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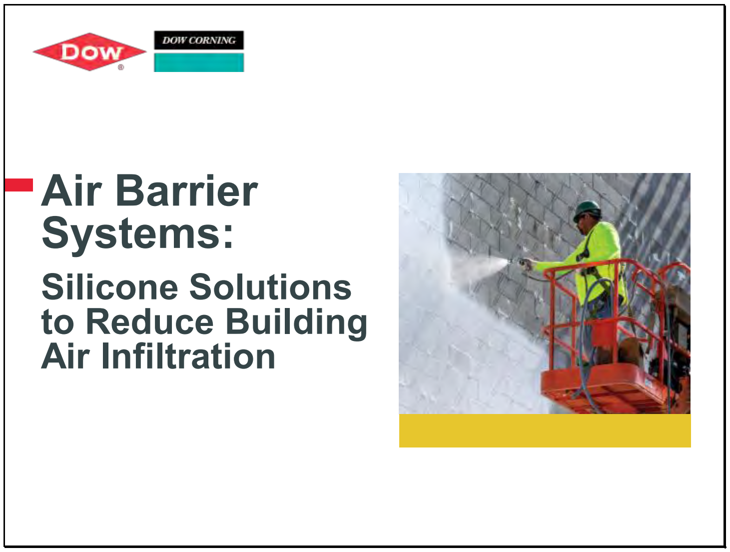

Welcome to today's course on Air Barrier ***Systems*** and silicone ***solutions*** to reduce air infiltration in buildings.

This is an AIA-accredited course in which you will earn one learning unit with HSW credit.

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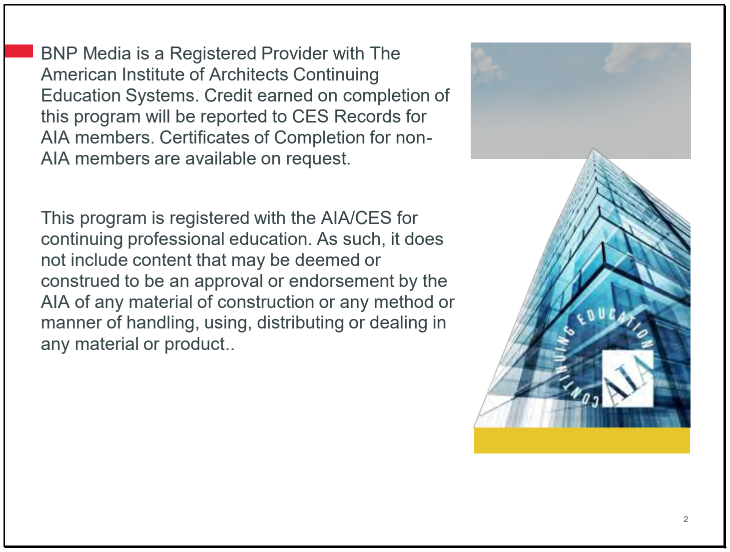

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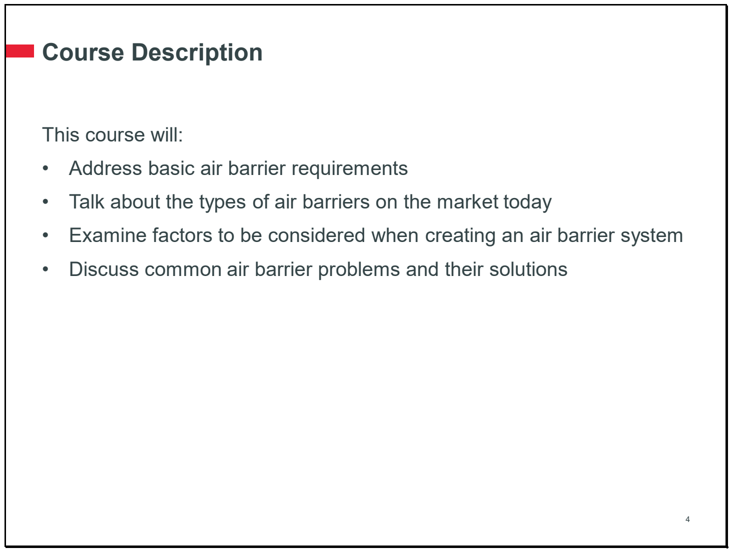

In this course, we’ll …

address basic air barrier requirements,
talk about the types of air barriers on the market today,
examine factors to be considered when creating an air barrier system, and
discuss common air barrier problems and how to solve them.

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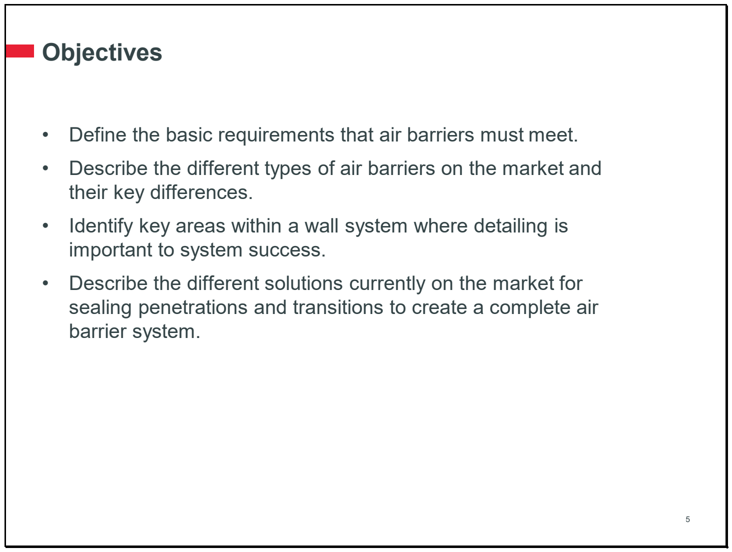

By the end of today’s course, you will be able to:

- Define the basic **requirements** that air barriers must meet
- Describe the different **types** of air barriers on the market and their key differences
- Identify **key areas** within a wall system where detailing is important to system success
- Describe the different **solutions** currently on the market for sealing penetrations and transitions to create a complete air barrier system

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Let's begin with air barrier **requirements**.

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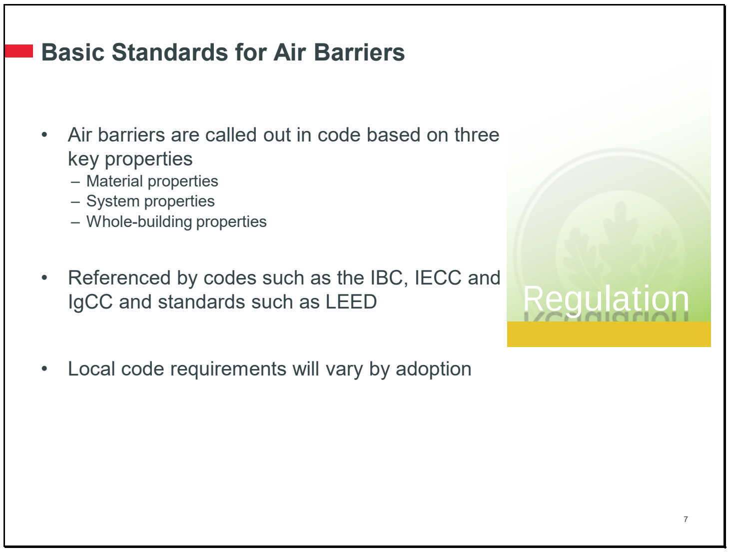

Air barriers are tested for their **material** properties as well as for their performance as part of a **system**, both in a lab setting and in the field.

Codes such as the …

- International Building Code – IBC,
- International Energy Construction Code – IECC,
- and the International Green Construction Code – IgCC … as well as
- ratings systems, such as LEED …

may reference **any combination** of these tests. The codes may also give the option of meeting **one** type of test or **another**.

It is important to understand the code requirements for your specific project, as **local** codes will vary.

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Material Tests

ASTM & CAN/ULC

- ASTM E2178 Standard Test Method for Air Permeance of Building Materials
  - Measures the air infiltration rate of 1 m^2 of material
  - Key data point for all air barriers
- CAN/ULC S741 Standard for Air Barrier Materials – Specification

ASHRAE

- ASHRAE 90.1-2010 requires an air infiltration rate of <0.02 $L/s \cdot m^2$ at 75 Pa (<0.004 cfm/ft^2 at 1.57 psf)

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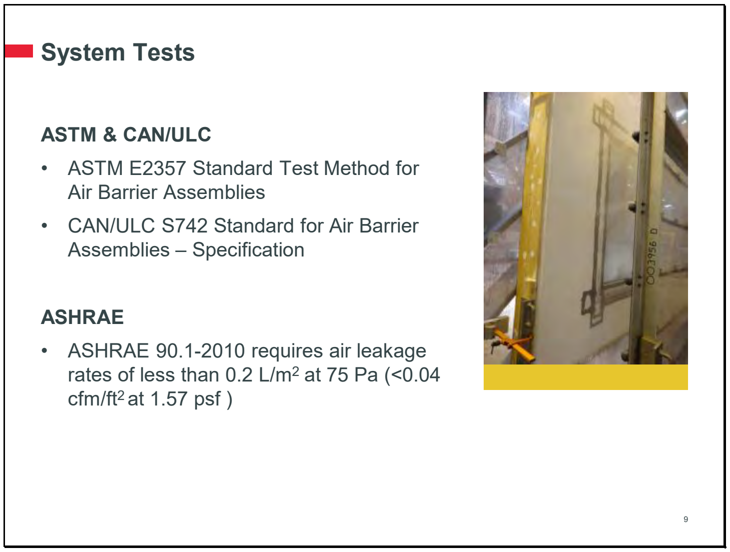
The primary **material** test for air barriers is **ASTM E2178** which tests for air infiltration rate of the material. This test measures the rate of air infiltration through a 3-foot by 3-foot (1-square-meter) free-film sample of an air barrier material.

The **Canadian equivalent** of this test is **CAN/ULC S741** Standard for Air Barrier Materials. The main **difference** between the U.S. and Canadian tests is that the **Canadian** specification includes **UV aging**.

ASHRAE 90.1-2010 requires an air barrier to have an air infiltration rate of **less than 0.004 cubic feet per minute per square foot** at a pressure of 1.57 psf.

Slide 9



Another way to test air barriers is in an assembly or **system**.

ASTM E2357 is the test used to determine the air infiltration rate through two 8-foot by 8-foot wall assemblies built using the air barrier and its accessory components.

- **One** wall is constructed **without** penetrations – testing only the **air barrier** and the treatment of the **seams** in the sheathing or back-up material.
- The **second** wall includes pipe and electrical box **penetrations**, a **window** opening, and roof and foundation **transitions**.

The Canadian test method – CAN/ULC S742 – tests a 10-foot by 10-foot wall and includes an additional thermal stressing component before retesting the wall.

Based on the current **ASHRAE standards**, an air barrier system must have an air infiltration rate **below 0.04 cubic feet per minute per square foot** at a pressure of 1.57 psf … both **before** and **after** the wall is structurally loaded when tested in accordance with ASTM E2357.

This test is performed separately on both the intact wall and the penetrated wall.

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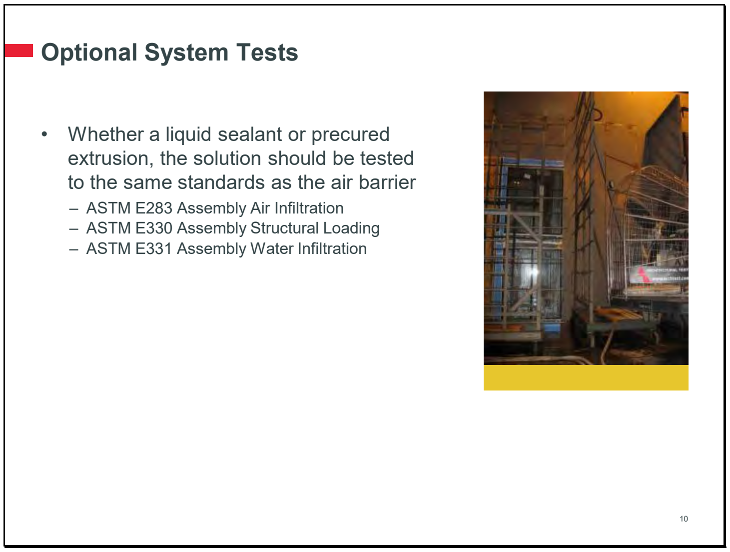

Whether your solution includes a liquid sealant or pre-cured extrusion, it should be tested in a system to the same standards as the air barrier.

In addition to the standard **air barrier** system tests, there are three **other** tests that can be used to evaluate system solutions for wall assemblies. They are:

- **ASTM E283** – the Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen,
- **ASTM E330** – the Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference, and
- **ASTM E331** – the Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference.

ASTM E283 is an **air infiltration** test that is typically used for **window** systems. Unlike ASTM E2357, which only tests a very **strict** system layout, ASTM E283 is used to test many **different** systems and is conducted at **different** pressures.

When combined with the **water** and **structural tests** – ASTM E331 and ASTM E330 – ASTM E283 can provide valuable information. For example, you can test for air and water infiltration – then structurally stress the system – then **retest** for air and water infiltration to ensure that the system remains **intact**.

There are other system tests available that test similar properties, but **these** are the test methods that are **specified most often** by the architectural and engineering community.

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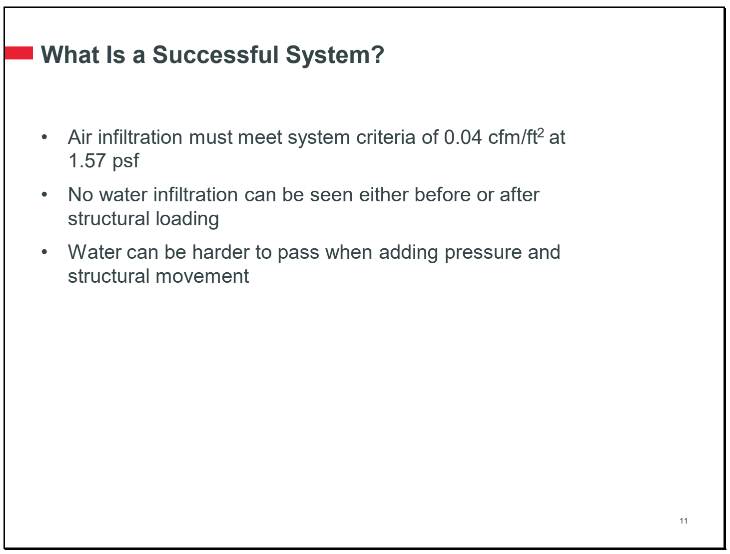

So how do you know your system is successful?

When testing using these three additional methods, the **air infiltration rate** must meet the **same** criteria as the **ASTM E2357 system** test – **less than 0.04 cubic feet per minute per square foot** at a pressure of 1.57 psf. In **addition**, there should be **no** water infiltration.

The air and water infiltration tests are typically done both before and **after** the **structural loading** test to ensure that the system is not damaged by the structural loading.

The **water infiltration** test can be more **difficult** for a system to pass because holes in the system open and close under the air pressure.

The results of these optional tests can be very helpful in evaluating the **integrity** of an assembly, which is why they are often conducted on project-specific mock-ups.

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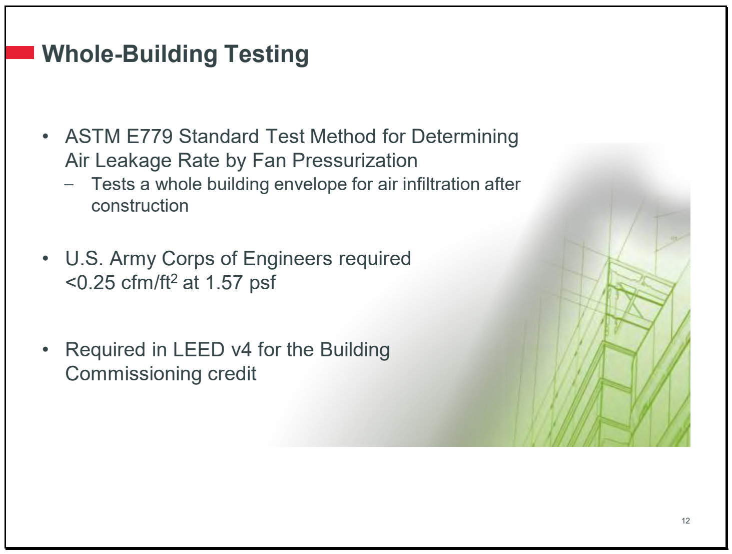

In addition to the laboratory test standards manufacturers must meet for their air barrier materials and systems, new codes and rating systems are requiring **whole-building** testing for air infiltration.

This is done using the **ASTM E779** test method – commonly referred to as the **"blow door test"** – which tests the **entire building envelope** for air infiltration. This test is conducted **after** construction of the building envelope is complete. It **cannot** be completed in a lab or on a mock-up.

The **air infiltration rates** that the building envelope must meet **vary** based on the code or rating system.

Acceptable rates range from …

- **Less than 0.4** cubic feet per minute per square foot at 1.57 psf for **ASHRAE 90.1-2010** …
- Down to **less than 0.25** cubic feet per minute per square foot at 1.57 psf for the current U.S. **Army Corps of Engineers** specification.

Whole-building testing is required by LEED version 4 for its Building Commissioning credit.

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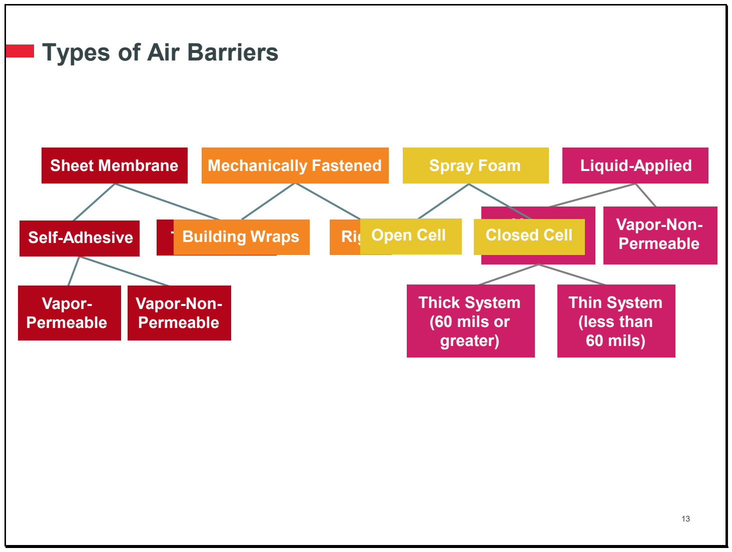

There are **four** general types of air barriers as defined by the Air Barrier Association of America – **Sheet Membrane … Mechanically Fastened … Spray Foam … and Liquid-Applied**.

Sheet-applied membranes can be broken down into **self-adhesive** and **torch grade**.

Self-adhesive membranes can be broken down further into **permeable** and **non-permeable** categories.

Mechanically fastened air barriers include both **building wraps** and **rigid insulation**.

Spray foams can be broken down into **vapor-permeable** (open-cell) and **non-permeable** (closed-cell) categories.

Liquid-applied membranes *also* include **permeable** and **non-permeable** categories.

Additionally, **both types of liquid-applied membranes** can then be broken down even further into **thick-mil** versus **thin-mil** systems.

The preferred **application method** and **wall system** will determine **which** type or types of air barriers would be best for the project.

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Liquid Applied

- Primer not required on most substrates
- Applied in uniform coat – no seams or edges
- Detailing can be done with liquid sealant – no complex shapes need to be cut or applied
- Some liquid-applied air barriers can take movement at joints
- Must take quality control measures to ensure proper thickness of material

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Although there are some **variations**, depending on the manufacturer, some **key properties** of **liquid-applied** air barriers are:

- Primer is generally **not** required.
- Coverage is **continuous**, with no seams or edges.
- And detailing can be done with liquid sealants.
- Some liquid-applied air barriers can withstand **joint movement**;
- However, quality control measures must be taken to ensure the proper **thickness** of the material.

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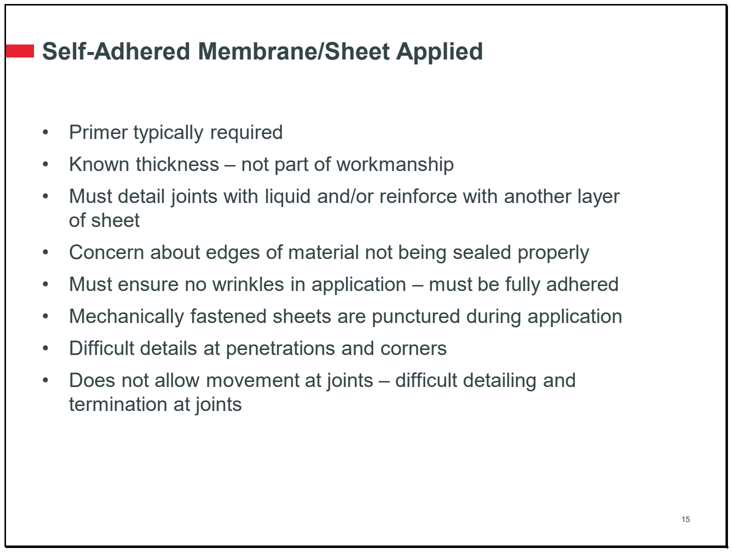
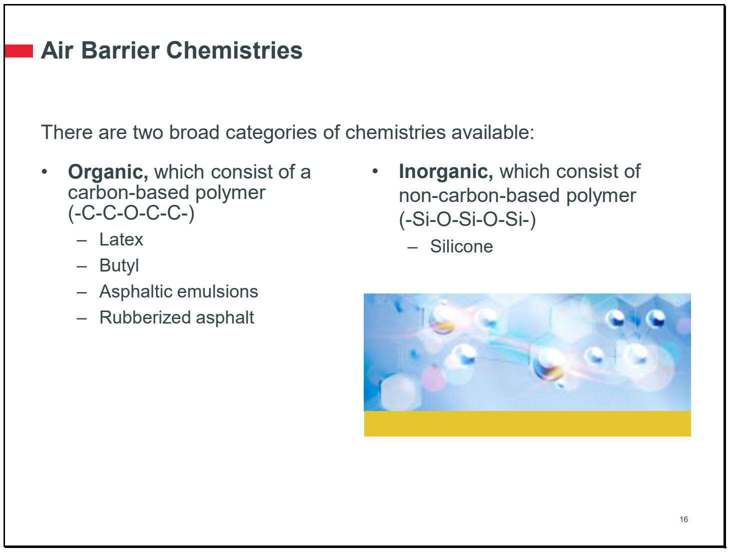


Here are some key properties of **sheet-applied membranes**.

- Primer **is** typically required.
- Thickness is **not** dependent on workmanship.
- **Joints must be detailed** with liquid and/or reinforced with another layer of sheet.
- There are concerns about the **edges** of the material not being sealed properly.
- You need to ensure that there are no **wrinkles** and that the material is **fully adhered**.
- Mechanically fastened sheets are **punctured** during application.
- There are **difficult details** at penetrations and corners.
- And the barrier does **not** allow movement at joints with greater than 15% movement.

As you can see, both systems have advantages and drawbacks.

Slide 16



Now that you have an understanding of the different **types** of air barriers, let's look at them from a **chemistry** perspective.

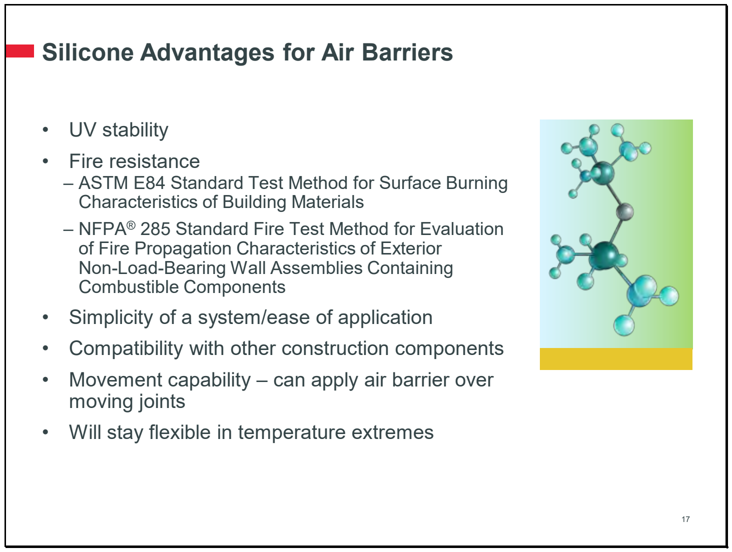
Just as with sealants, there are two broad **categories** of air barrier chemistries – **organic** and **inorganic**:

Organic air barriers have a **carbon-based** – or **organic** – polymer backbone.

- Examples of organic air barrier materials include acrylics and asphaltic blended materials.
- Currently, all available sheet-applied materials fall into this category.

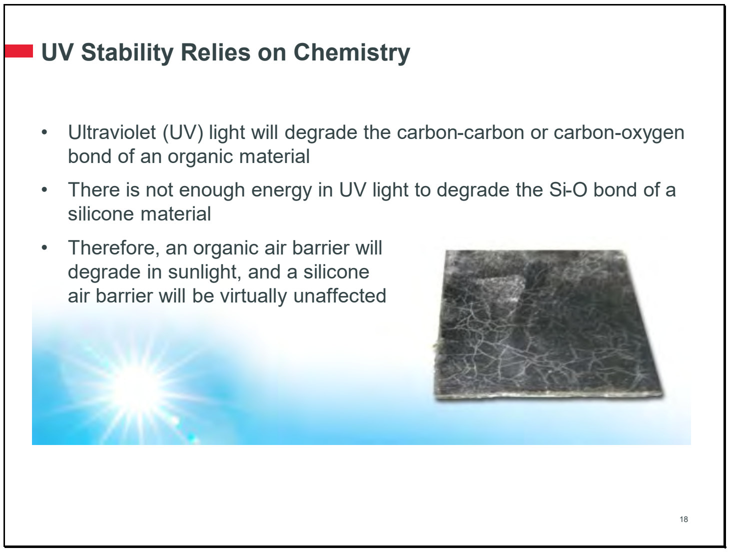
Inorganic air barriers, on the other hand, do ***not*** have a carbon-based – or organic – backbone. An example of an inorganic air barrier material is **silicone**, which is made from a polymer consisting of linked **silicon** and **oxygen** atoms.

Slide 17



There are some key **advantages** to using **silicone** air barriers – primarily **UV stability**, which allows design and construction schedule flexibility … **fire resistance** … and **compatibility** with current preferred construction materials.

Slide 18



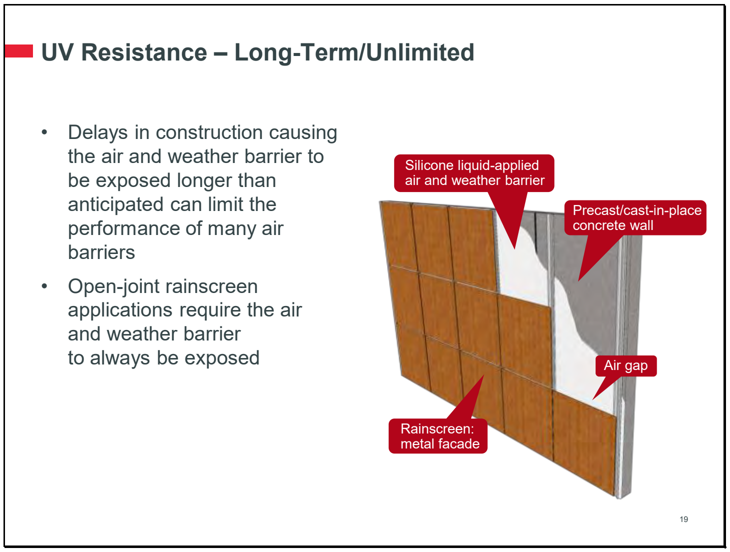
Air barrier chemistry is especially important when it comes to how the material performs on a building when it’s exposed to the sun’s UV rays.

A **carbon-based** polymer – or an **organic** air barrier – will change properties and **degrade** over time in the presence of UV light. Many of these properties degrade **faster** in **air barriers** than they would in a **sealant** with a similar chemistry.

The silicon-oxygen bond of a **silicone** polymer, on the other hand, is **stronger** than the rays of the sun and will ***not*** degrade over time. A silicone air barrier stays flexible and can remain uncovered **indefinitely**.

This photo shows the impact of weathering on an acrylic-asphalt blend liquid-applied vapor-permeable air barrier. This sample was aged for only 2 weeks during the summer in Michigan.

Slide 19



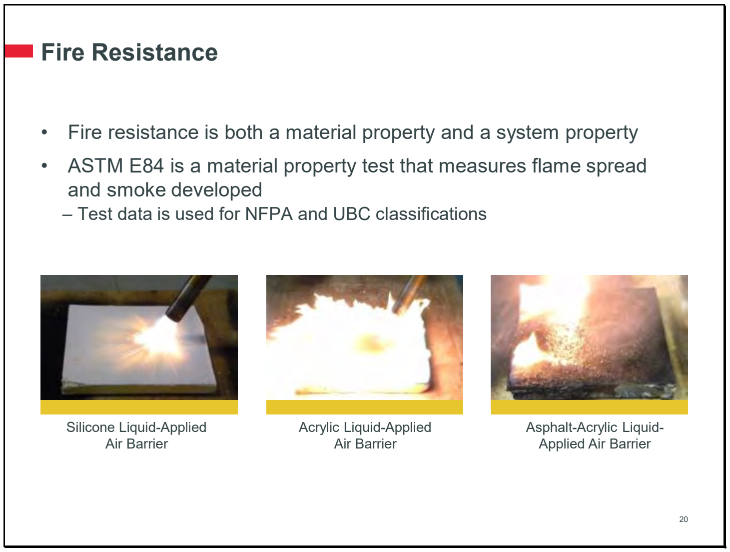
As we just said, silicone does **not** break down under UV light.

The ability to handle long-term UV exposure gives you flexibility in your construction schedule if portions of the project get **delayed** and the air and weather barrier ends up being exposed **longer** than anticipated.

Other air barriers on the market must be covered in as little as **30 days**. A silicone air barrier can remain uncovered indefinitely.

This means that silicone air barriers are ideal for open joint **rainscreen** applications where the air and weather barrier will remain exposed for the **life** of the building.

Slide 20



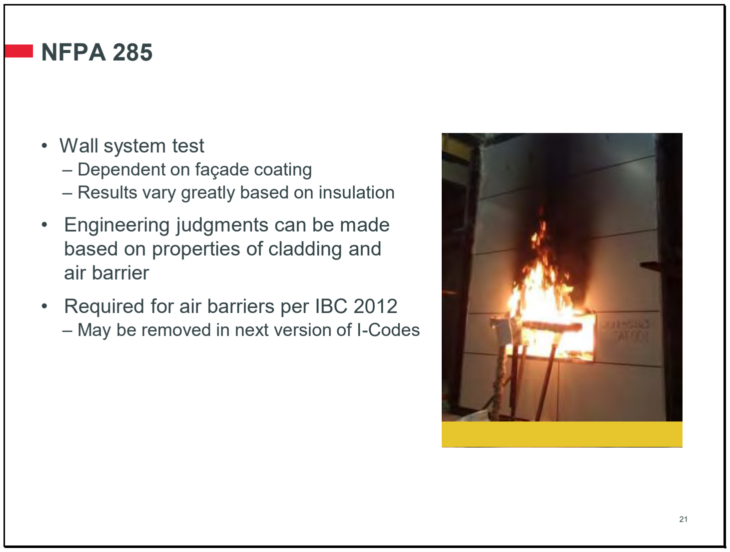
Fire resistance is another important property of an air barrier. It is important that the air barrier does not propagate or contribute to the fire properties of a wall assembly.

The basic **fire test** for air barrier materials is **ASTM E84**, which is used to evaluate and compare a large **variety** of materials. This test yields **flame-spread** and **smoke-developed** indices. Individual organizations, or code bodies, then set criteria for their **specific** applications based on ASTM E84 **results**.

For **air barriers**, these two numbers are used to classify the materials per NFPA and UBC.

- For example, an NFPA/UBC **Class A material** has a **flame spread** index of **less than 25** and a **smoke-developed** index of **less than 450**. ASTM E84 does not give you an hour-based fire rating.

Slide 21



Another important measure of fire resistance is **NFPA 285** … which is a **wall-system** fire test.

When a material is tested in an **assembly**, the test only gives you a **Pass/Fail** data point for that **specific** assembly. **Changes** to the assembly require either another test … or an engineering judgment – depending on the type of change you make.

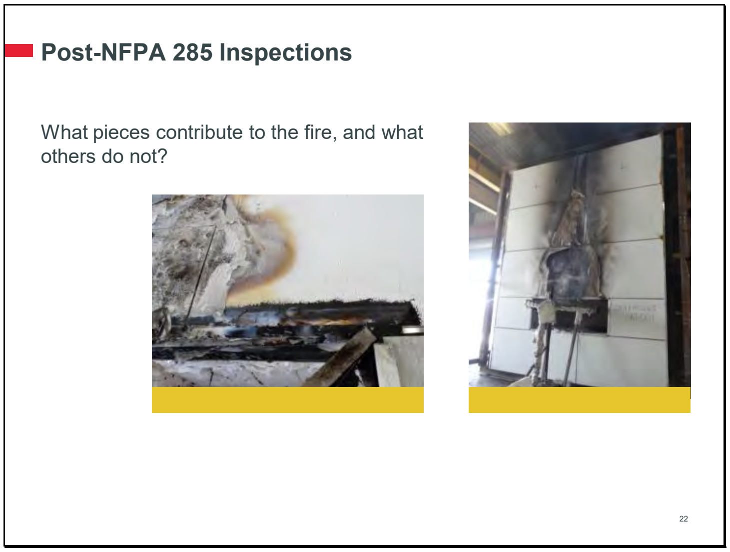
The materials that impact this test the **most** are:

- The **façade cladding** (brick, EIFS, aluminum composite panels, etc.) …
- and the **insulation** (XPS or polyisocyanurate, for example).

The **2012 International Building Code** currently **requires** this test for air barriers. However, it is **likely** that this requirement will be **removed** in the **2015** code. So it’s important to know **which code** you’re designing to in order to know if you’ll **need** this data point.

This photo shows an NFPA 285 test in progress. Two burners are supplying fire – one on the outside, which you can see here … and one on the inside. The burners run for a total of 30 minutes. During that time, the flame can only get so high and so wide, and the temperature can’t exceed a certain number, or the assembly will **fail**. What contributes to the spread of the fire really depends on the **materials** in the wall system.

Slide 22



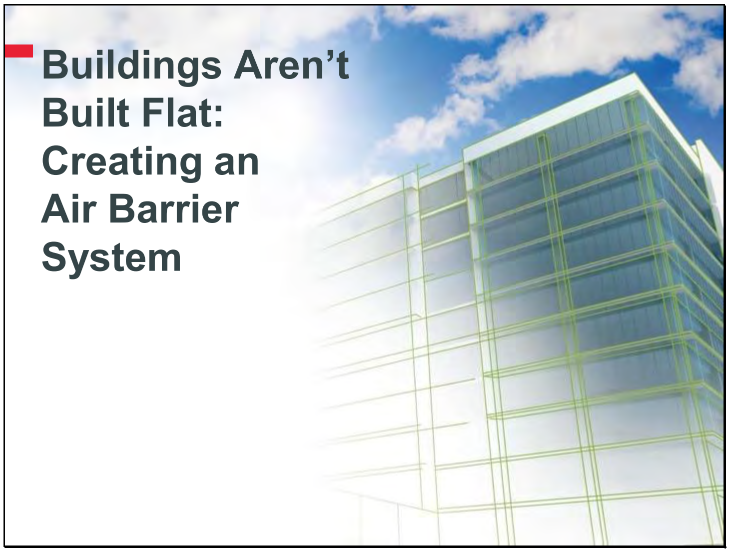
One **advantage** of the NFPA 285 test is the **inspection** of the **wall** assembly that takes place **after** the test is complete. It is **especially** helpful if you are trying to evaluate the fire properties of a **specific** component – such as the air barrier.

How did the façade perform? Did the insulation propagate the flame? How did the **air barrier** perform?

These pictures show the wall assembly after the conclusion of the test. The picture on the **right** shows the burned aluminum composite panel system and the burned insulation behind it. In the picture on the **left**, the panels and insulation have been removed. You are able to see that a layer of the **silicone air barrier remains** on the wall – even in the **hottest** areas of the burn.

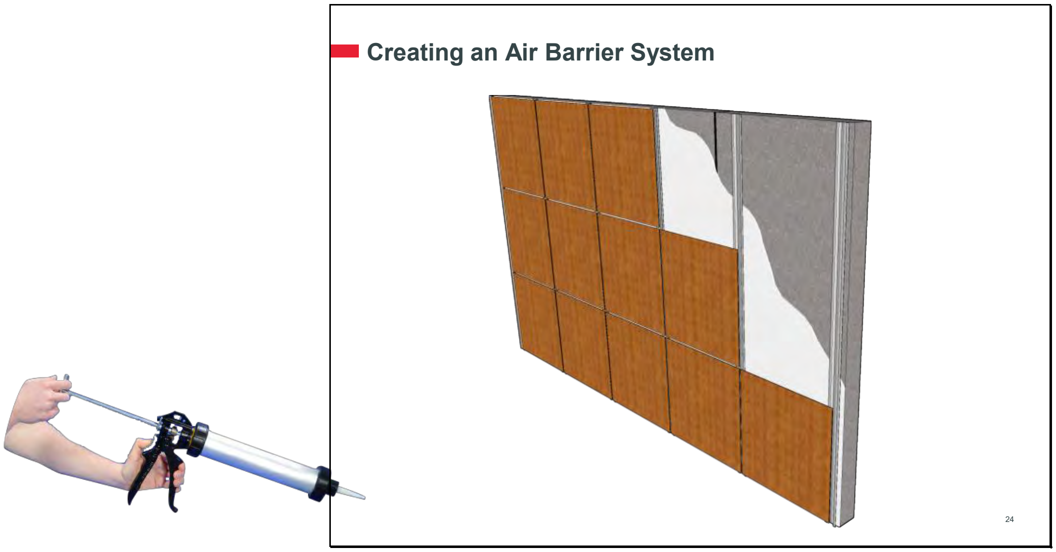
Many air barriers – especially those with an **asphaltic** base – are more **flammable**. They would **not** have performed as **well** in this test … and may **not** have passed in this same assembly.

Slide 23



Now that we've explored the **properties** of an air barrier, let's look at how a complete air barrier system can be **created**.

Slide 24



There are many steps to creating a complete air barrier system – even on a flat wall.

First, the **seams** of the sheathing must be sealed.

Second, the **air barrier** itself is applied.

Third, any **mechanical attachments** are added – and, if required, the screws or fasteners are sealed.

And, finally, the **cladding** is installed.

Slide 25

Detailing and Installation

No two buildings are exactly the same, and having a flexible system to create an airtight envelope is important

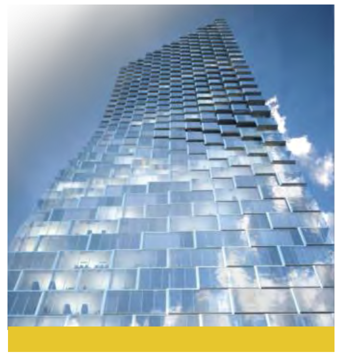


Photo courtesy of BIG

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But buildings are not **flat**, and elevations can be out of plane. This creates challenges for detailing as building components do not align. When you're working to create an airtight building envelope, it's important to have a system that's **flexible** enough to **accommodate** these unique details.

This is a rendering of the Telus Sky tower in Calgary, Alberta, Canada – a multi-use building currently in the design phase.

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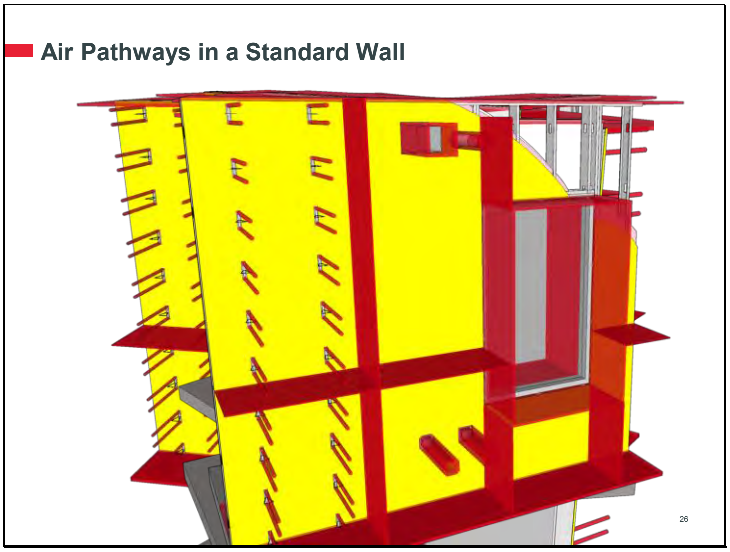
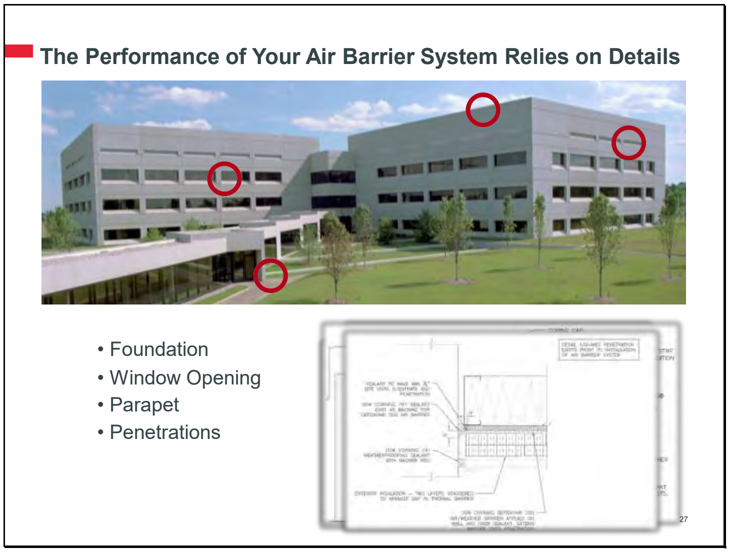


Every building starts with a flat wall that is easy to seal for air infiltration. But then we start to punch holes into it – we have items like **windows** and **air ducts** and **brick ties** that we have to punch through perfectly sealed walls.

These penetrations create even **more** challenges for air sealing, which is shown by all of the red areas. There are almost **unlimited** opportunities for air to get in your building if they aren't **detailed** correctly.

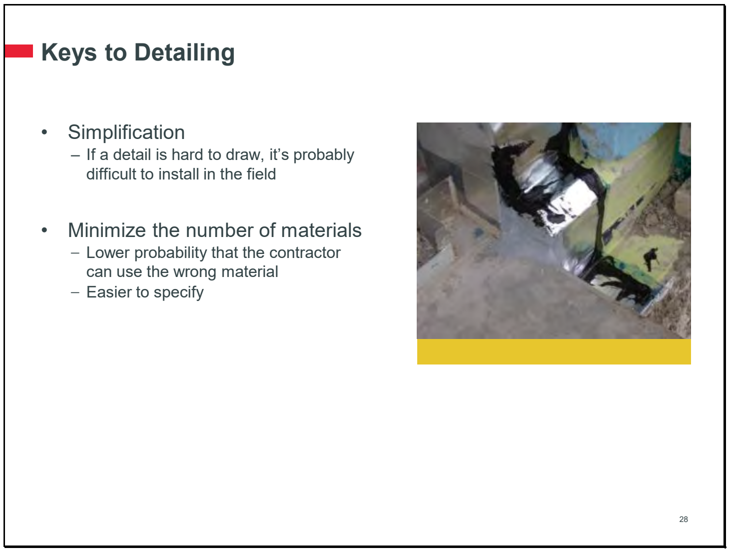
Slide 27



When we step back and look at the **whole** building, we can identify some key areas where details are **critical**.

The foundation … window openings … parapet… and penetrations **all** require a **well-thought-out** solution in which materials **work together** to create an airtight and watertight building envelope.

Slide 28



Two things are **key** for creating resilient details:

- **Simplifying** the detail itself and
- **Minimizing** the number of materials required to complete the detail.

Simplification is important, because "if you can't draw it, you probably can't build it."

Minimizing the number of **materials** required not only **reduces** the chance that the contractor will use the **wrong** material or **forget** a step. It **also** makes it easier to **specify**.

These keys are **especially** critical at **penetrations**, where details aren't always captured in the drawn details.

So let's take a few moments to discuss **penetration details**.

Slide 29

Sealing Around Penetrations

- Joints and penetrations must be:
  - – Airtight
  - – Watertight
  - – Durable
  - – Flexible
  - – Compatible
- Allow for building movement
  - – Precured elastomeric flashing to span wide joints while allowing for movement

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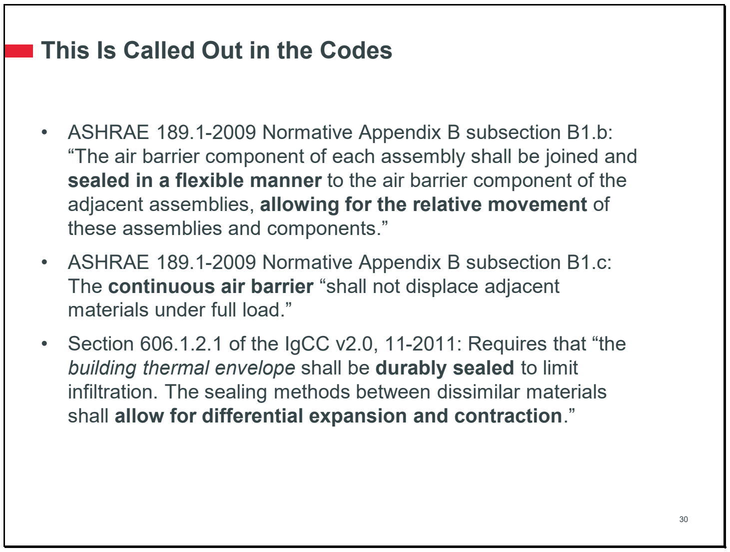
When sealing around penetrations, it's important for the interfaces to be **airtight**, **watertight**, **durable** and **flexible** … and for the **components** to be **compatible**.

In addition, these interfaces must be able to allow for building movement. For example, one option for wide joint interfaces is pre-cured silicone elastomeric flashing. This material allows for **movement** in a large **joint** while keeping the **air** and **water out**.

Slide 30

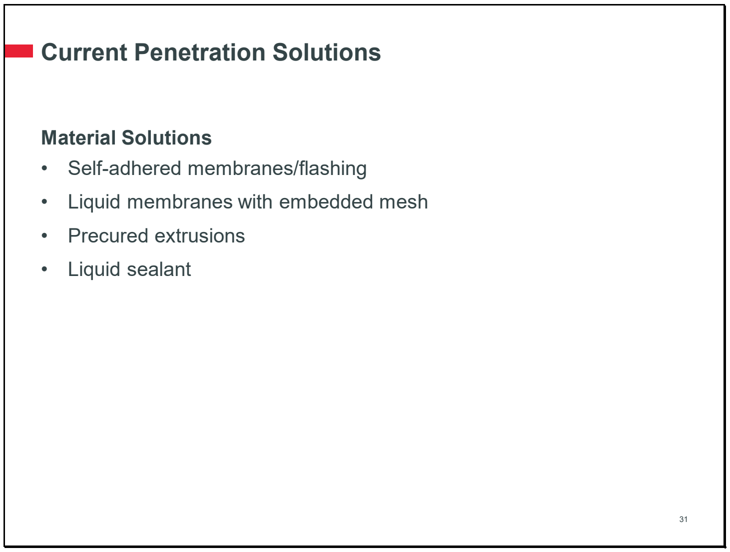


It isn't just **us** saying this – it's called out in the codes.

ASHRAE 189.1 – a code-adoptable standard designed to increase energy efficiency over standard code – calls out the need for air barrier components to be "sealed in a **flexible** manner… allowing for the relative **movement** of the assembly and components."

The **International Green Construction Code** also requires that the components of the building envelope be "**durably** sealed…and allow for **expansion** and **contraction**."

Slide 31

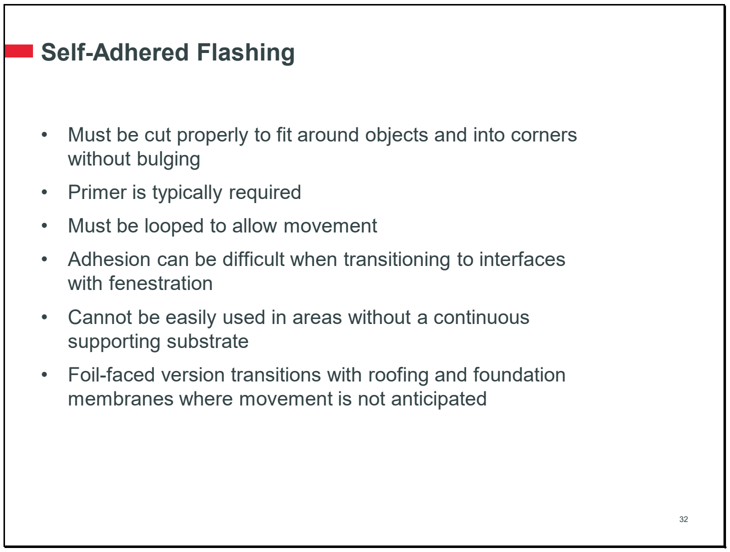


Currently, there are four primary material solutions for sealing around penetrations. These include:

- **Self-adhered** membranes or flashing,
- **Liquid** membranes with embedded mesh,
- **Pre-cured** silicone **extrusions**
- And liquid **sealant**.

Let’s look at some of the advantages and drawbacks of each of these solutions.

Slide 32

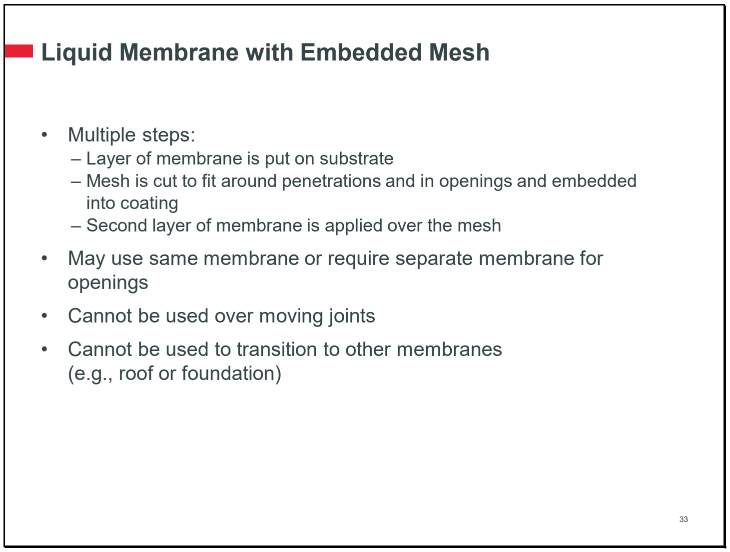


Self-adhered flashings are the most common solution for penetrations when using **sheet-applied** air barriers. They have the advantage of having a **known,** uniform thickness; however, they typically require **primer** to adhere to the substrate … and they must be **cut properly** to fit around objects and into corners without bulging or wrinkling.

These flashings **aren't** elastomeric and they **don't** stretch. This means they must be looped into moving joints to allow for movement.

Additionally, when transitioning to other parts of the building envelope, sealant **adhesion** to the membrane can be **difficult**. One option is to use **foil-faced** flashings that can be adhered to with **traditional sealants**.

Slide 33



Another solution – especially for smaller, non-moving joints and interfaces – is to **embed mesh into a liquid membrane**.

This could be the **same material** as the air barrier, or a **different** one. This option requires **a number of steps** to complete. And it **doesn't** work for **moving** joints or when **transitioning** between dissimilar materials … such as window perimeters or transitioning to roof and foundation membranes.

Slide 34

Precured Silicone Extrusions

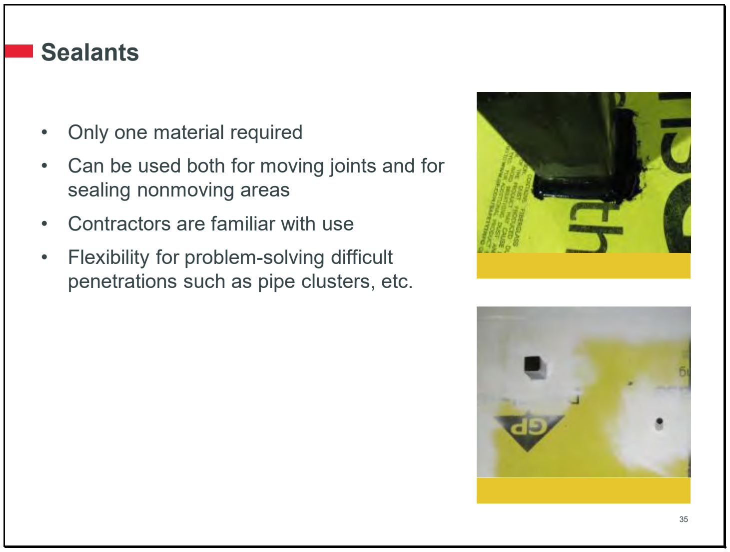
- Provide durability of silicones
- Allow for movement of large joints and transitions
  - Window perimeters
  - Floor slabs
- Easily spans across areas without a supporting substrate
- Flexibility to span between roof, foundation and wall systems
- If required at all details, can have difficulty cutting and folding around penetrations

34

Pre-cured silicone extrusions provide the **durability of silicones** – both for **long-term flexibility** and **UV stability**. Additionally, this solution allows for **movement** in large joints and at transitions – especially at window perimeters and floor slabs.

If this solution is required at all penetrations, the extrusions may need to be **cut or folded to fit** around different shapes.

Slide 35

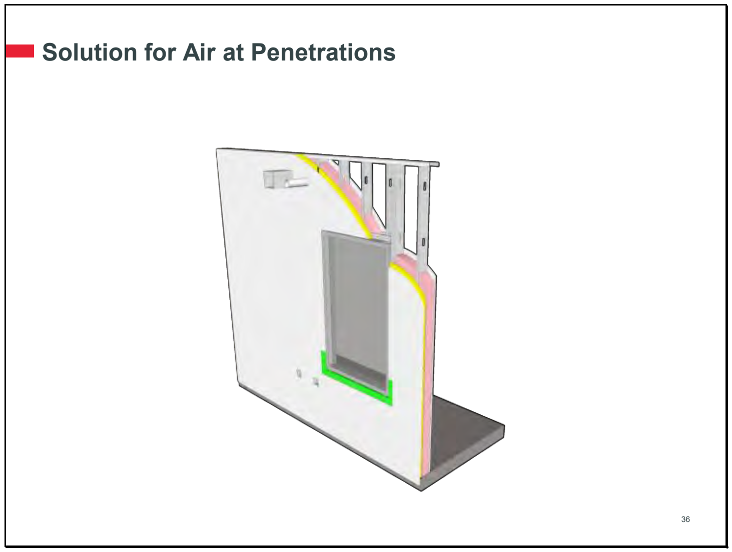


The benefit of using sealants for sealing around penetrations is that only one material is required.

Sealants can be used in both **moving** and **non-moving joints**. And contractors are **familiar** with how to **use** them.

This is a great solution for sealing around **complex shapes** and **difficult penetrations** such as pipe clusters. Plus, there are **no additional seams** that may cause air leakage if not installed properly.

Slide 36



Let's look at a solution for air infiltration at penetrations – specifically window openings, pipes and junction boxes – where all of the materials come together to create a **fully sealed wall solution**.

This animation shows how a system like this can be created using all **silicone liquid-applied components**.

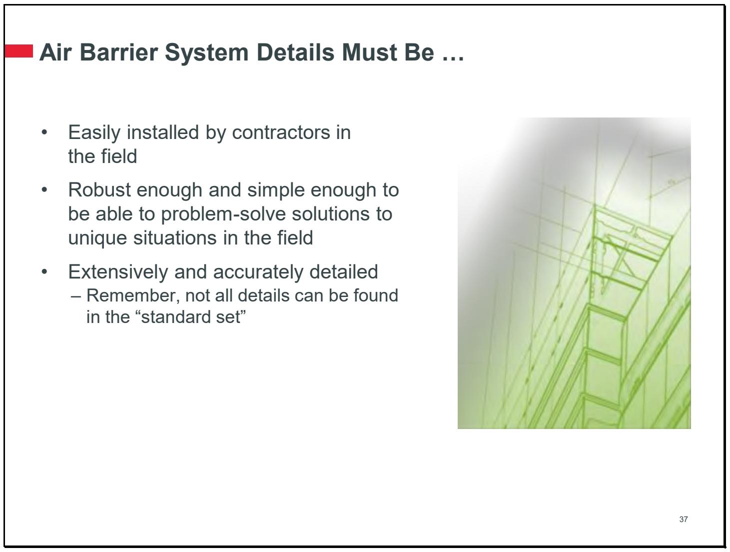
First, the seams in the sheathing are sealed with a silicone sealant. The openings around pipe penetrations and junction boxes are sealed in the same manner.

Next, the sill of the window opening is sealed using a silicone liquid flashing for extra robustness. The rest of the window perimeter is coated with a silicone liquid-applied air barrier.

Then, the entire wall is coated using the silicone liquid-applied air barrier.

Finally, the window is installed and the weatherseal joint sealed using a silicone sealant.

Slide 37

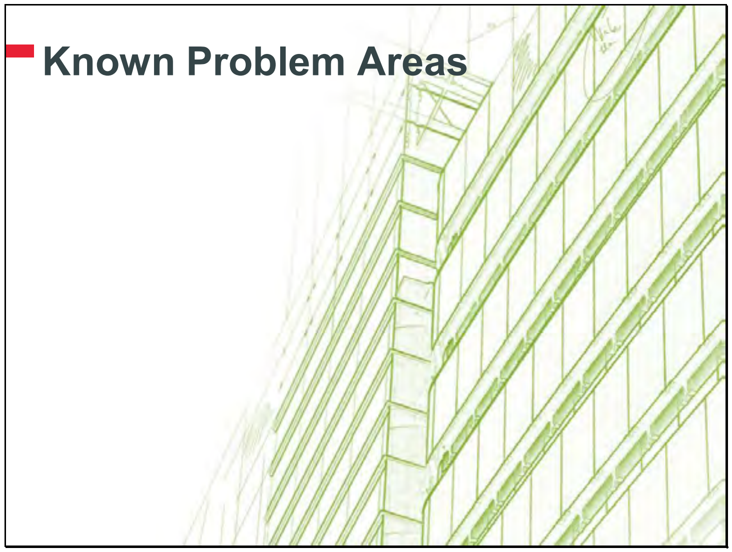


In summary, **air barrier system details** must be:

- **Easy** to install,
- **Robust**,
- **Simple,**
- And **flexible** enough to enable you to problem-solve unique situations.
- Plus, they need to be extensively and accurately **detailed**.

You won't find **all** the details you need in a standard set – you'll need to **custom-draw** them for your specific project or even problem-solve in the field.

Slide 38



Now that we’ve discussed current market options for creating a complete air barrier system, let’s talk about **some known problem areas** in building envelopes.

Slide 39

Known Industry Issues

- Flexibility at moving joints
- Compatibility with window sealants and other system components
- Sheet materials must be cut or folded to create airtight and watertight systems
  - Reverse lapping
- Some systems require ***numerous*** products to detail joints – confusing for contractors

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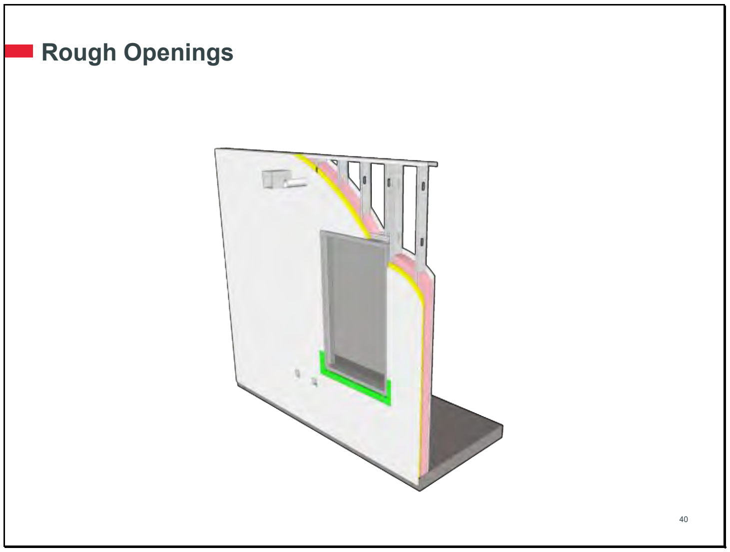
Some common issues include the need for **long-term flexible materials** at moving joints … and the need for the air barrier system to be **compatible** with the **other** systems it contacts.

Additionally, the need for proper **cutting, folding and lapping** of sheet materials can be **confusing** to contractors who don’t understand the reasons why they’re installing a specific detail.

The **numerous materials** required to install some systems can **also** create confusion on the job site.

Slide 40

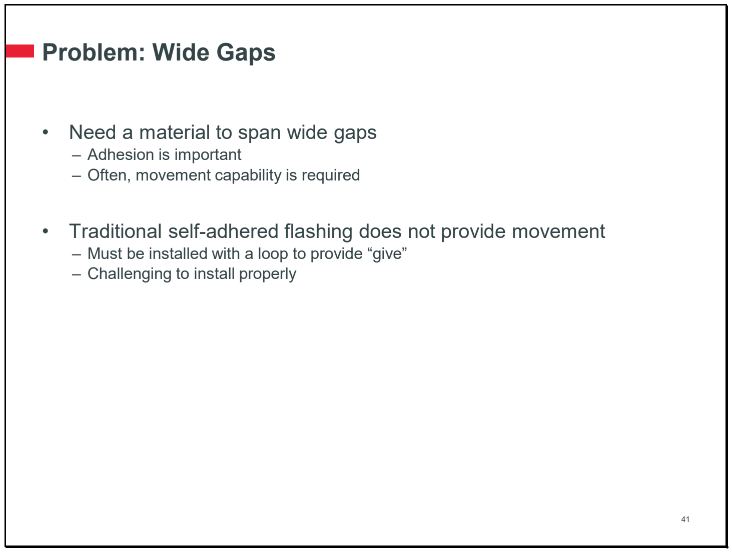


Rough window openings are a common problem area because of the **difficult transitions** among the many different substrates coming together, the many different trades involved, and the amount of wear and movement the area will endure during the life of the building.

Some manufacturers require as many as **6 different materials** to detail this area, including mastic tapes, termination bars, self-adhered flashings, gap-fillers, sealants, pre-cured extrusions and primers.

Using materials that are **compatible and adhere** to each other is **critical** to preventing air and water infiltration at these transitions in window openings and other through-wall areas. Using all **silicone-based materials** will provide a **compatible and primerless system** able to provide a **long-term, durable solution**. We'll talk more about this throughout this section.

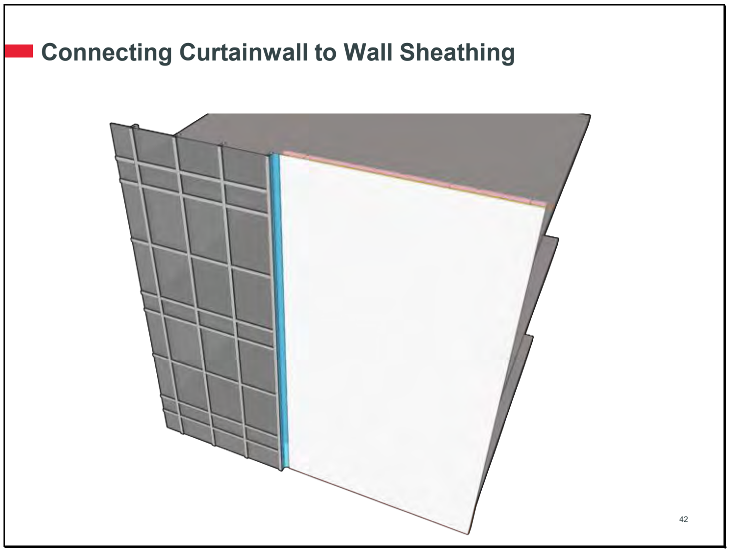
Slide 41



There are many times when **wide gaps** in the construction must be **spanned** to create an **airtight envelope**. This may be at a window opening … or where a pipe is penetrating the envelope.

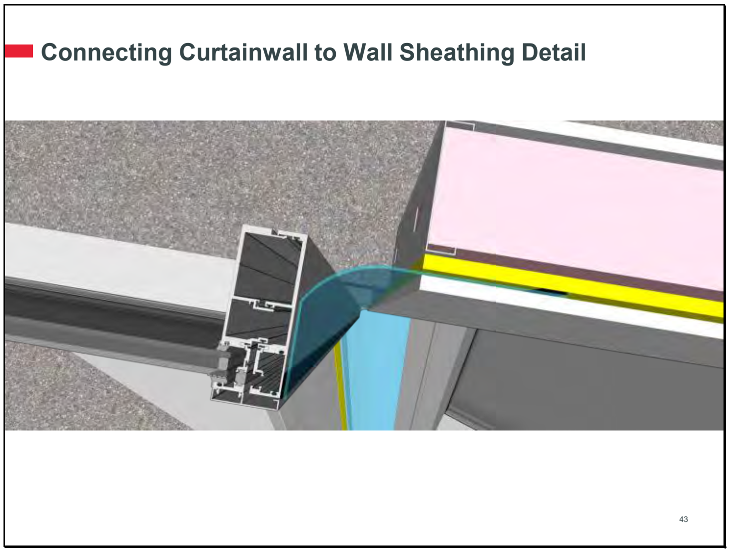
Adhesion at these interfaces is **critical** to creating a durable detail – and the **movement** between the system components cannot be forgotten. **Self-adhered flashing** may be a possible solution for **some** of these details, but the material itself, doesn't allow for any movement greater than 15%. This means it must be detailed and installed very accurately to accommodate a moving joint.

Slide 42



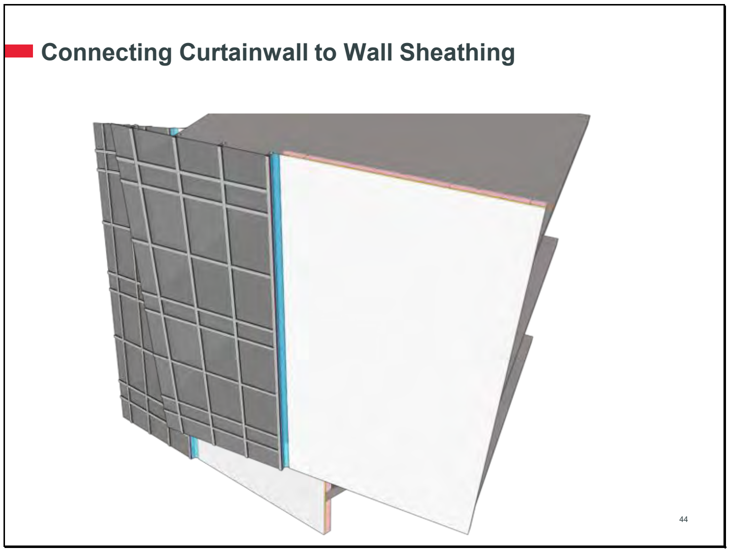
One area where a large amount of movement is expected is where the curtainwall must tie into the opaque wall. This illustration shows the building of the opaque wall and then the curtainwall. A pre-cured silicone strip is then adhered to both systems using a traditional silicone sealant. This strip allows for movement between the systems. It can be applied either before or after the silicone liquid-applied air barrier.

Slide 43



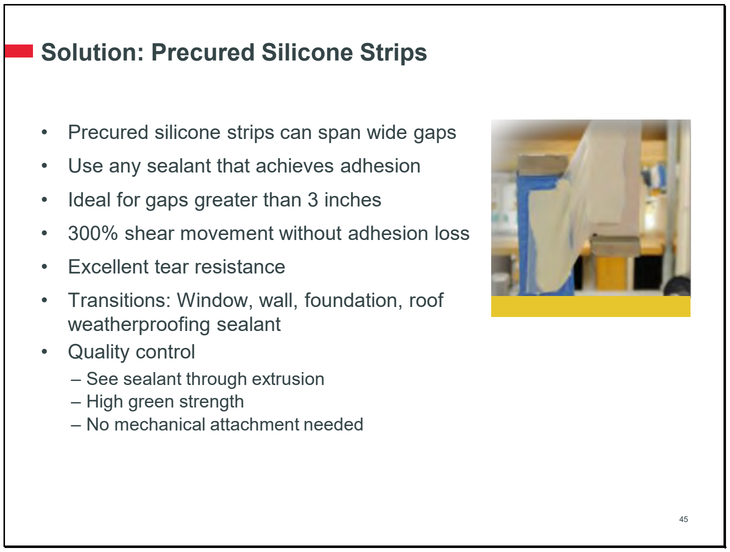
This is another angle of the same detail. You can see the pre-cured silicone strip adhering to the mullion of the curtainwall and the exterior sheathing using a traditional silicone sealant. The silicone air barrier is then applied over the strip.

Slide 44



This detail is one option for creating a robust, durable, airtight and watertight transition at this difficult interface.

Slide 45



As we just showed, one solution to this situation is to use a **flexible pre-cured silicone strip**. These strips are able to span wide gaps and can accommodate up to 300% movement in shear and tension without losing adhesion. They are especially valuable for sealing transitions at windows, foundations and roof lines.

Because the extrusions are **clear**, you can quality-control the sealant application through the strip. And the **high green strength** of the weatherseal sealant used to adhere the strips **eliminates the need for mechanical attachment**.

Slide 46

Problem: Continuity

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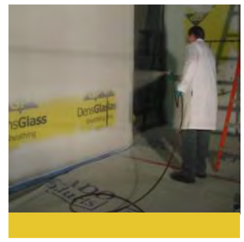
Building codes are requiring **continuous air barriers** around the entire building envelope. The rule of thumb for creating a **continuous**, airtight envelope is to be able to trace your air barrier around your **entire** building without picking up your pencil. But this can be challenging to detail at the **interfaces** – especially at the roof and foundation.

Slide 47

Continuity

- Air barrier on flat walls must be continuous
  - Lapping of joints if using a sheet-applied material
  - Elastomeric, liquid-applied air barriers do not require in-plane joints
- A continuous air barrier includes the foundation and roofing systems as well as the wall
- An air barrier for the wall must be able to tie into these other systems
- One manufacturer will likely not make all systems
- This is a critical point for detailing

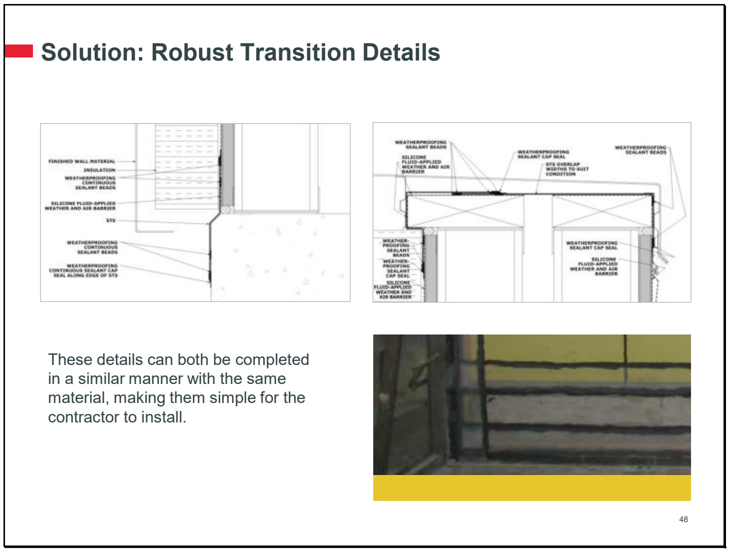


47

A continuous air barrier requires that the air barrier be **continuous on flat walls**. When using a **sheet-applied material**, the joints **between** the sheets must be **properly lapped** without any wrinkles or folds. Silicone, elastomeric, liquid-applied air barriers don’t require these in-plane joints.

The air barrier system also has to **tie into other systems** – such as the foundation and roofing systems. These interfaces are a common place to have failures within the air barrier system. It’s critical to **properly detail the interfaces** between these systems, as it is rare that one manufacturer will make and detail them all.

Slide 48

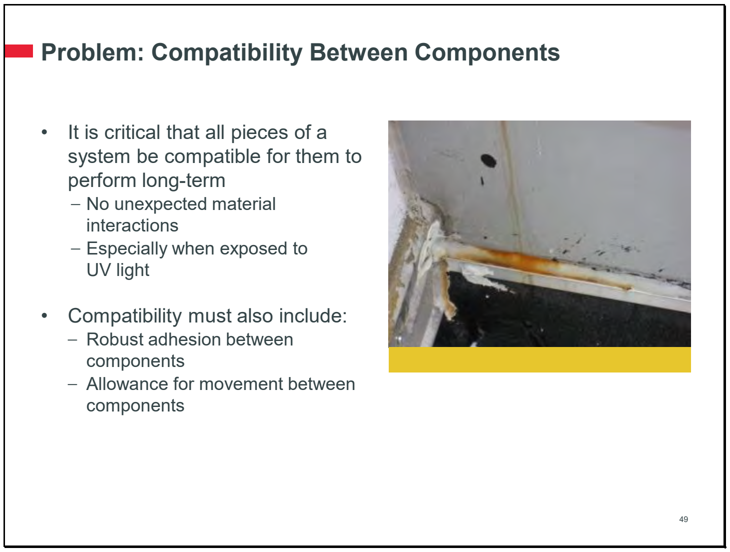


The solution to creating a continuous air barrier is to **create robust details for these key interfaces**.

We've already discussed some of the requirements to do this. It's important to reiterate that there is a need for **simple** details that can be **easily installed** by the contractor in the field in order to ensure success.

These details show how a **pre-cured silicone extrusion** can be used in a **similar manner** at foundation and parapet transitions.

Slide 49

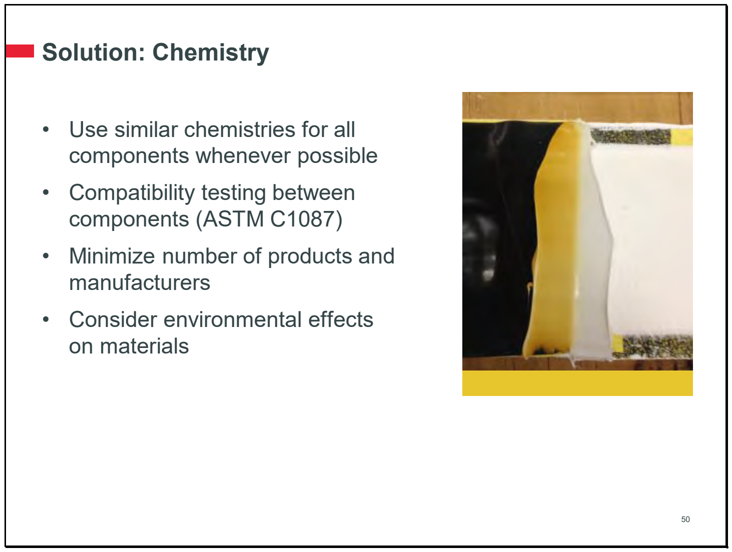


Another known problem area is the **lack of compatibility** among the different components of the building system. This can occur both **within a single system** … and **between different systems** that are part of the building envelope.

Compatible components are needed to ensure the **long-term performance** of your building envelope. In addition to **chemical compatibility**, the different components must have **robust adhesion** to one another and be able to **accommodate the movement between the substrates**.

The photograph shows poor chemical compatibility between a silicone sealant and an EPDM membrane that came into contact with it.

Slide 50

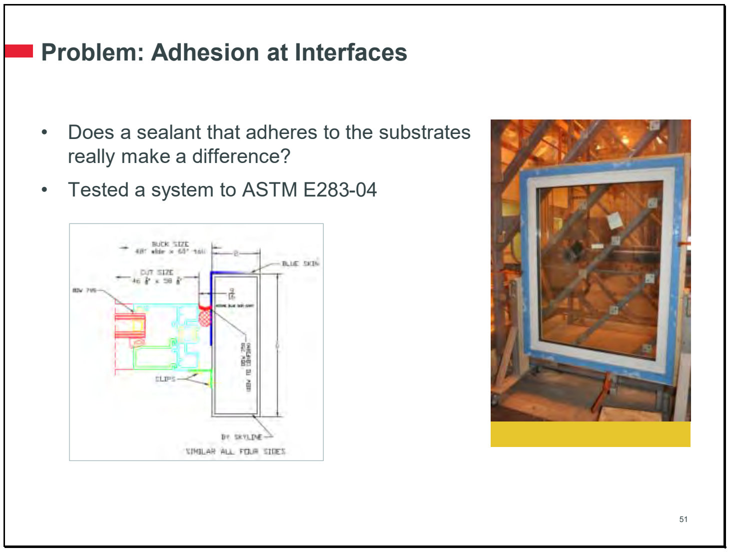


To ensure compatibility among system components, it’s important to **use similar chemistries whenever possible** … and to **test for compatibility** when that **isn’t** possible. Product manufacturers can test for compatibility using the ASTM C1087 test method.

Another way to reduce the risk of compatibility issues is to **minimize the number of products needed** to complete your building system.

Here’s a picture showing one example of a compatibility issue triggered by UV exposure. Here, a single sealant is shown after being in contact with two different air barriers for only three days in a UV chamber. The sealant and air barrier on the **right** are both **silicone** … while the air barrier on the **left** is **asphaltic**.

Slide 51



A big issue in the construction of airtight and watertight building envelopes is **robust adhesion at the interfaces of different components**.

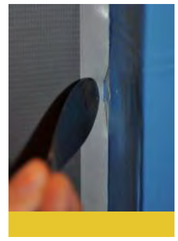
We asked the question: “When creating an airtight building envelope, does it matter if the **sealant adheres** to the substrate?”

To determine this, we tested the system shown here using both a sealant that is known to adhere to the substrates and a sealant that doesn’t adhere. The system was tested to ASTM E283 for air infiltration and obtained some telling results.

Slide 52

With and Without Adhesion

Pressure	Initial Tare, cfm	Infiltration		Exfiltration	
		With Sealant Adhered	Without Sealant Adhered	With Sealant Adhered	Without Sealant Adhered
25 Pa (0.52 psf)	0.11	<0.01	0.12	<0.01	0.1
50 Pa (1.04 psf)	0.22	<0.01	0.19	<0.01	0.18
75 Pa (1.57 psf)	0.33	0.01	0.27	<0.01	0.24
100 Pa (2.09 psf)	0.42	<0.01	0.34	<0.01	0.31
150 Pa (3.13 psf)	0.61	<0.01	0.45	<0.01	0.4
250 Pa (5.22 psf)	0.94	<0.01	0.67	<0.01	0.58
300 Pa (6.27 psf)	1.08	<0.01	0.74	0.01	0.64

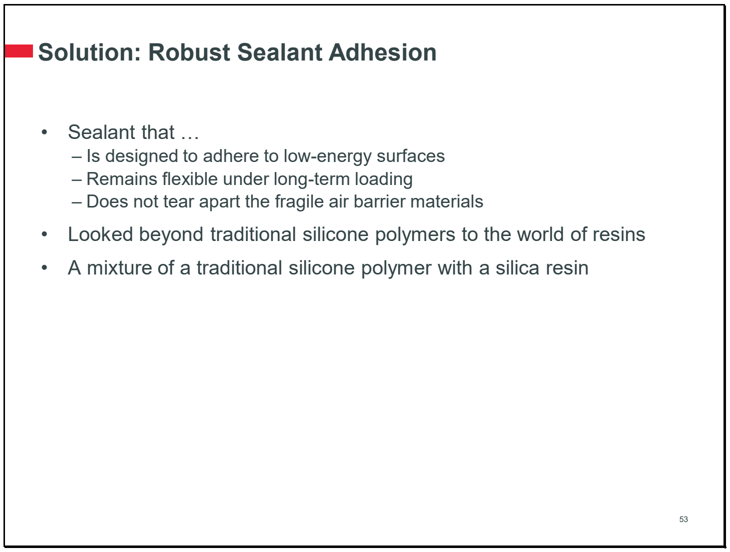


This chart shows the **air infiltration difference** between a sealant that is **adhering** to the substrate versus one that only **appears** to be adhering until it's **stressed** – as shown in the picture on the right.

In fact, when the sealant does not adhere to one of the substrates, the system no longer complies with current building codes in most areas.

This data **also** shows that when a sealant is designed for **long-term adhesion**, it's **all** that's needed to create an **airtight envelope** – extra flashing **isn't** needed, provided the sealant possesses the movement capabilities required by the system design.

Slide 53

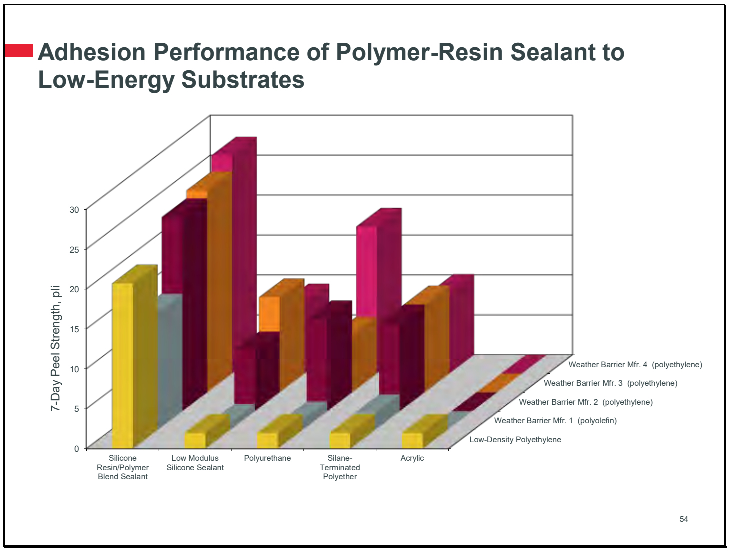


So what does **robust sealant adhesion** really mean?

When working with air barriers, it means that the sealant can **adhere to the low-energy surfaces** that are present on many air barriers – especially **self-adhered** and mechanically fastened **sheet-applied** systems. In addition, the sealant must remain flexible over the life of the building and must not damage the air barrier itself when the sealant is stressed.

When designing a sealant to do this, we found that we needed to look **past** traditional silicone polymers and create a sealant that also included a **silicone resin** component.

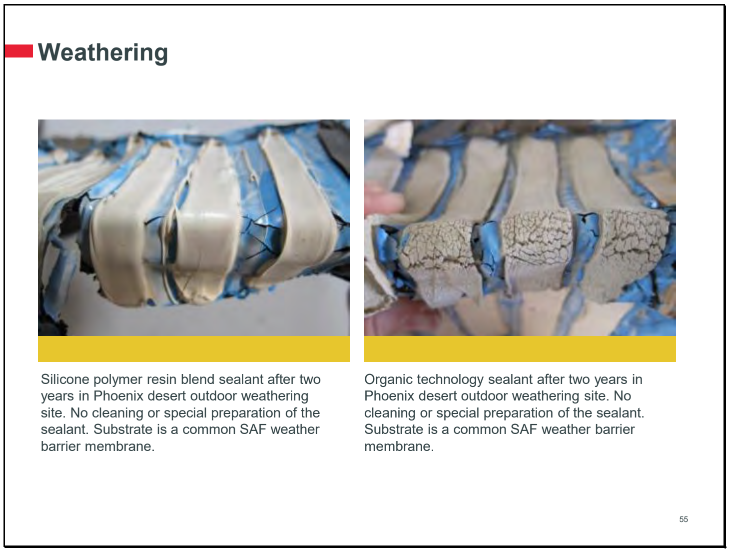
Slide 54



This graph compares the adhesion performance of a **silicone polymer/resin blend sealant** with a low-modulus silicone sealant **traditionally** used to adhere these materials … as well as with other sealants commonly found in this market. All of these materials were applied to various sheet-applied air and weather barrier materials.

As you can see, the silicone polymer/resin blend sealant demonstrates **better adhesion** to these low-energy substrates than **any** of the other sealant types.

Slide 55



While adhesion is critical, a new sealant’s **long-term performance capabilities** also must be tested. These photographs show the silicone polymer/resin blend sealant and an organic sealant that were allowed to age outdoors in Phoenix for two years.

Note that the high-density polyethylene-faced air barrier to which the sealant was applied has broken down during this time.

Slide 56

Weathering and Adhesion

Adhesion of polymer/resin blend sealant (left) and a common silicone sealant (right), after two years in Phoenix desert outdoor weathering site, to a common peel-and-stick weather barrier membrane with a high-density polyethylene top sheet.

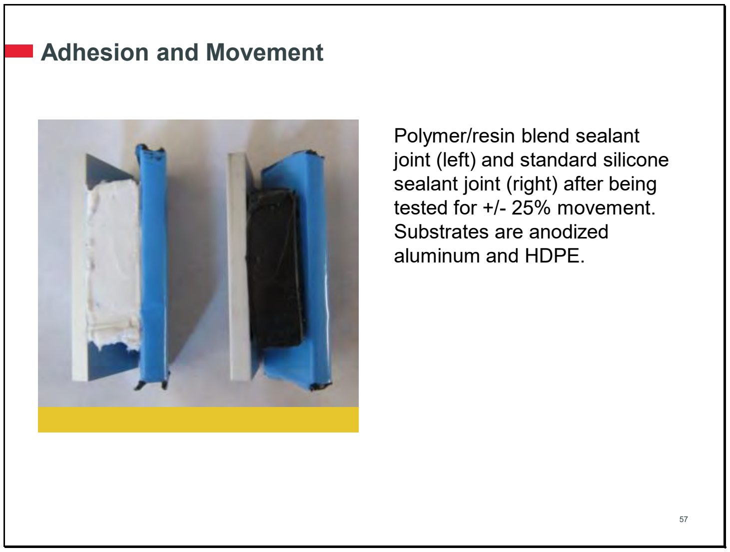
Adhesion of polymer/resin blend sealant (right) and a common silicone sealant (left), after two years in Phoenix desert outdoor weathering site, to a common spun bound polyolefin weather barrier membrane.

56

A common concern with weather barrier sealants is: **“Will they lose their adhesion over time?”** We found that the adhesion of the **new** sealant remained **robust** … **even after weathering**.

The two sealants in the middle photos **lacked adhesion** before weathering and after … while the polymer/resin **blend** sealant shown in the outside photos maintained **great adhesion** after the two-year aging process.

Slide 57

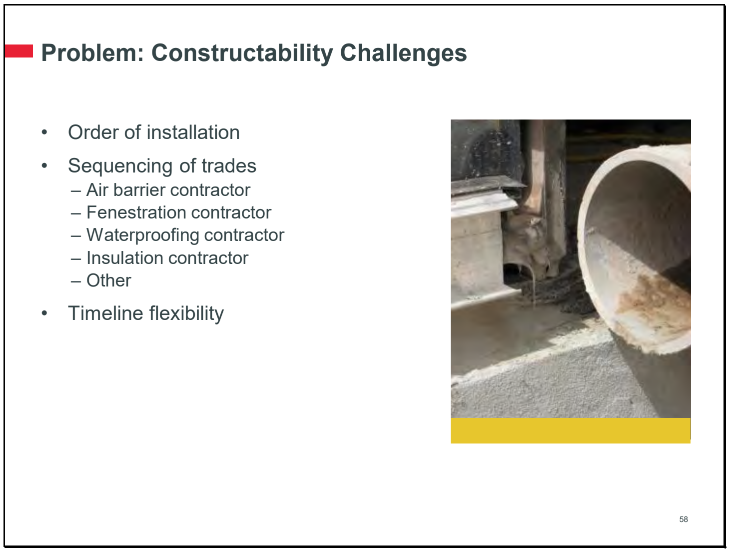


Additionally, the sealant must **maintain** its adhesion as the joint **moves**.

These two joints were subjected to cycles of plus and minus 25% movement. The traditional silicone sealant on the right **lost** its adhesion to the high-density polyethylene air barrier, while the polymer/resin **blend** sealant on the left has **maintained** adhesion through the cycling. Note that the traditional silicone sealant has a movement capability of plus or minus 50% – double the movement that was experienced here.

All of this testing reinforces that while a sealant may appear to adhere **initially**, it's important to ensure that the sealant will **maintain** adhesion once the joint is stressed.

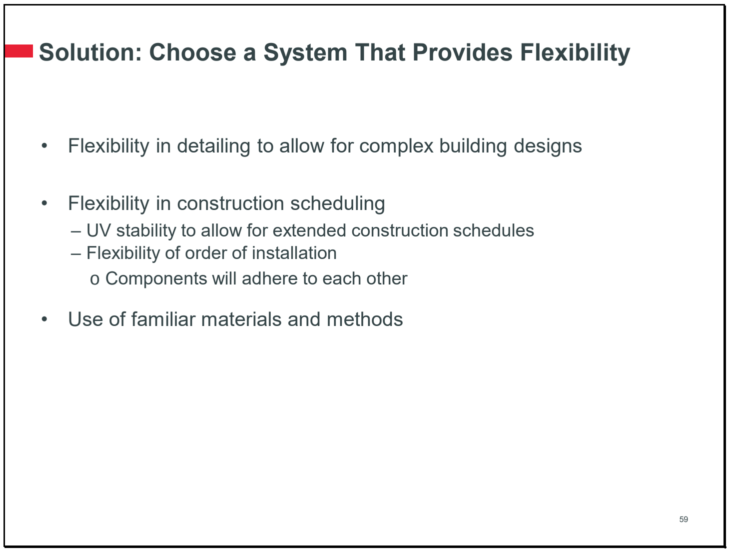
Slide 58



The final problem we'd like to address today is **constructability challenges** … including the **order** of installation and the **sequencing** of the construction trades.

It's important to think these challenges through when **designing details** and choosing manufacturers. This picture shows what can happen if trades are **not** sequenced properly … or when **how** a detail is going to be installed **isn't examined** during the **design phase** of a project.

Slide 59



One way to **combat** this problem is to choose a system that offers flexibility:

- Flexibility in how the **details** are designed to allow for the complexities of today's buildings.
- Flexibility in **scheduling** to allow for delays.
- And flexibility in the **order of installation** so different components can be installed at different times.

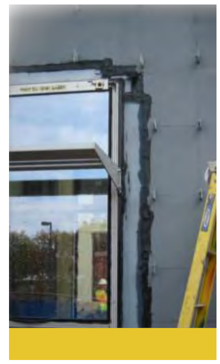
To ensure success, it's **also** important that the construction team is **familiar** with the materials and installation methods being used.

Using a system comprised of silicone sealants, pre-cured extrusions and air barriers gives the design team and the contractor flexibility in **all** of these areas.

Slide 60

Proving the Solutions: Pre-Construction Mockup Testing

- Determine air infiltration rate
  - <0.04 cfm/ft^2 @ 75 Pa
  - Test per ASTM E283
- Determine water leakage
  - Test per ASTM E331
- Confirm:
  - Compatibility of components
  - Sequencing of trades
  - Order of installation of materials
  - Quality control procedure

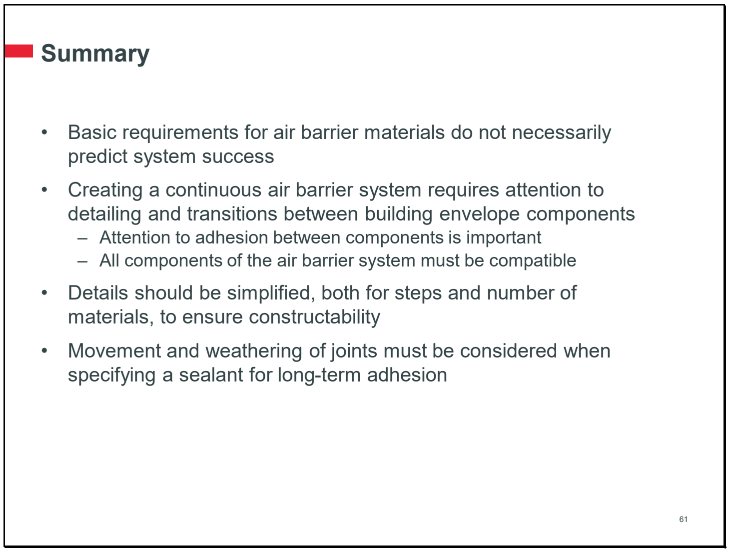


60

To prove that the solutions you chose will work, we recommend **pre-construction mock-up testing**.

Mock-ups can be tested for air and water infiltration as well as to confirm adhesion performance and component compatibility … the sequencing of trades … the order of installation of the materials … and how you’re going to ensure the quality of the work … all before getting to the project job site.

Slide 61

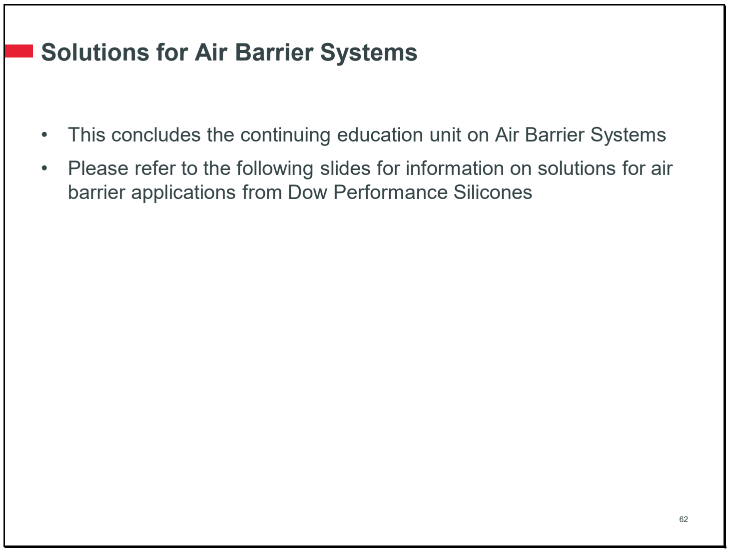


As you can see, simply meeting basic air barrier **code requirements** doesn’t necessarily predict system **success**.

Creating a **continuous** air barrier system requires attention to the **details** and **interfaces** between building components. These details should be **simplified** – not only to minimize the number of **steps** and **materials** required, but also to ensure the **constructability** of the detail and the **compatibility** of the components.

Additionally, it’s important to analyze the **movement**, adhesion and **weathering** capabilities of the different components within your system to ensure the long-term **durability** of your building envelope.

Slide 62



We are now at the point in the presentation where we can talk about products for air barrier applications available from Dow Performance Silicones.

Slide 63

This concludes our presentation. Thank you for taking time today to learn about air barrier systems and silicone solutions to reduce air infiltration.

Slide 64

For full credit, we'll now ask you to complete a short 10-question quiz.

You may answer more than once if your first answer is incorrect.

Slide 65

New Brand Name Introduced: DOWSIL™

- DOWSIL™ is the new product brand name for silicone-based building products from Dow High Performance Building

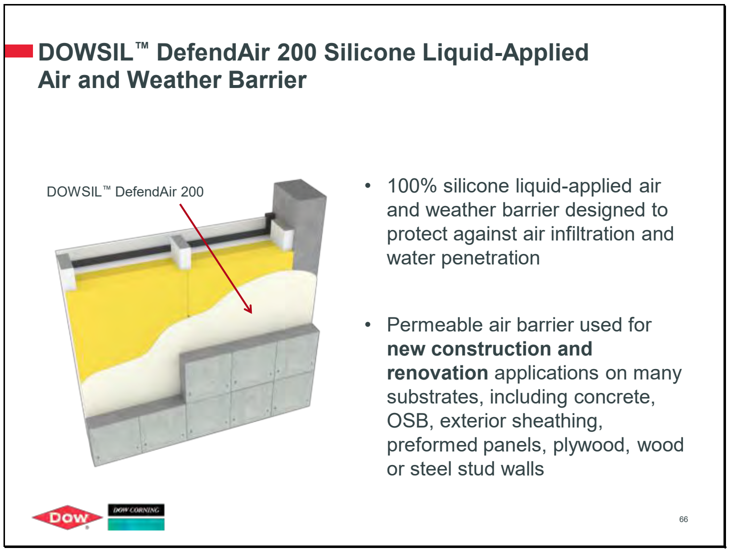
DOWSIL™

silicones by DOW

- DOWSIL™ represents the combined power of Dow and Dow Corning
- Introduced November 2017 for Europe, the Middle East and Africa; February 2018 rollout for the rest of the world

DOW DOW CORNING

Slide 66

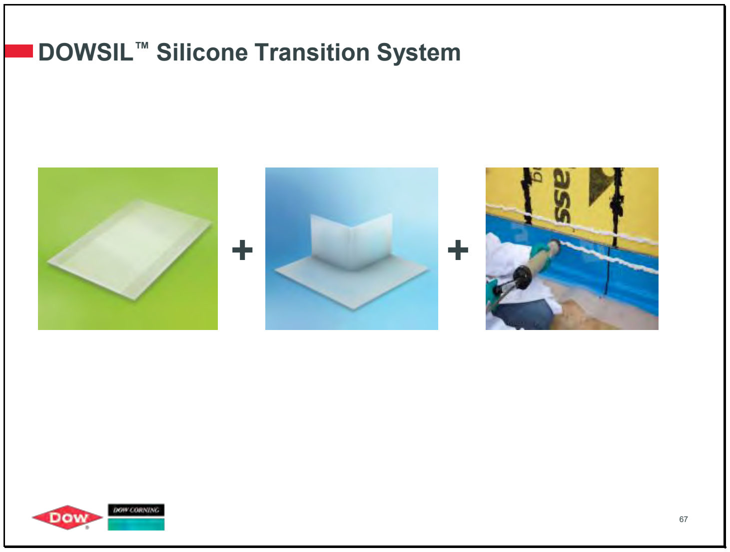


DOWSIL™ DefendAir 200 is a ***100% silicone*** ... ***liquid-applied*** ... ***air and weather barrier***.

DefendAir 200 is a **water-based, UV-stable, vapor-permeable** air barrier solution that can be used in both new construction and renovation and can be applied to most common construction substrates.

It's compatible with approved DOWSIL™ brand sealants and extrusions used as part of a building air barrier ***system***. We'll talk more about this system later.

Slide 67



To address the problem of ***how to adhere to air barriers at building openings***, Dow High Performance Building offers **DOWSIL™ 758 Silicone Weather Barrier Sealant**.

The addition of the **DOWSIL™ Silicone Transition System** – a series of clear strips and corners – can be used to bridge joints and openings where a simple sealant joint isn't possible.

The extrusions can be adhered using ***most*** DOWSIL™ brand sealants – simply choose the sealant that best adheres to your substrate.

Slide 68

VIDEO ATTACHED: You may need to load video prior to starting the presentation

DOWSIL™ Silicone Transition Strips have a tear strength of ***200 pounds per inch***. If the material is punctured, it takes an ***immense*** amount of ***force*** to make the hole spread – more than the force of ***two people*** pulling on it. This is a nice performance feature in the event that the strip needs to be mechanically attached or is inadvertently punctured during the construction process.

The Silicone Transition System can also withstand ***300% shear movement*** without tearing.

These are best-in-class properties for these materials.

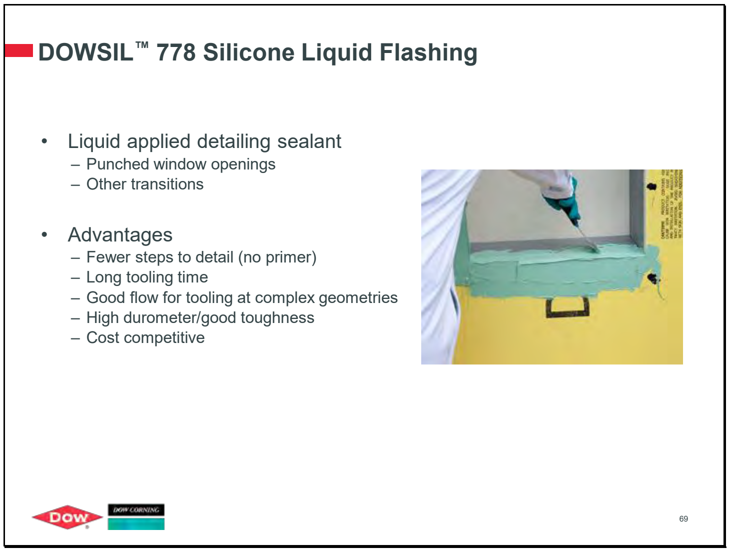
[AS VIDEO PLAYS]

In this video, DOWSIL™ 758 Silicone Weather Barrier Sealant was used to adhere the strip to the aluminum … and to the air barrier sheet. As you can see, the adhesion of the weather barrier sealant is robust enough to handle ***extreme*** shear movement.

[AFTER VIDEO ENDS AND IS CLOSED]

The photo on the right shows a competitive material that ***failed*** this test.

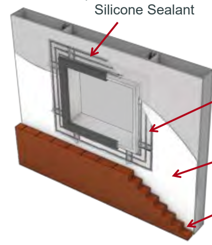
Slide 69



DOWSIL™ 778 silicone liquid flashing completes your 100% silicone air barrier system – with DOWSIL™ DefendAir 200 as your air barrier, DOWSIL™ STS for your transitions, DOWSIL™ 791 silicone weatherproofing sealant for detailing and DOWSIL™ 758 Silicone Weather Barrier Sealant for tying into roof and foundation membranes to create an air tight building envelope.

Slide 70

A Complete Air Barrier System



ASTM E2357	Assembly Air Leakage, Class 1A per CAN/ULC S742		
	<0.01 cfm/ft² @ 1.57 psf	cfm/ft²	< 0.000006
	<0.05 L/s/m² @ 75 Pa	L/(s-m²)	< 0.00003

The air barrier doesn't act ***alone*** – ***system*** performance is critical. The system test shown ***here*** is the ASTM E2357 test we spoke about before. It includes a blank wall as well as one with penetrations, brick ties and a window opening.

When installed per our full-system application instructions, Dow's silicone air barrier system components create a system that is ***so airtight*** that its air leakage rate is well within the testing equipment's margin of error – and ***far lower*** than what is currently required in the industry.

Additionally, our system receives ***the most airtight classification in Canada*** based on the CAN/ULC S742 test method. This test was performed at an independent testing lab.

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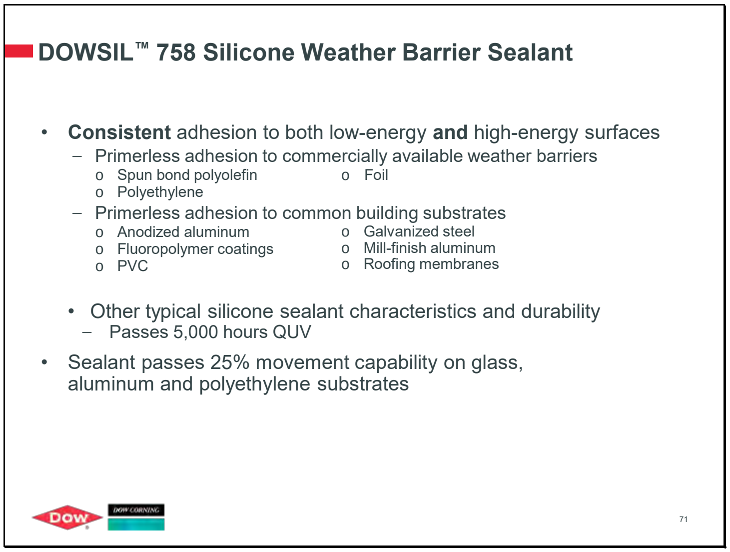

DOWSIL™ 758 Silicone Weather Barrier Sealant is a silicone polymer/resin blend sealant that has consistent, primerless adhesion to almost every construction substrate.

DOWSIL 758 Sealant has a movement capability of plus or minus 25% and has all of the durability characteristics that you expect from a silicone including UV stability.

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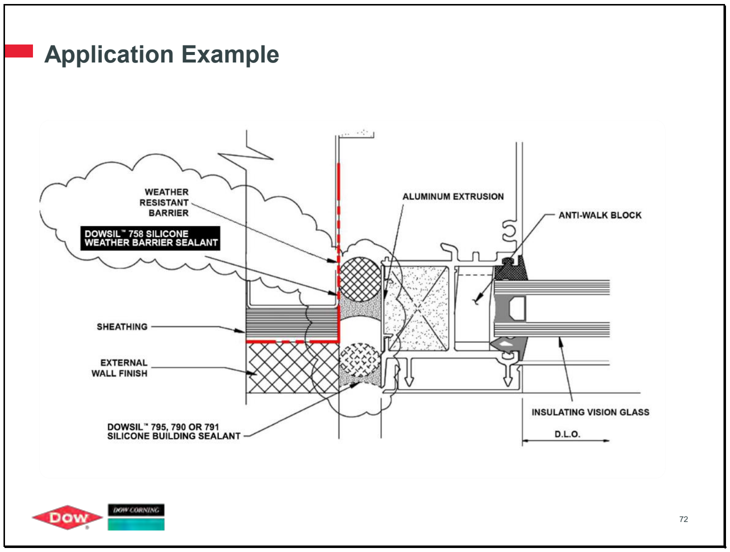

DOWSIL™ 758 Silicone Weather Barrier Sealant is designed to be installed as the inner seal of a double-weatherseal system where adhesion to the air and weather barrier is critical.

Traditional silicone sealant is then used as the outer, aesthetic seal. DOWSIL 758 Sealant only comes in white, so it is not the best sealant for the outer seal application.

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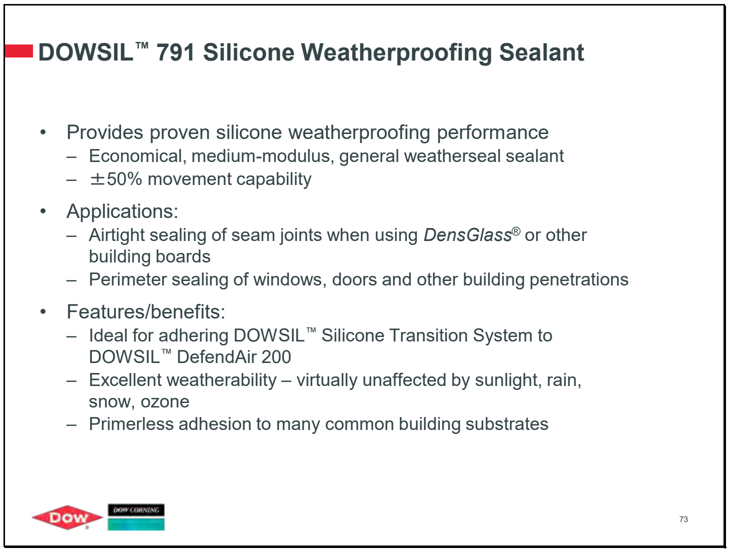

DOWSIL™ 791 Silicone Weatherproofing Sealant is the recommended sealant for use with DOWSIL™ DefendAir 200 to create a complete air barrier system.

DOWSIL 791 Sealant has proven performance as a weatherproofing sealant with a movement capability of plus or minus 50%. It is an economical, medium-modulus sealant that has excellent adhesion to a wide variety of substrates.

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Learn More

- Find more information at **BuildaBetterBarrier.com** or **dowcorning.com/construction**