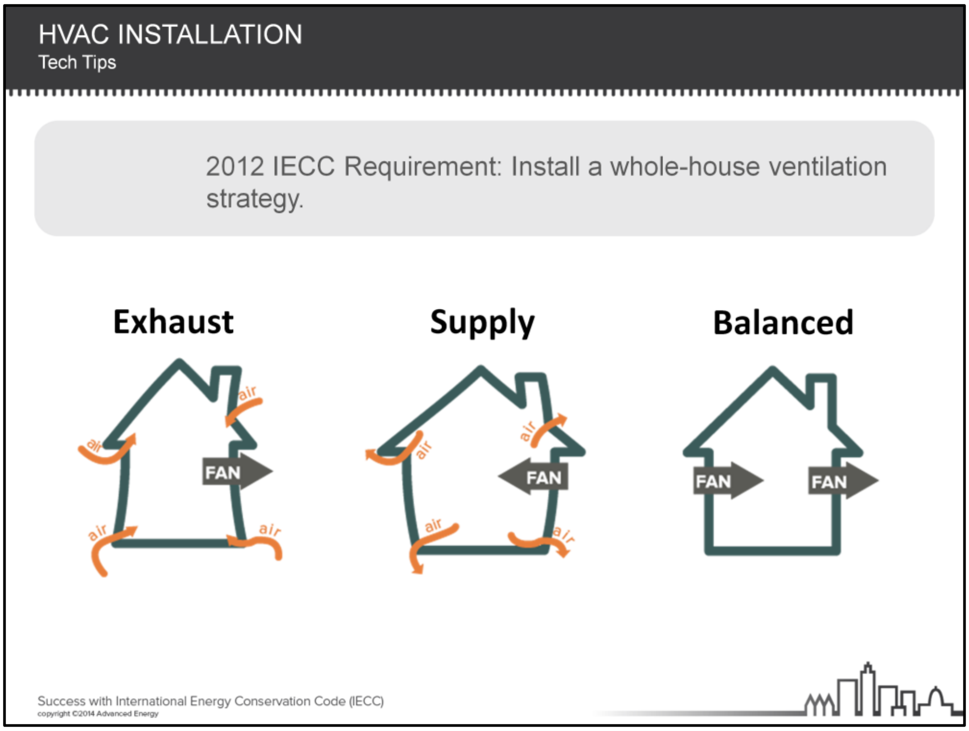
Narrative: Based on the square footage of the house and number of bedrooms, the whole-house mechanical ventilation system shall be sized to provide outdoor air at a continuous rate greater than or equal to the CFM values indicated in the top table, Table M1507.3.3(1).

However, the whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for no less than 25% of each 4-hour segment and the ventilation rate from Table M1507.3.3(1) is multiplied by the corresponding intermittent multiplication factor from Table M1507.3.3(2) based on the run time percentage selected.

Point of Slide: Compliance with the whole house mechanical ventilation standard starts with meeting specific ventilation rates and intermittent multiplication factors outlined by the International Residential Code.



Narrative: As we discussed earlier when covering design considerations and new mandatory mechanical ventilation requirements for homes built under the 2012 IECC, there are several methods providing ventilation.

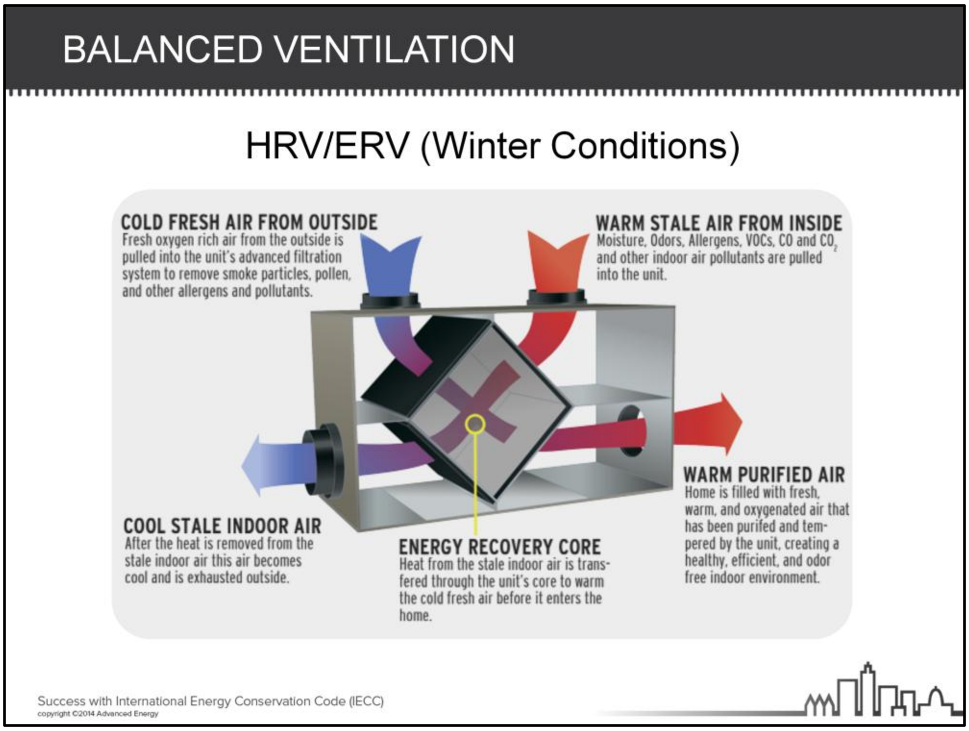
Exhaust, where fans, such as bath and kitchen fans, pull air out of the house. The ventilation is provided when make up air is drawn through cracks in the building envelope.

Supply, where a fan pushes ventilation air into the house from the outside.

Balanced, where a fan or multiple fans simultaneously draw air in from the outside while exhausting air from the house.

It is up to the HVAC contractor or engineer to work with the builder and any home energy raters to pick the ventilation strategy most appropriate for the house.

Point of Slide: The 2012 IECC requires a whole house mechanical ventilation strategy. The method installed is left up to the builder and their HVAC installer and/or engineer.

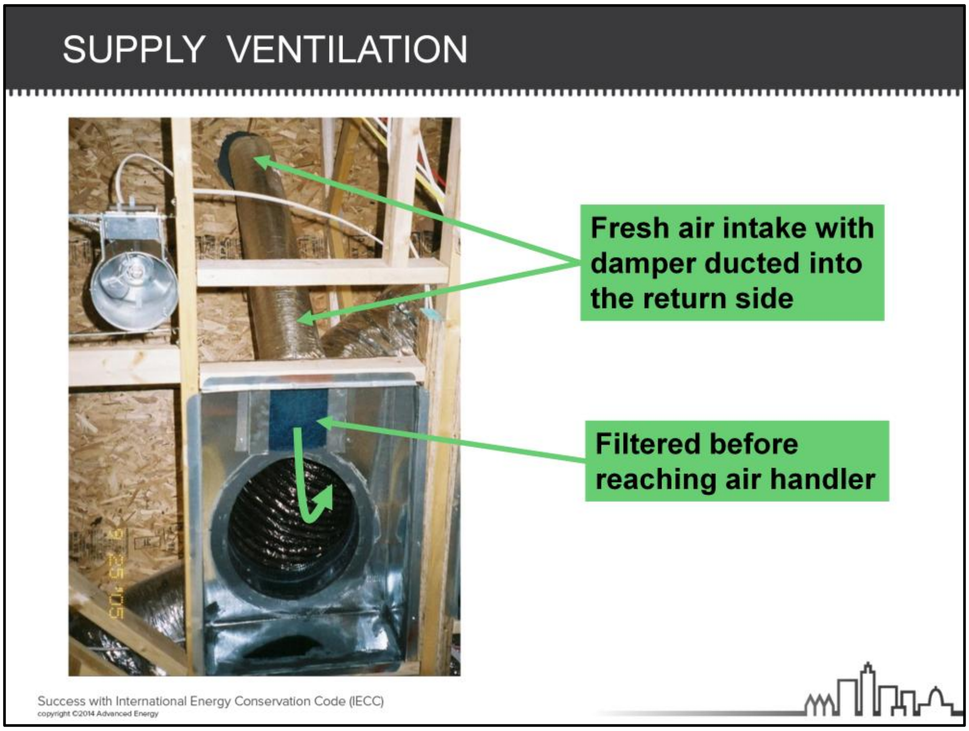


Narrative: Balanced ventilation can be provided through use of multiple fans, assuming they meet efficacy requirements, or through installation of an energy recovery device such as an Heat Recovery Ventilator (HRV) or an Energy Recovery Ventilator (ERV).

This is the most sophisticated, and expensive, method of whole house ventilation. It brings in outside air and exhausts an equal amount of stale air from the air. In the winter, the energy recovery core transfers heat from the air that's leaving the house and transfers it to the outside air coming in, so less heat is wasted. This is mostly used in very cold climates where introducing very cold wintertime air can cause comfort problems or cause a substantial energy penalty.

In hot, humid climates, people use an ERV. An ERV works very similar to an HRV in the winter, but during the summer, the system pulls the moisture out of the incoming air and transfers it to the air leaving the house, so you're not adding extra moisture to the house.

Point of Slide: Balanced ventilation through an ERV/HRV is another whole house mechanical ventilation option. But this installation is the most complicated so it takes an experienced contractor who pays attention to detail and is committed to commissioning the system to assure proper airflow and run time.



This is an animated slide. Please be sure to note the order of the animation.

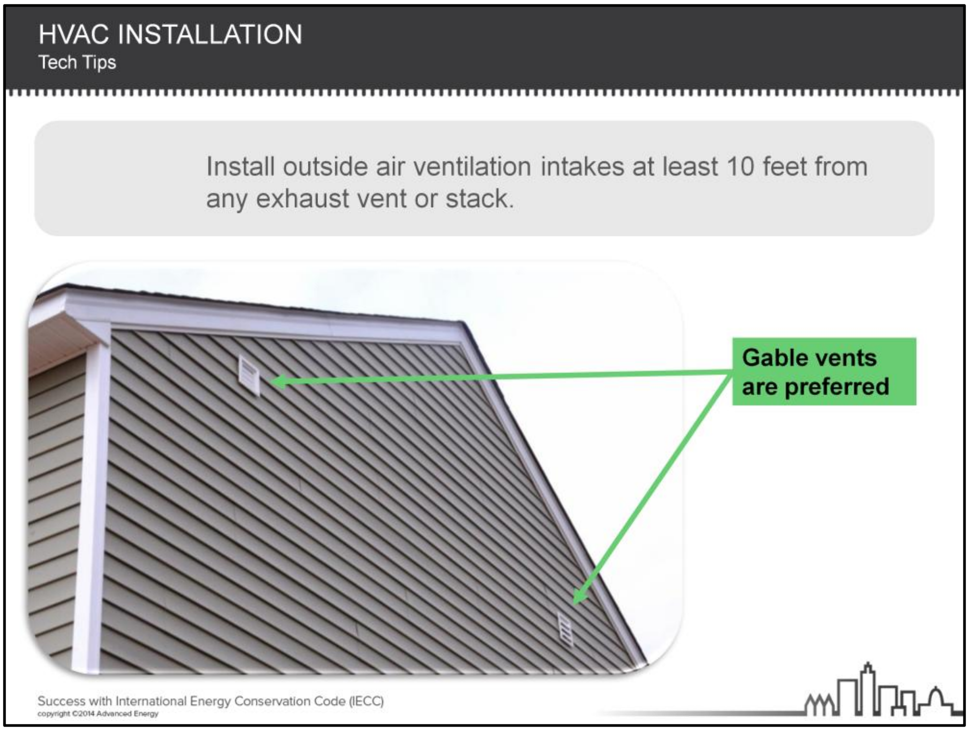
Narrative: Another common strategy for meeting the whole house ventilation requirement is to simply run a duct from outside into the return plenum.

This is an example at rough-in. An insulated 6" duct is run from an outside intake to a collar on the return box. **Click to animate first green text box and arrows.** The collar has a damper that can be adjusted by the contractor to set the airflow.

Whenever the system is running, it will bring a little outside air into the house. **Click to animate green arrow showing path of fresh air from intake into the return.**

It's important that this air is filtered. **Click to animate second green text box and arrows.** The homeowner can change the small filter at the same time she changes the primary filter in the same box.

Point of Slide: Supply side ventilation through a fresh air intake into the return, or with a dedicated supply fan, is another whole house mechanical ventilation option.



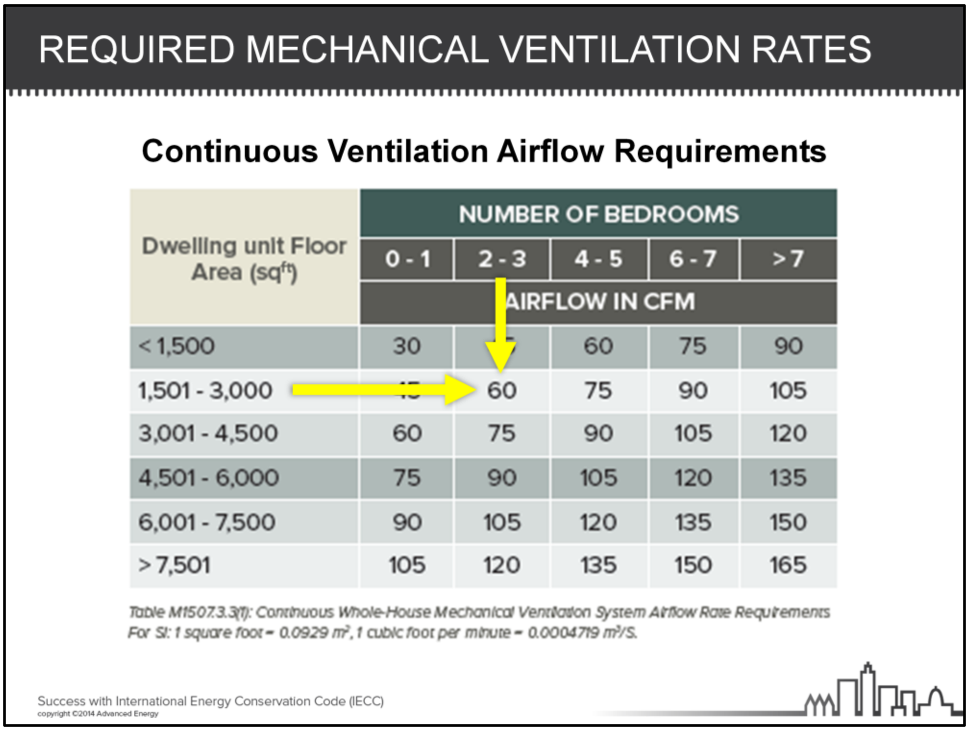
This is an animated slide. Please be sure to note the order of the animation.

Narrative: If you are designing a supply or balanced ventilation system, it is best to keep fresh air intakes to be at least 10 feet away from contamination sources. Contamination sources might include plumbing stacks, combustion vents, exhaust hoods, vehicle exhaust outlets, etc. You will also need to consider the intake height if you install it on a roof deck or near the ground. Especially if you are in a location that gets a fair amount of snow, even if only occasionally.

In terms of an ideal location, we recommend gable vents. **Click to animate green text box and arrows.** They are usually well away from the contamination sources we mentioned, are not close to hot roofs and the air tends to be well-circulated.

But the location will ultimately be decided by the builder. Often there will be places where the builder may or may not want an intake installed, or there may be space constraints based on equipment location or building geometry.

Point of Slide: If you are designing a supply or balanced ventilation system, it is best to keep fresh air intakes to be at least 10 feet away from contamination sources.



This is an animated slide. Please be sure to note the order of the animation.

Narrative: Check for understanding of this table. Ask the following questions:

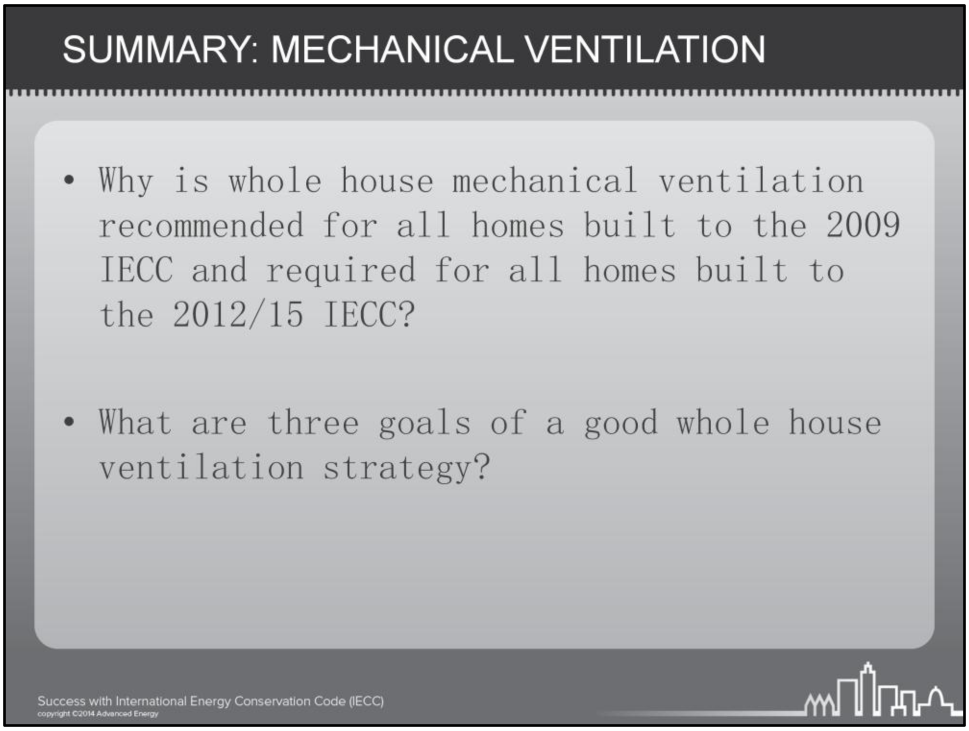
"In order to meet the intent of the 2012 IECC, what is the minimum continuous ventilation rate for a three bedroom, 1800 square foot home?"

Write "3 Bedroom" and "1800 sq. ft." of a piece of flip chart paper or white board.

Give everyone 20 seconds to complete the calculation, then ask for an answer. The answer is 60 CFM.

After everyone has had time to answer and you have confirmed, animate the arrows to show how you determined the answer of 60 CFM.

Point of Slide: Demonstrate that the attendees can use Table M1507.3.3(1) to determine the continuous ventilation target for a home built under the 2012 IECC.



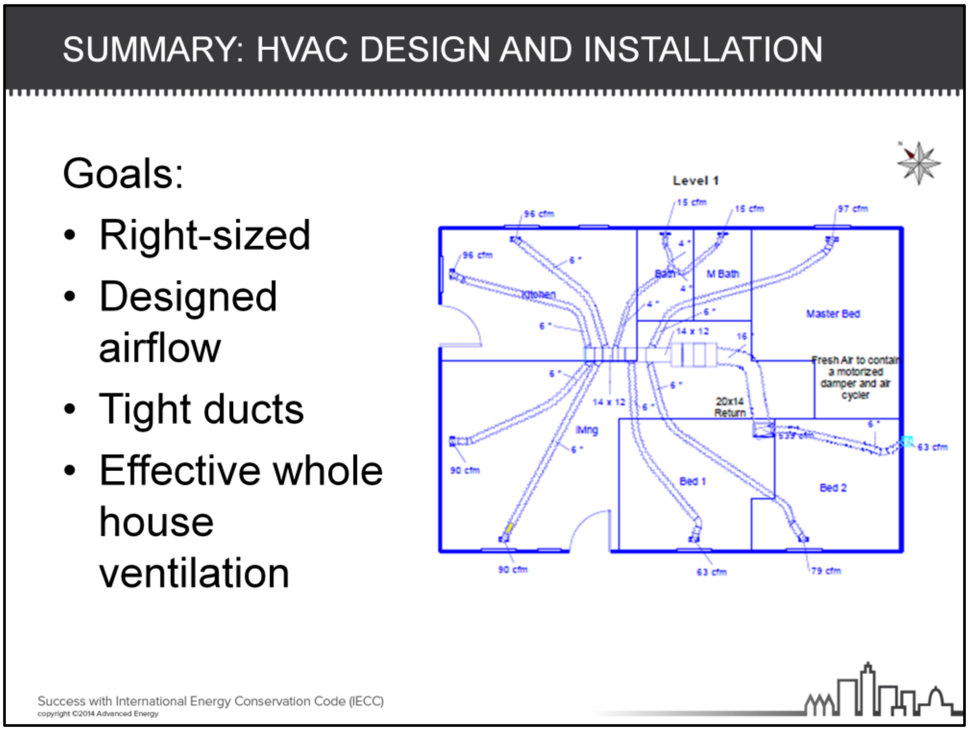
Narrative: Learning objectives are what we hope to have all (willing) participants achieve.

To demonstrate understanding, ask the class:

- “Why has the 2012 IECC required whole house mechanical ventilation?”
    - Over the past several code cycles, as residential building tightness standards have become more stringent, mechanical ventilation requirements have been added to ensure adequate outside air is provided for ventilation whenever residences are occupied.
    - These ventilation requirements can be found in the 2012 International Residential Code (IRC)

- What are three goals of a good whole house ventilation strategy?
    - Take out stale, moist, polluted air
    - Bring in fresh air
    - Distribute fresh air to occupants throughout the house
    - Quiet enough to run continuous
    - Comfortable and durable in your climate zone

Point of Slide: Asking them to answer these questions gives them an opportunity to demonstrate understanding of the 2009 and 2012 IECC R-value, U-value and insulation installation requirements.



Narrative: This is a picture of duct layout for an HVAC system. The contractor started by completing a Manual J to determine the home's heat and cooling load, factoring the need for mechanical whole house ventilation.

Manual S was then used to size and select a piece of equipment based on the actual building loads.

From there a duct system was designed, including ventilation intakes, using Manual D. This design includes register locations and sizes, duct diameters and layout, room-by-room airflow targets and fresh air ventilation flows that can be followed by the installer to achieve a high quality install.

When it comes down to it, we are really trying to achieve four things when it comes to the heating, cooling and ventilation system:

Right-sized: Don't size and select equipment based on rules of thumb, and by all means stop oversizing simply because you think it will keep the telephone from ringing. This will save the customer money, the equipment will operate more quietly and result in fewer customer complaints.

Designed flow: Equipment and ductwork installed so that the designed airflows are achieved. This increases energy efficiency, reduces stress on equipment and keeps rooms close to the set-point of the thermostat.

Tight ducts: Install and seal ducts to meet the leakage requirements of the 2009 and 2012 IECC. Ideally every system will have less than 4% duct leakage. The result: save

HVAC Resources

ACCA allows ICC Governmental Members to receive free ACCA membership and access to ACCA member benefits

ACCA Training Resources for Building Officials
Manual J Verification –
http://www.acca.org/wp-content/uploads/2014/10/Manual-J-Brochure.pdf
Manual D Verification –
http://www.acca.org/wp-content/uploads/2014/01/Manual-D-Brochure.pdf
Manual S Verification –
http://www.acca.org/wp-content/uploads/2014/11/Manual-S-Brochure-Final-1.pdf

Or visit eepartnership.org/energycodes/adoption/resources for links to ACCA and other valuable resources

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Success With Energy Code Resources

Success With Energy Codes Resources

Success With Energy Codes is a series of workbooks, inspector checklists, and tech tips for builders and contractors specifically developed for the Energy Codes in Texas and Oklahoma.

-Inspector checklists and builder tech tips can be downloaded free at:
Eepartnership.org/energycodes/adoption/resources

To purchase workbooks for Building Officials and Builders use the link at eepartnership.org

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Narrative:

Ask the class, “Any final questions?”

If no one has any questions, go to your parking lot or list of participant learning objectives identified at the beginning of the session and make sure you addressed everyone's questions or concerns.

If you think a question hasn’t been answered or an issue hasn’t been resolved, don’t make up an answer! Instead, let them know you will follow up with the appropriate person and get back to them.

Point of Slide: Show you are responsive to attendees needs and want to maximize their value for the investment of their time.

Narrative: Thank everyone and share your contact info.

Point of slide: You are a resource for them moving forward and appreciate their participation!