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Pam Cole: Our speakers today are Mike Barcik and Steve Herzlieb from Southface and we really appreciate them taking the time to share the information on various compliance paths air tightness with us today. I'm gonna let Mike go ahead, and it's all yours.

Mike Barcik: So, again, my name's Mike Barcik and I'm a senior technical person here at Southface in Atlanta, and I have been involved with energy code training for over 20 years now and a lotta other stuff. I come in the world from the mechanical engineering side of things but I've also built a lotta houses, I've remodeled a lotta houses, and a lot of other stuff. It's a lot of fun.

Steve Herzlieb: And I'm Steve Herzlieb. I've been in the industry about ten years and I've had experience with new homes construction testing, and also, I've had quite a bit of experience in the existing homes world as well.

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A lot of the time I've spent in this industry has been at Southface, but I've also worked as a home performance contractor doing energy audits, energy efficiency improvements, but among that, I also have experience teaching energy codes and a lot of things we're talking about today.

Mike Barcik: In fact, here's a picture of Steve teaching an EEBA track on the 2015 IECC, and that was the last week, the week before, at the RESNET conference, and there's a picture of me biking my daughter to school today. How's that, Steve? Right? And Steve and I have co-trained in the past. We love – we've taught a lot of certification-based training. Steve still teaches – I don't do it as much anymore, but he still teaches a lot of the BPI stuff, Building Performance Institute certification. I still am a trainer for RESNET for HERS; I've been teaching HERS since the late '90s. So we've been at it for a while.

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In fact, this is one of our early publicity stills from – was that from our early co-training in the '70s?

Steve Herzlieb: Yeah, I believe that was the first time we trained together.

Mike Barcik: That's a really good-looking sweater you've got there. Hoping we get some comments on that, if nothing else.

So, driving on, we will – I'm not seeing any comments. I'm sure that they're gonna just pour in. *[Laughs]* Driving on, as Pam mentioned, there's AIA credits – and I always want to mention that we will share all these slides and they'll all be available from DOE. And there's a fair amount of information in here today, so this is kind of a information-heavy content, but we're – we'll try to hit the high points, and please feel free to follow up with us.

Here's kinda what we're gonna talk about, basically making sure you understand what is the code asking us to do in terms of their feeling and their ramifications of that, I guess I would say, in terms of other codes and what is that making us do, and who can do the testing, and…

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We've certainly learned a lotta lessons in the last half-dozen years or so as we've kinda implemented this code in Georgia and other states, so we'll share that with – as we go along. I'd say – I think this is sort of the learning objective will tie into it, you know, making sure you understand the connection between air leakage and loads in particular, and so we added a little section on that making sure you understand that we're really talking about three different versions of the energy code today and how are they similar and how are they different.

Steve, I wanna – we're gonna talk more about this thing called the DET verifier program, but could you just give us the high-level view of that?

Steve Herzlieb: Yeah, and we'll give you more details later, but it stands for Duct and Envelope Tightness verifier. It's something that we started here in Georgia when we adopted and amended the 2009 IECC.

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And the air sealing requirements, in the 2009, the IECC, it's not required to do testing for the building envelope tightness. It is required to do the duct testing. In Georgia, we amended it to also, in our state, require blower door envelope tightness testing and duct tightness testing. At that time, we created the DET verifier program to ensure that there are trained and qualified individuals to actually perform those tests on – for code compliance.

Mike Barcik: Right. And it's a great way to sorta help – I guess I would say, help introduce the code into places that maybe don't have a huge array of HERs Raters or BPIs, and there was a question about BPIs versus certification – excuse me, credit for this webinar, and the answer is you will have to self-report, which I don't think will be a big deal. At the end of the day, also, realize there's some kinda good and bad the way we're doing some things in the code, and we'll take a look at that at the end.

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So we've got a lotta good stuff to talk about today, in the next hour and a half. So, driving on, again, our organization is based here in Atlanta, but we were founded in the late '70s, and a lot of people in the industry know our executive director, Dennis Kreach, who is actually gonna retire this year after only 38 years. Can you believe that?

Steve Herzlieb: Mm-hmm.

Mike Barcik: And we work a lot in the Southeast region, but we also work on the national level, and again, have been entrenched in codes for many, many years. We're not gonna go around and ask – I think there were 450 people signed up for this webinar, so we're not gonna go around and ask everybody what your role is, but I thought it might be worth touching on – we see the target audience of this, I would say, certainly builders, certainly code officials, anybody on the technical side of things, but also, I think if you're in the policy side of things, then you're trying to sort of say –

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"What are the implications of our state as going to one of the more current codes? What are the impacts? How's that gonna impact? What do we need to be aware of?" So, specifically, at the end and with the DET program, we'll try to share a lot of …

Mike Barcik: And I would think it's great to go to the PNNL website, http://www.energycodes.gov, and you can find a lotta great free information amongst them. I love that they update this slide every month, and it shows kinda how things are tracking, and at the moment, you'll see that the majority of the country is on the 2009 or better, and so, you know, about 28 – it does not add up to 50, but 28 of the 50-plus jurisdictions here, they mostly have the '09 and 10 out of 12, or approximate, and then a couple have the 2015 already.

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And then there's about 15 states that don't have a strong statewide code or no statewide code, but Steve, what does that mean? They have no code at all?

Steve Herzlieb: Yeah. It is sort of – yeah, some of those 15 states that are just in the pale, that indicates no statewide code, most of the major metropolitan areas do have some version of a 2009 or equivalent code, but it's just not statewide adopted. Right.

Mike Barcik: And a lotta times, big cities actually are fairly progressive in where they are. So this is, I hope, pretty relevant, and again, you'll see these icons on the side over here as we go throughout the day, referring to different versions of the code. And there are code references occasionally in there, and this – we're talking about different codes, and it may be correct for one person, but a version change may change from 402.4 to 402.5 in another version, so apologies about that. We'll do the best we can here.

[0:08:00]

Kind of a brief history, you know, for some of you folks who have been in it for a while, back in the late '90s was sort of the first – really, the first national code ever, little yellow book. They were kinda complicated and I remember them because they – they more or less forced us to go to double pane windows. We had a big change in the code in 2000, when, for the first time, that the solar heat gain coefficient came along, and that really helped spur the windows to switch to low leak. And then, in the 2004, but really, the '06 version was this vast simplification of code, which is, I think, a very good thing, and basically got rid of this, let's say, too many climate zones and just tried to streamline the code to improve the accessibility, and I sort of …before that.

In 2009, we hit, the first time ever, this need for efficient lighting; that first it showed up –

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the first mention ever of envelope or duct testing shows up, and many, many codes got – excuse me, many states got into the code

– the '09 code – because of the ARRA funding. And that was a big jump, we'll see.

2012 really pushed the bar in terms of prescriptive R-values, and 2015 is basically similar to 2012, but it has a new energy rating index, and HERS is in quotation marks there. So here's another way to look at it – the change in terms of code stringency.

Steve Herzlieb: Yeah, well, and hopefully, that – if you can interpret this graph, it might be pretty self-evident. You can see, basically, that the big drop's where you drop off a cliff, going from the '06 to the '09. We can see that the code becomes much more stringent. If you look on the left axis there, that energy use index, you can see that high numbers are more efficient.

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So you see a big drop going from the '06 to the '09, and likewise, a similar drop going from the '09 to the 2012. But you do notice that the 2015, like Mike mentioned earlier, a lotta the requirements are similar in stringency to the 2012, and we'll talk more, but one of the new compliance pathway, the energy rating index.

Mike Barcik: Right. So, here's kind of a summary, I guess I would say, of the big changes, 'cause again, I think we're going under the assumption that majority of states have the '09 code; you may have something better. Here are the big changes as you go to '12 and then on to '15. The R-values get much more strict, and now we're required to do a blower door test – that's a mandate – and also a visual inspection checklist, and also, a very strict duct leakage requirement of basically four percent.

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Some hot water requirements, and – here's the key. We're gonna touch on this later. The IRC comes into play in the 2012 and later basically requiring you have whole-house mechanical ventilation if you have a tight envelope, and you will have to have a tight envelope. Also, more lighting. But one big thing is, in the 2012 as well as with 2009, there's still no trade-off option for envelope-equipment, and then that's what really kind of – that becomes a major change when you get into the 2015, is it offers a different pathway to look at that, and we'll see that graphic here in just a second.

Commercial codes, you probably – if you've seen it, it's basically the commercial part and the residential part and the commercial part. I think residential, Chapter 4; commercial, Chapter 5. When they got into the '12 and '15, they split it up like this, with a sort of commercial half and then a residential half, and this is a little layout of it.

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Steve, finally, a non-code picture.

Steve Herzlieb: Yeah, and just – we're gonna be talking about – we already have been talking about air sealing, the building envelope, and we just want to go over a couple basics to make sure that we all understand what we're talking about: the building thermal envelope, and essentially, that is the barrier that separates the conditioned space from the outside, or unconditioned, space. It's basically comprised of two components: your air barrier and your insulation, or you could say your pressure boundary and your thermal boundary, and an important thing is that those need to be continuous with no breaks or holes or gaps, and any penetrations need to be sealed, and your pressure boundary and your thermal boundary need to be along the same plane or in contact with each other. You can't have your insulation a foot away from your air barrier.

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They need to comprise of the same boundary.

And of course, some materials can function both as the insulation and an air seal at the same time, and that's just fine, too, but for things like spray foam, it'll be both; it'll always be in the same plane. But if you're using air-permeable insulations like fiberglass or cellulose, they have to be in conjunction with a air barrier. It actually has to be in contact with it.

Mike Barcik: Right. So this is just a training slide that we use, and it's showing sorta how three identical-looking houses from the outside, and in each case, the builder chose to define the building thermal envelope in a different manner, and they're all legitimate. The R-values may or may not be the same requirement, but the big thing is that you need to be able to kinda draw the thermal envelope and never pick up your pen from the paper, and you know, here, you could choose, "Well, do I wanna go across the floor and insulate and not condition the foundation or basement? Or do I wanna include that?"

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And again, it's all acceptable by code; you just have to do the details correctly and meet the code. So I think that's all we need to say on this.

Steve Herzlieb: Well –

[Crosstalk]

Yeah, one important thing to mention is, you know, all these options are possible, and the design and construction of the house, basically, you get to decide where your building envelope is by where you perform your air sealing installation. It is a good thing to keep in mind: This affects the – how you would do the leakage testing of the house for both the blower door and the duct pressurization testing. We'll find out more in a bit how those calculations are performed, but when you do your blower door, your envelope tightness testing, you're going to need to know the volume of the house to do the calculations, and depending on where your building envelope is defined, you're gonna have to compute volume.

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Also important is duct systems that are entirely within the building envelope are exempt from the testing requirements, so if you see on the Example 1 there, where Mike has drawn the little "X" if you have an HVAC and duct system up in the attic there that's outside the building envelope, and down there, you've got, in the crawlspace, those need to be tested for leakage.

However, if you look on Example 3, where the HVAC and the duct systems are completely within the building envelope, those are actually exempt from the duct testing requirement if they're completely inside the building envelope.

Mike Barcik: Great. All right, so we'll move on, and we're gonna just mention, again, that the '09 code and the '12 code basically have three pathways to show compliance on the envelopes. You can meet the prescriptive codes; you can do simple tradeoffs within the thermal envelope using a tool like REScheck, which is free from http://www.energycodes.gov –

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or you could do a little more sophisticated simulation approach, but still, you are limited. You can only trade within the envelope. And then, of course, mandatory requirements are air-exempt. So the big change – let me get back to here – or here's the, I guess, the prescriptive code that shows the R-value that many of you are familiar with based on your climate zone, based on '09, and here's a – kinda highlited in red – what are the big changes. You can see there are significant changes in everything that's red that's going through the 2012 code, and one of the biggest one for us is the windows got a lot better; the ceiling got a lot better; the walls became R20 instead of R13, and so on. So, some big implications here in terms of the prescriptive code. And in 2015, Steve, I think you looked it up. These are 100 percent identical.

Steve Herzlieb: Yeah, yeah, yeah.

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This table's the same as the 2012, the 2015.

Mike Barcik: So the big thing that 2015 brings with it is this fourth task to be able to demonstrate compliance in terms of the shell, the thermal envelope, and it is the energy-related index – and we're gonna talk about it a little bit more as we go deeper into it. One of the implications is that it gives you more flexibility; it allows you to take credit for equipment efficiency. It also looks at appliance efficiency, things that aren't even in the code. So it's kind of an interesting option.

The basic way that the energy rating index works – and I'm gonna explain quickly – is you're going to key in the information about your home into the software and that's how the the rating is built: what you're going to build, what you're proposing to install, and going to simulate that home in one year's time –

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and it's gonna say, "Okay, how many million BTUs does it take to heat, cool, provide hot water, and run lights and appliances?" And so here's an example where the rated home is simulated, and let's just say so it's – it takes 40 million BTUs to heat that thing; it takes 30 million BTUs to cool it; it takes 30 for hot water and it takes 50 for lights and appliances. So, they're just made-up numbers, and those are annual energy, so to basically keep the thermostat happy.

At the same time, or behind the scenes, it's gonna take that same home and it's gonna dumb it down or beef it up, depending on the components, to the exactly meet code, and the version of the code – I hear an ambulance. The version of the code is 2006. It's okay as long as we always use the same reference, and so, in this example, made-up numbers – those would have to be 150, I should say.

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So the reference home, let's say we simulate it and it takes – oh, it's gonna take more for heating but maybe less for cooling, and the same for hot water and more for lights and appliances. So if you add those all up – 70, 20, 30, and 80 – you get two hundred. So, 150 million BTUs for the rated home over 200 for the just-met code, that's a 0.75 fraction, and that, multiplied by 100, gives you an index of 75. Steve, what does that mean?

Steve Herzlieb: Well, basically, that's saying that the rated house is 25 percent more efficient than the reference home. It's one point per one percentage of increase or decrease in efficiency, and the lower the number, the better. The lower the number, the more efficient the house. So, for example, if it was added up to be, say, 50 – or the index of 50, then that would be about 50 percent more efficient than the 2006 code.

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Mike Barcik: And likewise, if you have an old, existing home, it might have an index of 150, which means it's 50 percent worse. So the only other comment, Steve, is that there's also an additional multiplier that I didn't have that it has to do with renewable energy. So if you have a renewable energy source, let's say, photovoltaic panels on your home, and they generate, let's say, 20 percent of your home's annual energy use, you multiply your index by, in this case, 0.8, and so that would drop your index from a 75, basically, reduce it by 20 percent, and that drops it to a 60. So that's the – the home itself is a 75, but with the power generation, it's effectively a 60.

And then, Steve, is that at all controversial about using the renewable energy or code compliance? *[Laughs]*

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Steve Herzlieb: This is one thing that has, across countries, been raising a few eyebrows with the ERI being introduced into the 2015 code. Folks are calling attention to the fact that it's the International Energy

Conservation Code, whereas it seems like solar photovoltaic actually involves energy production. So some are wondering whether or not it's an appropriate way to address solar.

Also, it's not necessarily always the same people who own the solar system as the owner of the building, and that's another area of complication with introducing the ERI. So, just be aware that different folks are interpreting this in different ways. There's still some debate about it. Some jurisdictions are adopting the ERI and putting a cap on how much – how many points you can take for solar; others are shooting for not having solar in there at all; and other jurisdictions are just adopting it as-is.

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Mike Barcik: As-is, yeah. Very good. Okay, so in terms of code compliance for the 2015, one thing you'll notice is that the targets are pretty aggressive, but again, you're getting credit for stuff that formally was not in the code. So you're down in the – typically in the low 50's. And the benefits, again, are you get a lot greater design flexibility; you get credit for more efficient equipment, more efficient appliances. You are not allowed the trade-off to be worse than what the '09 code would allow you to do, so there is a backstop, and you still have to meet the mandatory requirements – things like air sealing and duct sealing and testing, and so on.

You know, concerns, also, you could say it's a conflict of interest in the sense that the person rating the home might be being paid by the builder. There is actually, unfortunately, a bit of a size bias against small houses. It's a little disappointing, but small houses are kind of penalized, which I'm not sure is what we wanted.

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In terms of the metrics we use, ACH50, it definitely favors the volume of a big house, and even the ERI itself, we find challenges with multi-family units because they don't have much exterior shell. So it's a little challenging, in some cases, for smaller homes. And you could ask the question, you know, "Should I be allowed to trade my insulation down because I have an ENERGY STAR dishwasher?" That's an extreme example, but these are all valid questions.

At the end of the day, I think it's worth it because I think you've got a professional, such as a home energy rater, involved, who does typically understand energy efficiency pretty well, and often, the code officials just have so much on their plate that the energy code is tougher than to allocate much time or resources to. And then, of course, the builders can market, so there's tremendous opportunity for the builders to market the index.

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And, Steve, if you're looking at buying these two homes and they really like both of 'em, which one are you gonna choose?

Steve Herzlieb: I would choose the more efficient one, and to be clear, too, we're kind of interchanging the energy rating index, ERI, with the HERS index, and they are, in fact, basically the same thing as – in the context of using HERS index for code compliance, we refer to it as the energy rating index, the ERI. But it – for homeowners, it's sort of like having that fuel economy sticker on a car, but having something on your home. You can have this ERI or HERS index – whatever you'd like to call it – and at a glance, a homeowner can – potential homebuyer can have a nice, easy-to-understand indication of the energy efficiency of that home.

Mike Barcik: Right. Okay, so now, we talked about sorta the big picture of codes. We're gonna get into the mandatory requirements and really focus on air sealing.

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And then, just to kinda segue, one of the first mandatory requirements is this need for a code compliance certificate that is usually mounted on the panel box. Some people say, "Oh, I'm worried about covering up the wiring diagrams." Typically, you just put a plastic sleeve and just insert the document, and it's basically a nutritional label, like when you pick up a box of cereal and it tells you the ingredients. So it's got the R-values and the U-factors of the windows and equipment efficiencies and so on. It's also a very good place to put the duct and envelope testing results information because the codes were originally not thinking about where it should go. So we felt like that was a good place in Georgia, and then I think the '12 and '15 codes picked that up.

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We also, in Georgia, even require – a load calculation has to be summarized on it, and at the end of the day, there's an example of what one might look like and filled in, and I wouldn't say we see it all the time; I wouldn't say that it gets filled in correctly all the time, but at least conceptually, I think it's a neat idea.

You can also get several versions of this form on our website for free, and some of them are static, like this, and some of them are fillable PDFs. So I'm gonna try to discard outta here and see if I can find that. Let's see. So if you go to the Southface – http://www.southface.org, there's some free – a lotta good free information. Go under Learning Centers. There's a library section here, and you can find something about building energy codes, and there's this cool little house that you can click on and – now, this is set up for the '09 code.

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This just sort of says, "Hey, here's what you gotta do," and little buttons like that, but there's field guides; there's videos to use the field guides; there's – this is – there's a training ten-minute overview video of how to do blowdoor testing.

[Phone ringing]

I should turn off my sound – and how to do the tests, and got great little diagrams and – let me see if I got stuff I can show – kinda walks you through what you're trying to accomplish, and – I like this part, where the – showing the pressure dynamics. There's depressurization in the house. Nice little video, free, ten minutes' time. There's a similar one for duct leakage testing as well. So, good, free information to follow up with.

And there's also a training page that talks about some of the training you do, and particularly the one about the duct and envelope tightness verifier.

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It has a lotta good information over here, including here is the static form that we were talking about, which I think I have that pulled up, so that's that one. Here it is, blank. You can print it and use it, and here's one that just has an example with checkmarks and stuff filled in – and let me see if I get that. There's also a fillable one, which, if you put your – it's got spaces to put in your information and you can put in your – I think I can put in 2000 and – I was trying to pick one that would look more impressive, so 16,000, and then it'll calculate 17.5 ACH50. It's not smart enough to tell you you failed by a long shot, but it does at least do a little bit of the basic math. And also, on the checklist, you can come down here and say –

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"Oh, crawlspace walls, we don't have a crawlspace so we'll pick N/A on that one, but for narrow cavities, yes, we did that, and garage separation, we don't have a garage but we do have canned lighting," and so we just fill in the checklist and then print it out. So, again, a nice little tool.

There's also some other good free information on this page, including – I'm gonna mention later a white paper that we talk about what we've kinda learned from the program, and so I'll just reference that and bring this back to our presentation. This is one of my daughters.

Okay, so, Steve, why are we talking about air sealing? Probably important.

Steve Herzlieb: Yes. *[Laughs]* Air sealing's actually very important, not only just for the energy use for the home, but also for the healthfulness and the comfort of it, and if you're not familiar – you know, infiltration, exfiltration.

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Infiltration means uncontrolled, undesirable air changes, air coming into the house. Exfiltration is basically uncontrolled air moving out of the house to the outside, so air –

Mike Barcik: And you can't have one without the other.

Steve Herzlieb: Yeah. They always happen simultaneously and that is an energy penalty. It will result in higher energy bills. You can imagine if it's a cold winter night and you have that cold winter air coming in through the – what should be the warm exterior of the house – through gaps and cracks, you're gonna have to run the furnace or heat pump to heat that air, so it results in higher energy bills. Obviously, comfort, you know, drafts coming in make a home uncomfortable.

Another thing that's getting a lot more attention these days is the impact on the healthfulness of homes, the indoor air quality. Air sealing's important because a lot of the contaminants, pollutants, that can cause the poor indoor air quality actually can come in from the outside of the house through these gaps and cracks – talking like pollen and carbon monoxide, those types of things.

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Another thing that's important, though, is when you do air seal the home, you have to be very mindful about what kinda materials you bring into the house because, just like how that sealing can keep pollutants from coming in, if you bring a pollutant in, it can actually ensure that it stays in the home, and we'll talk about that a little bit more later when we address ventilation.

Also, moisture coming in, it could be comfort issues but it also could be durability. If you have humid air coming into a house that is being air conditioned, as that warm, humid air works its way through the gaps and cracks, it might encounter surfaces that are below the dew point and cause that – the moisture, the water vapor in that air, to condense, especially in wall cavities or behind walls, places like that, so you can get liquid water forming over a period of time, and a person might not even know there's a problem until they start seeing mold growth or something like that.

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Mike Barcik: So, pretty important, huh, I guess? I also would like to say we can snare – we can snag all kinds of very cost-effective energy savings by air sealing, but there is a point where we absolutely have to give something back. We've tightened up a building. We've got to provide essential ventilation. So the codes today have really – align pretty well with building science and recognize that what we want is a tight, well-insulated structure with intentional ventilation. That way, we get the best of everything, and so I think it's a key part of that.

And here's some great pictures, just some things we're gonna be talking about more and more, you know, air leakage in knee walls and chases in the attics and tubs set on exterior walls and plumbing penetration, so we'll get more and more of that.

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In terms of the code, the 2009 code, I think, did a really big jump in terms of helping us to better enforce and better understand air leakage. Oh, we've got a chuckle out of this, Steve. It says, "Number 1: Thou shalt air seal all joints, seams, and penetrations," and then Number 2 through 11 are a bunch of specific places –

knee walls, tubs, and so on. Number 12 is: "Oh, anything I forgot to mention, be sure to go ahead and seal it." So it was a pretty good cover-my-rear-end statement at the end and a few specific details for some of these things.

The – well, I guess there's also a – I'm gonna jump over and show this. There's also a air sealing and insulation installation checklist. Here it is for the 2012 code. I'm just gonna jump over and pull it up for the – this is the '09 version, and I'll blow that up a little bigger.

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What we did at Southface, we took the checklist and we just put a number by each of the items on the checklist, and you can go down the list and read them, and there's some important detail – we're gonna review this 15 one in a second – and then we said, "You know, that's great. It'd be really nice to have a picture of a lotta these." So we've got a lotta graphics that show – and the numbers illustrate what they're kinda demonstrating – I may have to just back out a little – and kinda demonstrate places to air seal. And it's not necessarily the only way to do it, but it's talking about sort of the details we're looking for. And here's a great one that's a duct shape or – and a duct penetration and so on – and we've got these – this slide coming up in a second – a tub on an exterior wall and windows and rough openings, and so I'm gonna – I think what I'm gonna do is, when we're done, I'll throw in this PDF of the presentation, but I wanna just include these 13 slides as well – or 13 images as well so you can download the presentation and get all these graphics, and please feel free to use 'em.

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I personally think this is a great one because it shows an attic knee wall with an attic air – an air barrier on the attic side, which is – we've really stiffened that up in Georgia, and it's helped a lot, and also, blocking under the attic knee wall. This diagram's, I think, just help me. I guess I'm a picture person. You, too, probably.

Steve Herzlieb: And these – like Mike said, we'll make these available to everyone participating, but these are also available on our website in the library section.

Mike Barcik: And then the multi-family has its own set of issues, for example, a cutaway of a mechanical closet in multi-family and sort of some of the air sealing locations, and here's one that talks about the stairwell that's adjacent to multi-family units and the fans and that diagram we talked about earlier, and even some details about attic insulation. So, hopefully, that might be helpful to you.

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And the 2012 – there were a couple of changes between the '09 version of this checklist and the '12, and we're gonna see, also, the '15. One of 'em that went away, interestingly enough, was the requirement to air seal common walls on multi-families. I guess someone said, "How does that save energy?" But why would we really want you to air seal the common wall in a multi-family application?

Steve Herzlieb: Basically, to either isolate the units to make sure you're not getting air exchanges between them, but also, from indoor air quality as well.

Mike Barcik: Yeah, and frankly, even when you blow a door test, if you don't seal between adjacent units, your unit is gonna appear to be leakier than it really is because, normally, we do what's called an unguarded test. So it's – where is it on here? Common walls.

[0:37:00]

Number 15 on my 2009 list, and whatever reason, it disappeared in the '12. There's a couple other tweaks and changes, but otherwise, not terribly crazy.

Fireplaces have caused tremendous confusion, and the way it was written in '09, I thought they were gonna fix it in '12. They almost did, but then they put this gasketed door thing in. So try to explain that.

Basically, it says, "New wood burning fire – " originally, it said, "New wood burning fireplaces shall have gasketed doors and outdoor combustion air." That was in the '09 code. And then we got a letter that kinda says, "You know, what we really meant was not the kit – " because if you retrofit glass doors on a kit, that could void the UL listing, so in Georgia, at least, we kinda said, "This only applies to a true stone or brick mason rebuilt type fireplace."

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But then the 2015 code kinda came and said – they actually helped to clarify it here. They – "New wood-burning fireplaces – " they got rid of the gasketed doors. They now say "tight fitting dampers and outdoor combustion air." So the combustion air thing is a really good one, so that's, you know, combustion air to the fire box, there's a damper and a flue damper. It says, "When you're using tight-fitting doors on factory-built fireplaces," basically, they have to be UL-listed if you're gonna add it to a kit, and then if you're gonna do it on a masonry one, it has to be – that's not such a tripping point. It kinda makes sense. You're making your fireplace just as – in accordance with UL 907. So it's a fun little area to get lost in the weeds.

So here's the 2015 checklist, and Steve, I'm gonna pull it up in just a second, but the main thing is, now, there's an extra column. Can you explain that?

Steve Herzlieb: Yeah. In the previous versions, they addressed the air barrier and insulation in a single column at the same time.

[0:39:00]

In the 2015, it's a little bit clearer because they divide it up into two columns – air barrier criteria and the insulation installation criteria, and so previously, those were just all lumped together, but it makes it a little bit straightforward and easier to read with them in the separate columns. Also, a lotta the items are very similar in the 2015 compared to the previous versions, but as – you just go through these, if they're looking at 'em, back-to-back, if you're reading 'em together at the same time, you notice that the 2015 offers a little bit more clarity and improved wording and more detail.

Mike Barcik: I think they keep getting better. I'm gonna say it's still not to where I necessarily want it, but it certainly is better. Couple key things, you know, air barriers shall be continuous and external thermal barrier envelope contains a continuous air barrier.

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Breaks and joints have to be sealed. The – you can't use air-permeable insulation as air sealing materials – that would be things like chinking fiberglass around window, rough openings. You know, just some details which I think is a representation of improvement. Still kinda vague, though. It says, "Knee walls shall be sealed." You know, I think more description is useful. It doesn't also mention this need to insulate corners and headers and an R-3 minimum, and that is an important detail because that really pushes us towards what we sometimes call "advanced training," and every – and basically, your rigid insulation on the outside has to be in substantial contact and continuous alignment with the air barrier. So a lotta good detail there.

Rim joists, floors – floor basically says, "Wherever you end up putting insulation, the air barrier has to be continuous all the way around it – "

[0:41:00]

-- I think is kind of the summary I read in there.

Steve Herzlieb: And –

Mike Barcik: And if you wanna ask – Steve, sorry –

Steve Herzlieb: I was gonna say, in general, that the 2015 does a good job of adding details. There is some notable places where it seems to be – could use some improvement if they included more details, like if you look where Mike scrolling up here, the plumbing and wiring. In the air sealing, they haven't mentioned anything in there. And it does say in the code, basically all penetration should be sealed in the general section, but it would've been helpful in the plumbing and wiring here, since a lot of – you know, you'll have wiring going through top place or plumbing going through top place of the ceiling of a building. It would be nice if they called that out specifically and mentioned that all penetration – plumbing, wiring, penetration should be air sealed.

Mike Barcik: Yeah, yeah. I mean, they do say fit the installation, which is nice. They have more detail on tubs that are on an insulated – really, it shouldn't say "exterior"; it should say "insulated" walls, and it's all good, but it's making a lot of progress.

[0:42:00]

Here's – the big new one, Steve, I guess, right here would be concealed sprinklers. That was not in the '12 or the '09 version.

Steve Herzlieb: Yeah, and basically, in the 2015, it's just saying if you're going to air seal around concealed fire sprinklers, it needs to be done in a way that's not going to affect the performance of the sprinklers in accordance with the – how it's recommended by the manufacturer.

Mike Barcik: Yeah, generally, light safety trumps energy code, I think, is a good way to look at it.

Great. Anything else on that? So there's our sort of code references. Here's a bunch of pictures that we're just gonna talk about, some common air sealing locations, and some of these have the diagrams in 'em that we quickly went looking for. So here's a classic one, you know, the tub penetration – the pipe on the tub is about 2.5 inches or so and the opening is big enough to pass the – what, a six-pack of beer through there? Is that how that works? So that might be a code requirement to work out. I'm not sure. But –

[0:43:00]

Steve Herzlieb: This is a very common non-conformity to code, I guess you could say; it happens in a lotta houses to often overlook the giant, gaping hole underneath the bathtub that leads into a unconditioned basement or a crawlspace, someone needs to be on the lookout for.

Mike Barcik: And we had mentioned this earlier, Steve, about the need to be able to insulate headers – window headers to an R-3 or better. There's a number of ways to do that as well as insulating in corners and intersecting corners, and there's a lotta techniques to do that, but you can have a section of the wall that doesn't have insulation anymore, and that's a good insulation detail.

Here's another one. I think we mentioned the HVAC chase. You know, it's always better to have the framer cap the chase with a piece of plywood, say, or OSB or something rigid and then have the HVAC contractor cut the hole for the duct to run in.

[0:44:00]

Once this area gets several ducts running in it, it's really hard to retrofit Swiss cheese and to fill that up, so that can be a challenge.

Here's somebody sealing the boot to the ceiling drywall, same thing to the floor, and then, of course, here is the diagram that shows the same kinda thing. So there's this sort of miscellaneous stuff.

You mentioned tubs on – or we mentioned tubs on an exterior – or on an insulated wall. Here's a great – whoops, let's go back on that one. Wait, I wanted this. This is what I wanted. So the picture on the left is kinda the bad, and this is the second-floor Jacuzzi tub set on a exterior wall that had a little shed, probably a porch, and you can see they didn't run the sheathing, which they should have. And here's a great pathway for exterior air to basically infiltrate into the home and then basically get in between the first and second floor.

[0:45:00]

And this leads to all kinds of crazy, "Why is there condensation in my kitchen ceiling and there's a second-floor bedroom above it?" Here's the pathway. So this needs to be sheathed on the outside; it needs to be insulated – and of course, typical insulating is not an air barrier – and then it needs to have an interior air barrier as well, sort of what you see over here.

The picture down here, builder did a great job. This wall on this side is basically an interior wall, so they didn't do anything. This wall out here is an exterior wall, so they insulated it and they put a thin air sealing sheet material called Energy Brace against it. This is a garage wall. They did the same thing. So, attention to detail with tubs is – timing is important to get the insulation and the air barrier before the tub is set.

[0:46:00]

Steve Herzlieb: Yeah, the order of operations. You know, oftentimes, the plumbing rough-in occurs before the insulation, but the way they do it in this case is actually – the diagram to the lower right, they did install the insulation in the subcavities and then sheathed over it and then set the tub. So you can see the rest of the wall is going to be insulated later on when they do the rest of the exterior walls.

Mike Barcik: Okay. So here's a couple pictures, too. Again, we mentioned that tub one. I thought this was kinda funny because you can see someone had bothered to air seal these two penetrations but perhaps missed the forest for the trees, I guess that we might say. Here was the retrofit sealing, and I'll share – I live – you live in a newer home, right? And yours was built to a green building standard. I live in a 1920 home, and that was a whole – it was in my – under my tub, and I'm like, "What's holding the tub up?" But the interesting thing is, my motivation for sealing that was more about getting better air quality in the house because –

[0:47:00]

you know, Steve, my house, when we bought it, was very leaky and had a lotta air changes, but it wasn't necessarily healthy, and a lot of those air changes were coming from the very moldy crawlspace. And I'm allergic to mold, so, again, it was a pretty low-tech solution to fix that problem.

Steve, I'm guessing from your background, you've crawled in crawlspaces before?

Steve Herzlieb: *[Laughs]* Yes, and they typically are not the nicest and healthiest environments you can find in most homes.

Mike Barcik: Have you ever encountered camel crickets before, Steve?

Steve Herzlieb: *[Laughs]* I was about to bring that up. We forgot to mention that earlier, but one of the benefits of air sealing is to limit pest intrusion as well. You can imagine these gaps and cracks; they allow critters to come through, and doing air sealing helps eliminate that.

Mike Barcik: Yeah, and I was working on this, and my crawlspace, it's not my favorite place to be, like you said, working on my back, sealing this up, and all of a sudden, those camel crickets – one of 'em started gnawing on my leg, and I'm not kidding, Steve, I freaked out.

[0:48:00]

And it turned out it was my dog, so it was okay. But anyway, my other great air sealing story was we were doing some habitat splitsville homes in the late '90s, and we stayed in a kind of Norman Bates motel, and two doors down was a traveling reptile show, and the – that's not an indigenous snake to Tennessee. That's a five-foot python that it crawled through unsealed plumbing penetrations, and from his hotel room several down to our hotel room, and honestly, I'm not sure what's scarier: the snake or this guy's hairy back, but maybe I could be wrong. So these weren't paying attention on that one.

All right, so the other diagrams we talk about, you know, we want air seal at the fan on multiple-story buildings, and of course, window rough opening.

[0:49:00]

Here, he's using a backer rod material. They obviously make a foam that's designed to go for windows, low extension.

This is a great picture. Took these from a training I did in Maryland a few years ago. I really like this. They use the sheathings as the exterior air barrier. I'm a big advocate of trying to make the sheathing airtight, and there's some tremendous systems out there that really use some very good – they do a great job of integrating the weather barrier as well as the air sealing barrier, but here, they used the sheathing as the weather barrier and the main air barrier, but they also ran a strip of housewrap and taped it where there was a band, which I think is a beautiful detail, and that's a place where I think housewrap actually does – generally, we see housewrap as just not sealed properly and people get the details wrong. I've got, actually, some pictures of it being done correctly, and this is a nice job where they actually followed the rules.

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Instead of cutting an "X" in the housewrap, and that's – I'll admit that's how I was taught. You know, you come in here and you cut an "X" through the – over the rough opening, and you get these four triangles. The bottom goes down; the left and right go in; the top goes in, and then your window, with the plan, is basically reverse flash. Doesn't make sense.

So, what's the right way? The right way is to use kind of an upside-down "Y." You cut a splint across the top and then you cut the upside-down "Y." The bottom triangle goes down, the left and right go in. The top, you actually cut a flap. You flip it up, install the window, and then put the flap back down on it, and so there's a picture of it actually done correctly, in nice detail.

And moving on, we're gonna talk about cantilevers – we're gonna come back to that, but just more details on there.

[0:51:00]

Like, I think we've mentioned the attic kneewalls, the air barrier on the back of the kneewall as well as locking – and what's going on in this picture?

Steve Herzlieb: Yeah, this is a fairly common problem with folks who are almost there but not quite when they're doing their air sealing, and in case you didn't mention, with the kneewall, we're talking about a vertical wall between an attic space and a living space. If you can see in that diagram up there, you see the shiny, silvery – they sheath the attic side of the kneewall with a foil-face foam board, but one of our colleagues, they did not extend that sheathing down between the – into the joint cavities, and you see him sticking his arm down there. He's actually holding a digital camera, and that picture on the lower-left is the picture that he's taking. Basically, the entire band area between those two floors area is open directly to the attic, and if you look, you can see that there's some _____ foam insulation there that is piled up in front of that but is not acting as an air barrier, and that area is completely wide open to the attic.

[0:52:00]

Mike Barcik: And at the end of the day, this house probably will never pass the blower door test, right, 'cause that's a leak out.

Steve Herzlieb: Yeah, and an interesting story, too. I didn't mention it from my background, but when I got started in 2005 in this industry, was working for Southfaces in the Greater Atlanta Homebuilders Association, in the EarthCraft program, which was beyond code program in 2005, but it's interesting now, is what was beyond code in 2005 is now very similar to the current requirements of the 2009 and beyond energy code. So, in 2005, I was doing very similar inspections and the testing for the beyond code program, which is now mandatory. Yeah, and basically, this is one of the things that I would be on the lookout for because builders would be sheathing their kneewalls and they would forget this detail between the joint cavities. Almost guaranteed to fail the blower door air tightness test, and that would be one of the first things I would look at.

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As an inspector, I would go up and move the insulation aside, make sure they extended that sheathing. If they didn't, I would basically tell the builders, "You might want to reschedule before I get started because it's highly likely you're going to fail your blower door test."

Mike Barcik: Yeah, and that's what the visual checklist for the code can help check those things, so before you actually waste your time doing a test that you know you're gonna fail.

Here's a similar picture, but this is actually from the attic side. This is a weatherization photo, and you can just see that there is no blocking and this is – this area is gonna need to be blocked. What are these things, Steve, these little white knobs?

Steve Herzlieb: Shouldn't be seeing that too much in new construction. You see this a lot in existing homes, the weatherization, knob and tubed wire.

Mike Barcik: Oh, so if you lick your finger– *[inaudible due to crosstalk]*

Steve Herzlieb: Yeah, I would recommend not.

Mike Barcik: Yeah, okay, so that needs to be removed before we can air seal an insulation and decommission. Well, here's, again, new construction. Again, the leak here is the lead path underneath the kneewall, and here's attic insulation just hanging off in space, so that's no good.

[0:54:00]

No sheathing on the attic, no – here's another one. Here, they got sheathing on the kneewall, like you were talking about, but they did not block, and again, this makes a lotta cold drafts in the wintertime, so it almost certainly will fail the blower door test.

I'm not saying this is the only material you could use; some folks don't wanna see the rigid foam like this exposed on the attic side, but this is a great job of sealing. The blocking has been done. They're gonna add additional insulation. The kneewall, itself, has been insulated and sheathed, and the insulated sheathing helps overall R-value. Attic access, the code says that's gotta be air sealed and insulated.

Here's a very important one. When you have a garage adjacent to the house, you've got issues in terms of how the steps – a lotta times, there's a basement on that home and the steps connect up into the house, and a lotta times, we find no air sealing.

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The steps, themselves, kinda become a poor air barrier. So that's a very important detail. But more importantly, whenever you have, say, on slab home, you have an attached garage with, say, a second floor above it, this need for blocking up in this location – that has a very – poor drawing, but that is a crucial, crucial air sealing detail that often gets covered up. It may even get insulated, but it becomes a giant leak path.

Steve Herzlieb: And very important for indoor air quality and that healthfulness of the home to ensure that the attached garages are completely isolated from the living space. And here's a picture; you can see that the daylight's shining through. Imagine the attached garage on the other side of that. Any penetrations you might have in the ceiling of the garage, from the garage door opener, light fixtures, when you have automobiles running in the garage or even some of the paints and other materials, gasoline, that people might store in the garage –

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the air can travel up through the penetrations in the garage drywall ceiling and get in the area between floors and then migrate into the house. So it's very important, not just for energy, but for legal air quality.

Mike Barcik: Love it. Okay, and the last kinda big detail is it's a small joint – it's a small leak path, but it's very, very long. So it's this interior wall plate, and here's a truss roof assembly with an interior wall, and they're gonna hang the drywall and the – the drywall gets mudded and taped from the inside, but you go in the attic, there's a crack right here. Might be an eighth of an inch, but the problem is, it's hundreds of feet long, and it turns out that that can really – after you get all the big holes, that can actually be pretty significant. So try – there's a number of ways to try to seal that. But just remember, the flat ceiling, it's – your only air barrier is a half-inch deep drywall, and it can work, but you gotta pay attention to the details.

[0:57:00]

And –

Steve Herzlieb: Yeah, and one thing we don't show in this picture, but this is important to mention – you mentioned the wiring and the plumbing penetrations earlier. The top plate in this picture doesn't have those penetrations through them, but typically, you would often have wiring and plumbing coming through that top plate, and it's very important to air seal around those penetrations. As Mike is kinda sketching there, if you have an open hole, the attic air can get down into the subcavity of the interior wall. It might travel into the home through a electrical socket or outlet, but even if the air itself doesn't actually travel into the living space, having that attic air in that wall cavity inside the home, if it's a – and during the hot summer, that interior wall, the surface will be hot and it will increase the cooling load on the house and decrease the comfort.

Also, if there's any moisture in that air, it could cause durability problems, you know, if it condenses in those interstitial cavities –

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– you know, those behind-the-scenes places.

Mike Barcik: Good point. So we have a picture of plate penetrations, yeah.

All right, very quickly, I think most people are kinda up to speed on this, but the option of a blower door test in the 2009, it says you have to be less than 7 ACH50 – that means air changes per hour when the building's kept at 50 Pascals. Another way of thinking that is if I do a test on a house and I hook up a blower door and the volume of the house changes out, if I keep the blower door keeping the house at 50 for one hour, how many times will the entire volume of the house change out? And the answer is it has to be less than seven.

And so the turnout, CFM50, is unique to every house. Every house depending, how tight or how leaky it is, will get its own unique answer, CFM50, and we want that number to decrease.

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The '09 code puts a pretty doable target. Less than seven is pretty doable. As you get into the '12 and the '15 codes, basically, most of the country has to be less than three or – and it's kinda weird. It says, "Not exceeding three air changes per hour," so I guess it's less than or equal – there's kind of some confusion about that.

When you get to, basically, the Gulf Coast, most of Florida, the – Climate Zone 2, they say less than five, but everywhere in the country has to be less than five. Most of the country has to be in the two-point-something range, and here's the formula. Notice it takes this blower door number, which is cubic feet per minute, multiplies it by 60 minutes in an hour. So it's really cubic feet per hour, divided by the volume of the home in cubic feet. And that's where, unfortunately, big homes get a big sort of easier time because large homes have large volumes.

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And the home could be pretty leaky and still, essentially, pass codes. So it is a little bit biased – or more than a little bit biased, okay?

Steve Herzlieb: And a quick reminder, too, the 2009, the blower door test wasn't required; it was optional to do the blower door test or the checklist, but starting with the 2012, the blower door and the checklist are both required.

Mike Barcik: I think we have that coming up. And then the implications of this, if your state is on the '12 IRC or later, basically, in Section 303, it says, simply, "If you're tighter than five, you've gotta have a whole-house mechanical ventilation system." So, once you get to the '12 cycle of code, you're there. Now you gotta build tight and you gotta put in whole-house ventilation.

And they use a table. The table comes from ASHRAE 62.2, but – and this is the 2010 or '07 version – the table – based on this formula, the table tends to round up, and so that's just an important detail. In terms of the IRC, they just use a table.

[1:01:00]

And I thought I'd share with you, we've been involved with a compliance study in Georgia and we tested about 90 homes that – randomly selected around the state, and remember, we had to be less than seven, our median was – our average was around five, and only a few were actually worse than seven, so – and the conclusion was half the homes we tested would be required to have a whole-house mechanical ventilation system. I would say we did not see that, necessarily.

And here's a really quick overview of ventilation. There's a lot more to this. This is one of our favorite topics, so maybe if you're interested, maybe ask Pam to let us come back and do one on ventilation, but basically, you can suck air out of the house; you can push air into the house; or you can do both at the same time, and that will sort of affect the pressure on the home.

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And so, in many cold climates, the cheap ventilation strategy is just a good-quality exhaust fan that runs all the time. May not be appropriate for all climates, like the heat itself. There's energy recovery ventilators, and also, HRU, heat recovery recovery ventilators. These are balanced systems that essentially say, "Well, we've got an air stream coming in that's fresh air. We've got a air stream going out that's stale air." The stale air is usually sorta room-conditioned. The fresh air might be hot, might be cold, might be humid, and so we can eventually precondition the incoming air with the energy of the exhaust air. Those two streams don't mix, but we can capture some energy savings.

And then another one that's pretty common is positive pressure or supplied ventilation, where we essentially dump outside air into the main return, and when it operates, the air hammer pulls mostly return air, some outside air, and it switched a little bit more back into the house than it took out, so that's why we call it positive pressure.

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All of these are viable and some are better suited for certain climate zones than others.

We wanted to mention duct testing – a lot more strict.

Steve Herzlieb: Yeah, and then the – and duct testing has been required since the 2009, and the 2009 version allowed some more options and the numbers weren't quite as stringent. Depending on the type of test you did and when you did it, you're going anywhere from 6 to 12 percent of duct leakages of what you had to meet in the 2009.

Starting in the 2012, they made that stricter. For – basically, for total leakage with the air handler unit installed, that's four percent – the ducts need to be tighter than four percent. And then if they're tested without the air handler, it's a little bit more extreme than three percent. But whether a rough-in or a final, with the air handler in there, the duct system needs to come in at least than four percent.

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And when we say four percent, it is actually referring to the –

Mike Barcik: CF –

Steve Herzlieb: – CFM25 that – result that you get from the duct test divided by the square footage of the served by that duct system. Not to mean that its technically not a percent, but that's just kind of a way of referring to it.

Mike Barcik: Thank you. Good point, and why is this so important? There's some details – just, if you think about it, duct sealing is very high to the building envelope leakage, so – and here's a very, very, very fine drawing I'm doing. Maybe you could kind of –

Steve Herzlieb: Yeah, and as Mike is drawing here –

[Crosstalk]

Duct tightness is very important. It has a lot of effect on the performance of a house. You know, starting in the 2012, both duct testing and envelope tightness – duct pressurization testing and blower door testing are required.

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The duct – holes in the duct system are actually also included in the blower door test and then tested separately with a duct pressurization test. This is because your duct system is actually part of your building envelope, and what Mike is – he's doing better than I could, but what he's attempting to draw there is a house with a air handler and a duct system up in the attic to kinda illustrate this point.

Steve Herzlieb: And you can imagine, if you had a hole in that duct system up in the attic and the duct system's not running, essentially, it's the same thing as having a hole in the ceiling, itself, of the house. One example we used when we do trainings on this is people might be familiar with having hamsters and habit trails. They would have the hamster cage with the little activity tubes that the hamsters could go run up in above the cage and do various things.

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And that's like your duct system. When the hamster's up in that tube, he's still inside the cage even though he's outside the main body of it, you know, similar to the duct system.

Mike Barcik: I was thinking maybe more of those waterslide parks where you go outside the building, then come back and inside– *[inaudible due to crosstalk]*

Steve Herzlieb: Exactly. Yeah, but you're still in – yeah, you're not being exposed to the exterior.

Mike Barcik: So this is supposed to represent a blower door test being done right here, where we're depressurizing, and you can see air is leaking in through various leak paths, but one of those leak paths is the duct's leak itself. So this is a pathway, and also, the seal – let's say the boot right here, let's say that's not sealed well. That's a pathway.

So the duct system could truly impact leakage. I think that's what we're trying to get at.

Steve Herzlieb: And without going and spending too much time on it, you know, when the system's not running, it's just like having a hole in your wall or your ceiling of the home itself. But when the system is running, it becomes even more serious because then you can have either conditioned air being ejected into attics and crawlspaces and costing homeowners money –

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or it could be drawing in outside air through, and leaks on the return side that need to be conditioned. But also, having leaks in your duct system can change the pressures within the house compared to the outside.

Mike Barcik: When it operates, yeah.

Steve Herzlieb: When it operates. So, actually, if you have a leak in your duct system on the supply side, you'll be blowing conditioned air out into your attic, but also, that would cause the entire home to go underneath a negative pressure that would then draw in air – outside air through gaps around the windows and doors and things like that as well.

Mike Barcik: So, apparently, the house is a system. That's what you're telling me.

Steve Herzlieb: Exactly.

Mike Barcik: Well, I was really hoping we wouldn't dwell on this particular drawing –

[Inaudible due to laughter]

Steve Herzlieb: *[Laughs]*

Mike Barcik: this drawing will be available in the lobby, so we'll just drive on from that. *[Inaudible due to laughter]* I think the other big thing we wanted to mention is load calcs. Load calcs will be affected by the leakage of the envelopes.

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And the code says, essentially, "Follow the mechanical code for sizing," and then when you go look through the mechanical code, it says, "We're gonna do a Manual J load calc and then we're gonna select equipment using Manual S," which basically means we're gonna meet the latent requirements of our loads, blah, blah, blah. But the way people have traditionally entered envelope leakage in terms of the house is pretty crude, and so the – you have the tightness choice right here, and it – this was based on, I swear, this is from the '70s or maybe the '80s, where it was just like, "Well, you know, the leakage in your house is a sole function of the number of fireplaces that you have," and then you view this tightness, and your choices are tight, semi-tight, average – *[laughs]* – semi-loose, loose. So, kinda suggestive here, I think. That's the big takeaway. So, yeah, we're watching it.

[1:09:00]

So at the end of the day, this is pretty crude. I certainly think, for a code-based home, that you would be at least semi-tight if not tight.

Here's a better way to do it, is the software allows you to enter a CFM50. And so if you tested the home, you can enter that in, and then it will take it and massage it, and it will come up with its own natural air changes in the winter and natural air changes in summer, and you don't have to do that. All you do is enter the CFM.

If you don't have – if the house hasn't been built and you're trying to do a load calc, what you should do is assume the worst case that's allowed by code at ACH50 and back out a CFM. So if the worst case allowed is a five, ACH50, back out whatever CFM you'd be getting on your home, type that in here, and then you're gonna get a much more accurate load calc. So that would be our recommendation.

[1:10:00]

Just tying in, the whole interesting thing about loads, we've made so much progress on energy codes that we really reduce the impact of heating and cooling in terms of total load. Here – in the '90s, it was – almost 60 percent of the energy in a home was for heating and cooling – this is an average home. Every home has got its own pie chart. But now, here we are, for the first time ever, in the last little bit, that we're finally seeing heating and cooling's actually less than 50 percent, and obviously, we've knocked that down, but we – our increase in energy use comes mainly from more appliances. Water heating sort of hung in there.

Last thing we wanna talk about is a program that came about because we recognized the need to make sure people testing had some knowledge of how do the test. We certainly wanna look to and recognize the national industries such as RESNET, which is the HERS industry, and Building Performance Institute, which focuses a lot on existing buildings.

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And – but we were worried and we got the feedback from builders that there's just not enough of those, necessarily, all around the state or all around the region, and so, today – so, back in the late 2010, we created this course or certification that was basically giving you just what you need to know for code, and that was the point of it. And it did involve knowledge of the code and it did involve ability to do math, which is important. So that's basically what I covered: how to set it up, how to get the right numbers, how to crunch the right numbers, and field exams and a written test as well. And we always made everybody watch the videos before they showed up.

And so any of those people – basically, HERS rater and BPI folks are grandfathered in. Steve, did you wanna add anything?

[1:12:00]

Steve Herzlieb: You just – there was need for this because, you know, starting in 2009, the code started mandating tightness testing but didn't provide any guidance on who would be a qualified person to do that. So the DET verifier program was born in Georgia, here, to address that need of a minimum standard of qualifications of who would actually perform these tests.

Mike Barcik: And there's been at least a half a dozen other places now, so if you are interested in this program for your state, we would love to try to transfer it to you; probably follow up with Steve or me would be the best thing.

Also, we did a little study after about the first year and a half of this being a requirement in our code, and I'm not gonna go into this – I have some very word-extensive slides here, but this white paper is on our website. If you're interested, talks about some of the lessons learned and kinda compares the '09 code, the '12 code at the time, and where we were, which is kind of in the middle.

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And again, we tried to answer some questions ahead of time, like, "How does this duct leakage test apply to an existing home?" And, "Does the air leakage test require – apply on an addition to the home or on a gut rehab?" or things like that. So we try to answer some of those questions. And that picture is showing the cat that's about to eat a cactus, so that's – I had to clarify that. That's a lesson learned, I think.

We've learned a lot about how to make this work better, and fortunately, everybody has played nice, so if you get trained in Louisiana or Alabama and then you wanna work in Georgia or South Carolina, you have reciprocity; the DET transfers aross, and we're trying to make sure everybody teaches from a pretty consistent sheet of music, so we're – that's why we shared it with so many folks that are trainers.

And then I also did this study of about four main companies that were scattered throughout our state, and we were two, three, and four and what they learned, and some did a lotta testing; some did not so much and some of the things we learned –

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and I know I'm not going to go into all this, but we learned a few consistent things. Code-based homes were, in this guy's data – or this company's data – were about 4.4. Beyond code program homes were about one ACH50 tighter. So, some things like that, and I'm not gonna go into it – that was another interesting one.

Here's probably the key takeaways: We definitely felt like 7 was really attainable, and it has been, and I think, certainly, you can go deeper. Beyond code programs really show a pathway to help you get there, I think, and sometimes the company does additional services to help.

Code enforcement, the places where the homes failed and the ducts failed were places where they got the seal, and so when you didn't have anybody checking up behind you, you got what you got. And so the test matters and having somebody check on the test matters.

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We also found that, at the time, at least, spray foam houses generally performed pretty well. I think that's probably the big stuff here, and then finally, the '12 requirements are – and '15 requirements are much more strict. You gotta pay more attention to detail, but it can still be met. You might consider a phase-in of the tightness; you might consider – the last thing I wanna show you, which is maybe another way of looking at instead of ACH50, and then, again, don't forget, ventilation is another issue that we all have to address now if you haven't been doing this.

So – trying to wrap this up here, Steve. *[Inaudible due to crosstalk]*

Steve Herzlieb: Yeah, and we're going through quickly here, but the white paper that Mike mentioned is available for download on the DET training page of our website. *[Inaudible due to crosstalk]* We showed you earlier.

Mike Barcik: Thank you. The last three things just to maybe consider a different metric than what the code says, we use one called the –

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we call it the "envelope leakage ratio," but it really just means the CFM50 divided by the shell area of the house. ACH50 not – normalized the blower door because it's by volume, and that's a mistake.

The other – a better way of doing it – the leaks don't occur through the volume of a house; the leaks occur through the shell of the house. So if you normalize by the shell, it's a better way. And the other option is to say, "Well, you know, maybe we'll have a staggered ACH50 based on the size of the home, and we'll make a smaller home have a little less stringent ACH." You're gonna stick with ACH50; maybe you just have a staggered one.

So these are just sort of different ways you might approach that. Bigger homes have to be lower ACH50; smaller homes, maybe be a little higher. It makes it more fair across the board.

And I guess – I think the last thing I have is kinda talking about that concept of the shell, and I won't go into this, but it really is a better way, and it really does allow you to, say –

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compare a 1,000 square-foot house with a 6,000 square-foot house, and they're both allowed leakage proportional to the size of the thermal envelope. And there's just some spreadsheets, a little complicated, but it just sorta shows ACH50 bogs down when you start getting to bigger homes.

So, with that said, I wanna – we finished on time, on budget. Do we have any questions? *[Inaudible due to crosstalk]*

Steve Herzlieb: I do have a list of questions. One of the questions was, "Repeat what DET scores," and it's duct and envelope tightness testing.

Mike Barcik: Or duct and envelope tightness verifier.

Steve Herzlieb: Yeah, verifier, yeah, yeah.

Mike Barcik: It's all good. *[Laughs]*

Steve Herzlieb: Yeah. Basically, performing blower doors and duct pressurization tests.

Mike Barcik: And I wanted to mention, too, that BPI, in more recent times, have come out with the IDL, which stands for infiltration and duct leakage certification, and it's very similar, in some ways, to the DET.

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But I don't think it has some of the math that I would like to see in it, but it's a great certification about how to set it up and do it, and we would certainly say that's pretty good or that's good enough, and that would count. That's fairly recent. That was not around when we started all this, and you know RESNET may be trying to come up with something similar as well. Okay, what else do you got? *[Laughs]*

Steve Herzlieb: We have a question from ASHRAE Standard 62.2, the Q fan was Q total minus the Q infiltration. Basically, an ASHRAE standard – the nature of this question, I'm gathering, is you get infiltration credit if you just use the ASHRAE standard. The code doesn't go into that level of detail. They just do a simplified version of it. And I'm reading the rest of the question here. Basically, making tighter buildings means you get less infiltration credit. And then the person's asking, "This suggests there's actually a penalty for making buildings tighter?"

[1:19:00]

Mike Barcik: "Do you advocate that Standard 62 should be ignored?" And I'd like to answer this. This is a great question. You know, Steve, you set it up really well. So, first of all, what you're commenting on, the acute band, is basically the credit for infiltration does not apply to new homes until you get to the 2013 version of ASHRAE 62. So the IRC version that you're looking at right here is using the 2010 or the 2007 equation to create the table, and all they brought over was the table. So, in other words, yes, ASHRAE 62 is a great ventilation standard. I may not agree with everything in it, but it is sort of a thing we look to. However, the code listed the table values but not the equation, and that includes the infiltration credit portion. So that's where we stand right now with that, and in terms of code compliance, you have this code to go by.

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One of the big, important differences starting in the 2010 version of ASHRAE 62, there's a – not a requirement – yeah, there is a requirement to verify airflow, but the code does not – so the code uses only the table, not the equation, and the code requires your design to meet this, but there's no requirement that you verify. So there's a very important distinction between 62 and the IRC.

Steve Herzlieb: And couple things to add, too, is it's important to remember ventilation's not an energy efficiency mixture, but having mechanical ventilation could cause an efficiency hit – penalty, but it's not all about efficiency. You need to have good indoor air quality as well.

Mike Barcik: Yep, wanna jump down to that?

Steve Herzlieb: And also – yeah, but real quick, too, in the 2015 code, they do have efficacy – efficiency requirements for a whole-house ventilation fan.

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So there are benchmarks in the 2015 code of the minimum requirements for how efficient your whole-house ventilation fan needs to be. It needs to be an efficient fan.

Mike Barcik: That's true. So we – the next question we got had to do with why – it said, "Why are you using the reference homes from the 2006 code and why not a more current version of the code?" Well, it turns out it kinda doesn't matter which ones you stack it up against as long as everybody uses the same one. In the very early days of HERS, we actually used to use the '93 model energy code as our reference home, but in the year 2006, they changed it to that and they said, "We're probably gonna coach here for a while." It's what everybody is used to; it's what everybody has been marketing, and I'm not saying that we shouldn't ever or won't ever update it, but it's something that has been marketing for a while. So I think that it's probably not gonna change in the near term.

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And as long as we all use it at the same benchmark, it really doesn't matter. So if we change this to the 2012 or 2009 or something, then instead of having to get a 51, you might have to get an 8, you know? So it's just that we're gonna stick with this as the reference home.

The next question is, "Can you compare the fuel index – " *[laughs]* – that was just a –

Steve Herzlieb: Yeah, and most car shoppers – and where this is going at is, you know, a lotta people, with their – if it's important for them to find a fuel-efficient car, they can just look on the label of the cars for sale and it gives the miles per gallon, and most people just know that a higher miles per gallon means more efficient car. Using the VRI or the HERS index, basically, you can assign a number to the house indicating its efficiency. In this case, the lower the number, the more efficient the home. So that's that connection there, is that for the consumers – ratings aren’t really alike; it's just that it's a very convenient, easy-to-understand index that you can tell immediately what's the overall efficiency of that home.

[1:23:00]

Mike Barcik: Very good. So we also had a question about attic sealing, and so I wanna –

Pam Cole: And then when you get a chance, jump back to that URL so that people that are jumping off can capture that, too. I know you wanna show the pictures, but periodically jump back to that URL where they can read all that – yeah, there you go. Perfect.

Mike Barcik: There's the URL and –

Pam Cole: Then you can go back to pictures, but I'm just worried that a lotta –

Mike Barcik: – now I'm going back to where I was. That was really good. I hope you got that.

Pam Cole: Yeah.

Mike Barcik: Sorry, Pam.

Pam Cole: No, no, it’s just a long URL.

Mike Barcik: Yeah, so I just wanna say it's – the code says something like, "Kneewalls shall be sealed," so we had a specific question about kneewalls, and this is actually the reason – we changed the language in our code in Georgia to be very specific about this to require the blocking and to require the attic-side air barrier, and in my opinion, the code should require that as well.

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Obviously, if that would say, "Air impermeable insulation, that attic – that air barrier may not be required," but I think that it's absolutely crucial and – to seal that backside. So, again, I'll go to the – that picture. Assuming you don't have issues about fire – of the foam being put up in the attic, that picture, I think, is really showing what we want to accomplish, and it is definitely to your benefit to have the continuous installation. There are foam boards that are certainly ready to be exposed to the attic side.

Steve Herzlieb: And the details of this question, too, is referring specifically to the contractors are sealing the seams and the inspector's also requesting that you seal the perimeter, and it's – basically, everything should be sealed and the airtight is the answer. The juncture of the foam board, the seams in the foam board – one of the things with the blower door testing is –

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for the person who asked this, if they're looking for a way to demonstrate this to the builder you're working with, if you're running the blower door and use a smoke stick while standing in the attic, you're depressurizing the house, and if you move the smoke stick around the perimeter of the foam board, if you see smoke being drawn into that crack, that should do a good job of demonstrating to the builder that that's – it's not actually sealed there. It is connected to the inside of the house.

Mike Barcik: There's a question about retraining general contractors and the answer's we will train anybody that shows up. I think that's a fair statement. Next question is –

Pam Cole: Could you take some more questions and then we're gonna wrap it up? And put back on the website, the URL? So if they do have questions, we also can get any of those questions over to Mike and Steve. They also have contact information out on one of the web – one of our slides here as well. So, two more questions, and then we're gonna have to shut the webinar down. *[Inaudible due to crosstalk]*

Mike Barcik: Two more questions, sure, yeah. Pam. *[Inaudible due to crosstalk]* No worries.

[1:26:00]

So the one question was about the exterior shell, and I would say that I am a fan of – basically, on new construction, I think the air barrier – the primary air barrier – needs to be the sheathing. I'm not saying there aren't other ways to do it, but the sheathing, itself, is, I think, your best shot at a good air barrier. On a retrofit, on existing homes, sometimes you got brick veneer, you can't get to the sheathing. So you do the best you can with the drywall on the inside. There's certainly nothing wrong with having redundant air barriers inside and out.

On new constructions, if the sheathing is used as a air barrier and if the seams are sealed and the penetrations are sealed, I think that can make a pretty good assembly. Where it gets interesting is the weather-resistant barrier, and I don't wanna cause controversy here, but some people kinda believe that the building wrap can serve as an air barrier –

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and I guess, in theory, if it's taped and done right, it can. I certainly think it can help, but I've also seen a lot of instances in this field where – I prefer to rely on the raft as basically the weather barrier. So there are some products that do it all. There's some sheathing – OSB sheathing that has a coating on it – that basically is like a weather barrier, and it's very nice, special tape for the seams; it's a very good method that this is gonna be sealed. I think those work well. I think there's a lotta ways to get to it, but I think, ultimately, my advice is focus on the sheathing, get that airtight, and then the weather barrier might be a different product or it might be the same. And then, Steve, you wanna do the last one?

Steve Herzlieb: Ventilation or…

Mike Barcik: No –

Steve Herzlieb: Yeah, so – well, and Mike mentioned this, showing that foam board picture of the kneewall. It is important.

[1:28:00]

Foam products, if you're going to use them for insulation or air sealing, you need to make sure that you follow all fire safety codes as well. It depends on the particular material and the jurisdiction, but oftentimes, using a spray foam or a foam board, it would need to be covered with either a thermal barrier or an ignition barrier depending on where it's installed, so that is an important consideration, and that's constantly in flux because manufacturers of foam air ceiling and insulation products are continually trying to get their products rated, whether or not it needs some kind of exterior ignition barrier or external barrier or if that's actually included in the material itself. So if you're working with foam, make sure you have a good understanding, good communication with the code officials in that area to make sure everyone's on the same page and whether or not what you're doing meets fire safety requirements.

Mike Barcik: We keep saying "foam." We probably should generically say "rigid insulation" because there's some – I think we should end on this.

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There's some great products out there like Rockwell products that are rigid and can also add continuous insulation. So we love products that do the job and we're wide open to opportunities. Pam, I think we've probably gone past our time limit, but thanks so much for the opportunity.

Pam Cole: No, thank you, you guys. You did a great job.

Mike Barcik: All right.

Steve Herzlieb: Thank you.

Mike Barcik: Thanks, everybody, for listening if you're still around.

Steve Herzlieb: And we'll send out the slide –

[End of Audio]