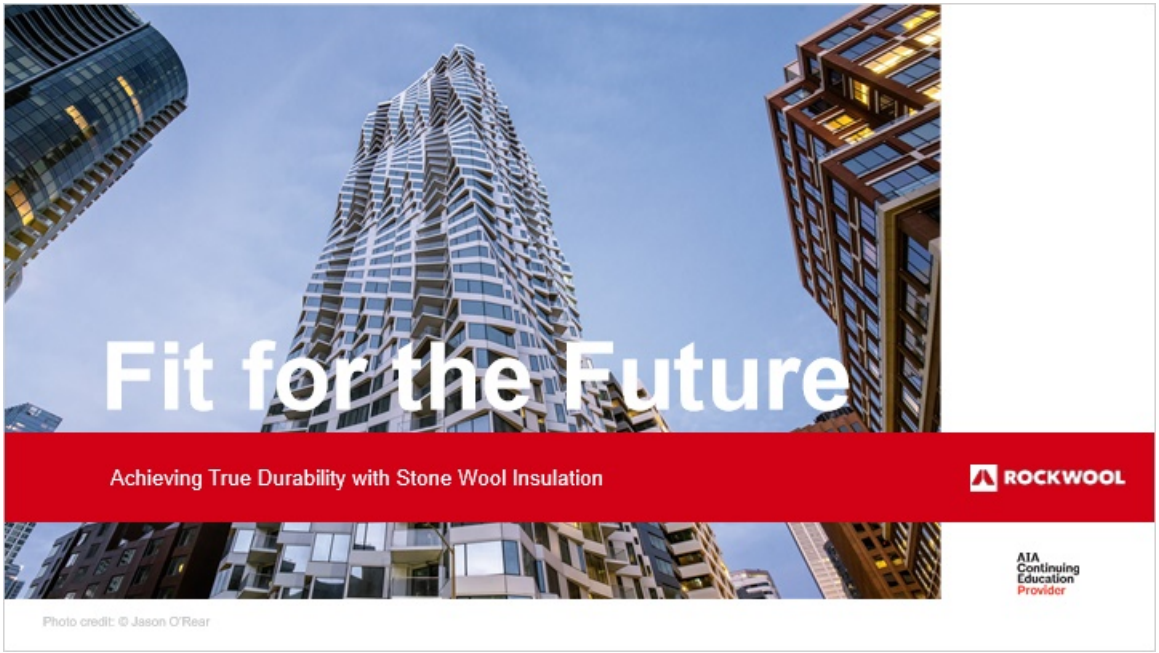
Fit for the Future

1.1 Fit for the Future



Notes:

Fit for the Future

1.2 Program Registration

Program Registration

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

AIA Continuing Education Provider

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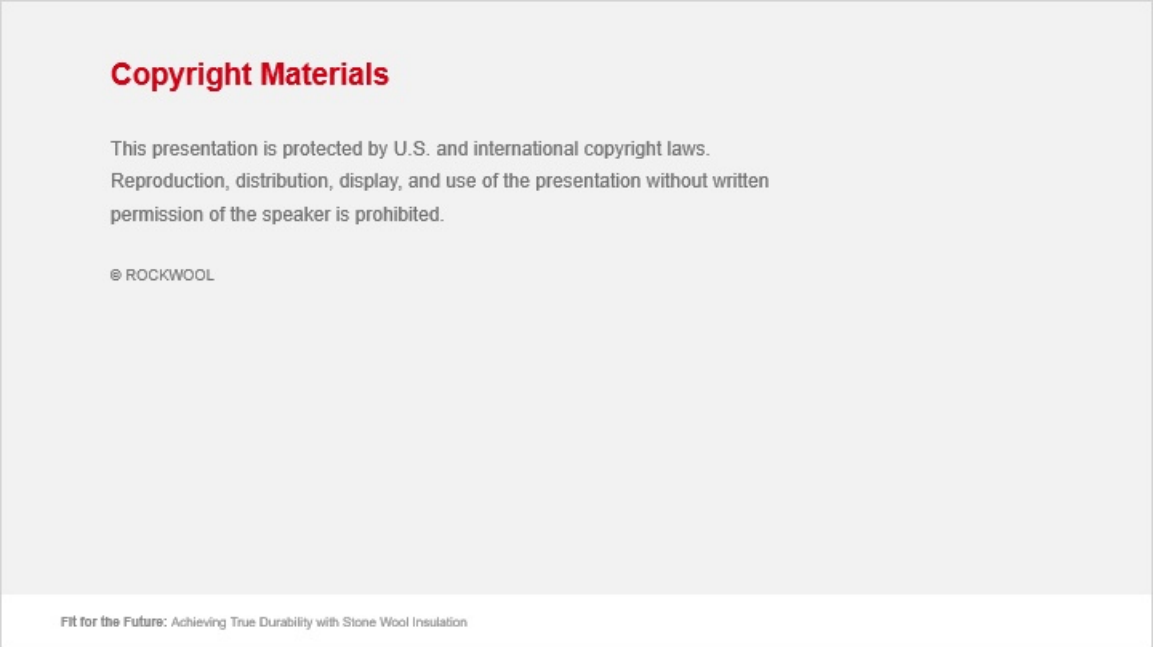
1.3 Copyright Materials



Notes:

1.4 Course Overview

Course Overview

Choosing the correct insulation is a critical component to achieving the long-term resilience of the built environment. Over its service life, a good insulation must perform day in and day out against weather and environmental volatility while also standing ready to shield a structure against sudden and extreme threats, like fire. To be a better insulation, the insulation product should demonstrate undegraded, as-manufactured performance for as long as possible, maximizing service life and the performance of the building. The very best insulation must add one additional layer of performance: ensuring the safety and wellbeing of all the people interacting with it.

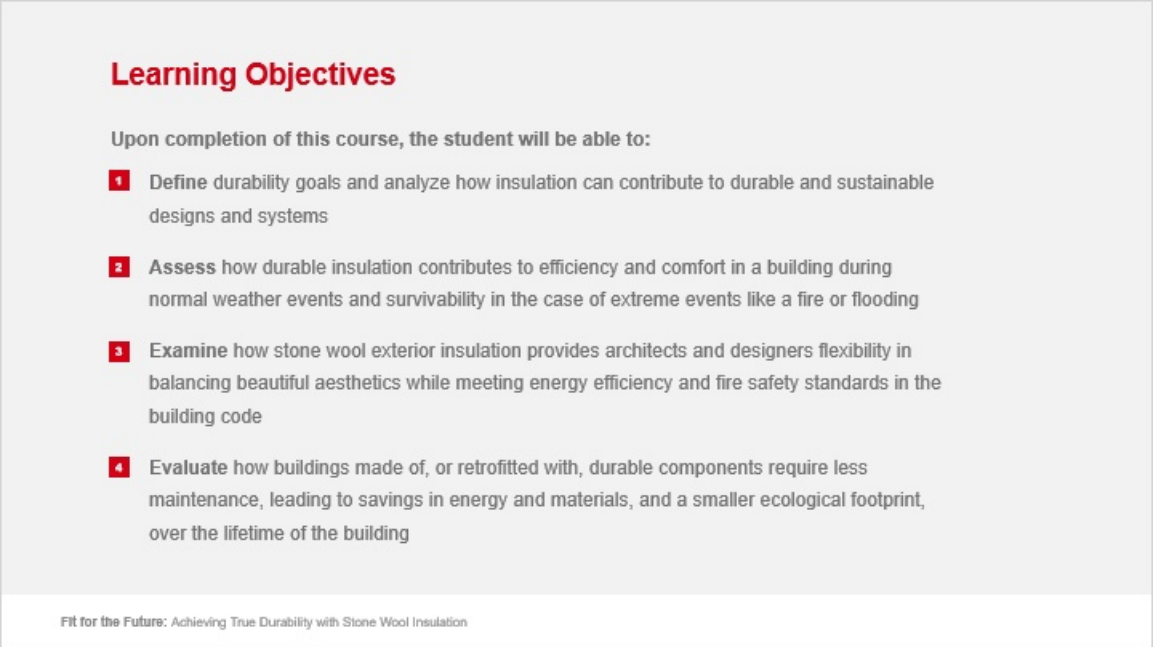
Besides acting as a thermal barrier, the testing matrices used to evaluate insulation will be discussed in detail, as well as the unique attributes of stone wool insulation, aiding architects in making a durable insulation decision.

Notes:

Choosing the correct insulation is a critical component to achieving the long-term resilience of the built environment. Over its service life, a good insulation must perform day in and day out against weather and environmental volatility while also standing ready to shield a structure against sudden and extreme threats, like fire. To be a better insulation, the insulation product should demonstrate undegraded, as-manufactured performance for as long as possible, maximizing service life and the performance of the building. The very best insulation must add one additional layer of performance: ensuring the safety and wellbeing of all the people interacting with it.

Besides acting as a thermal barrier, the testing matrices used to evaluate insulation will be discussed in detail, as well as the unique attributes of stone wool insulation, aiding architects in making a durable insulation decision.

1.5 Learning Objectives

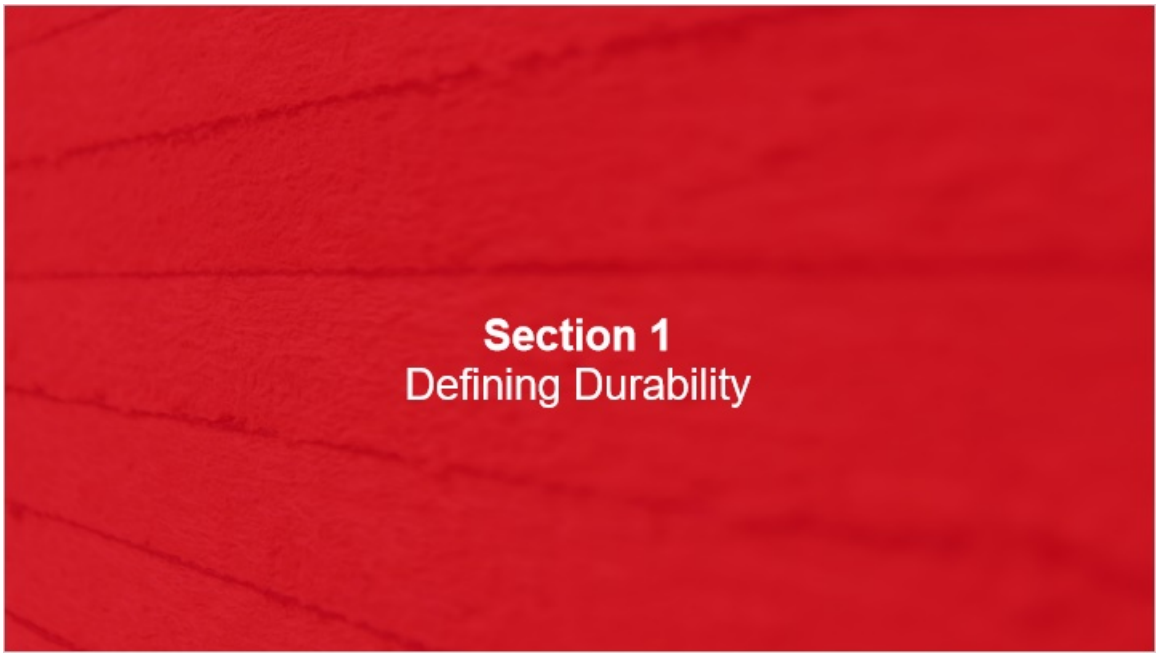


Notes:

Upon completion of this course, the student will be able to:

- Define durability goals and analyze how insulation can contribute to durable and sustainable designs and systems.
- Assess how durable insulation contributes to efficiency and comfort in a building during normal weather events and survivability in the case of extreme events like a fire or flooding.
- Examine how stone wool exterior insulation provides architects and designers flexibility in balancing beautiful aesthetics while meeting energy efficiency and fire safety standards in the building code.
- Evaluate how buildings made of, or retrofitted with, durable components require less maintenance, leading to savings in energy and materials, and a smaller ecological footprint, over the lifetime of the building.

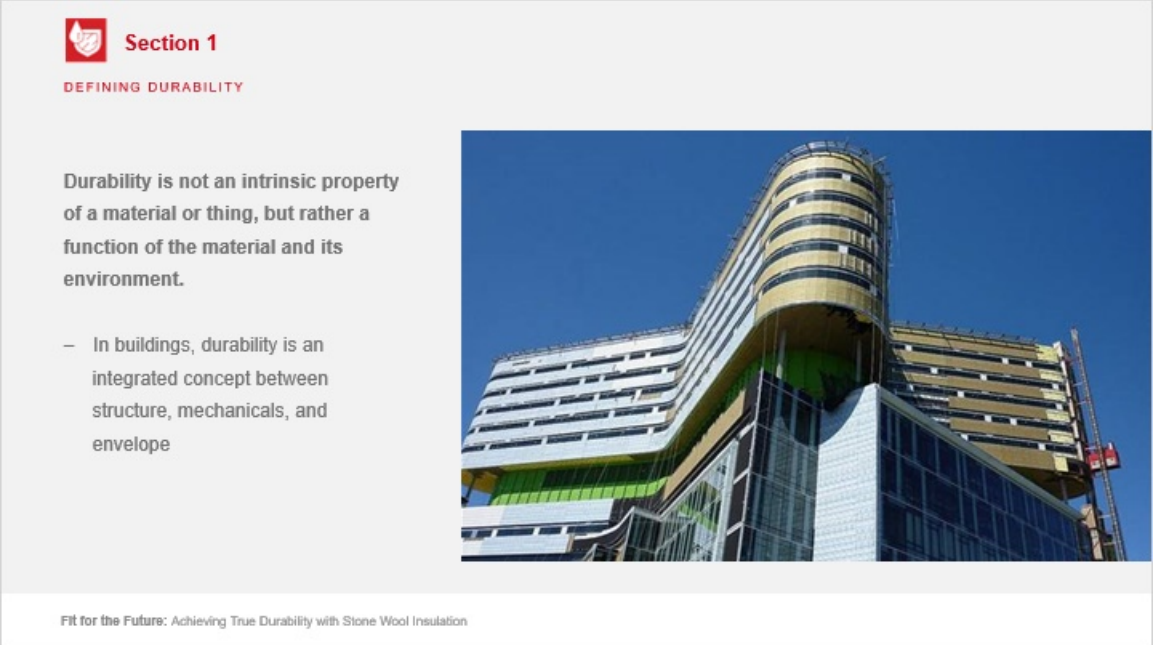
1.6 Section 1



Notes:

Section 1 Defining Durability

1.7 Defining Durability



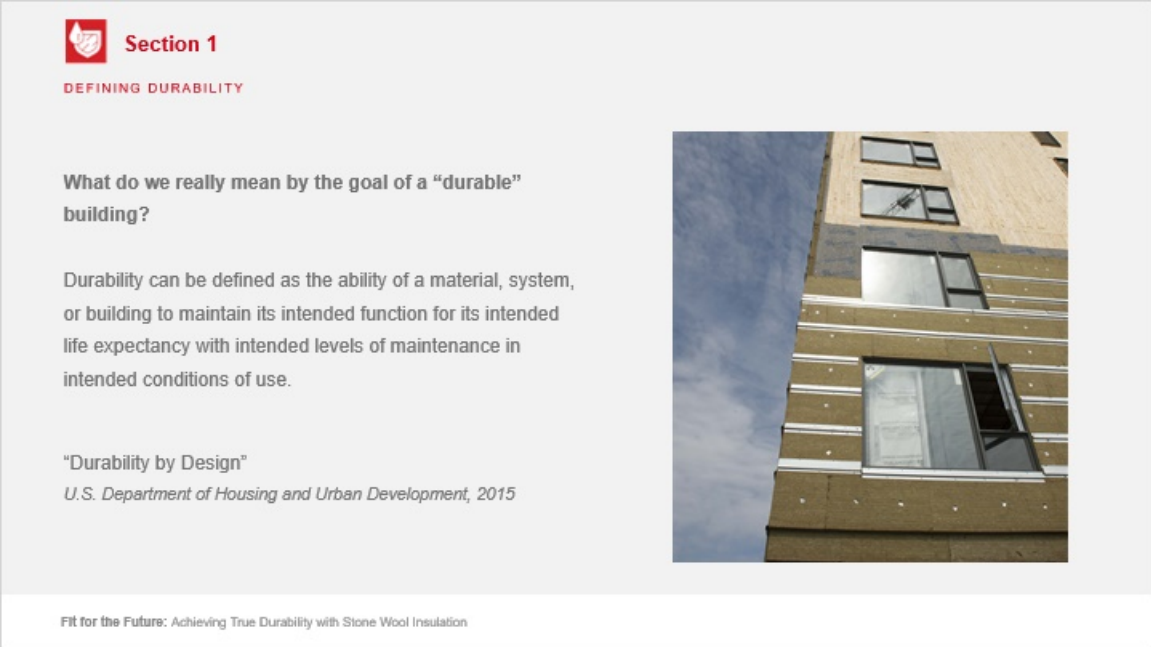
Notes:

Durability is not an intrinsic property of a material or thing, but rather a function of the material and its environment.

In buildings, durability is an integrated concept between structure, mechanicals, and envelope.

Code requirements, performance requirements, and external forces that impact the building - like climate volatility and hazards such as fire - all dictate what products go into a building and why and how they are placed there. Taking a durable view of construction means making considerations beyond what's listed in code requirements. Durability means planning for a long term, holistic view of the build, and thinking through what happens with all the materials over the course of the building's life. How long does each material last, beyond the initial spec sheet? Are you building to spec or are you building with materials that maintain performance over the lifetime of building?

1.8 Defining Durability



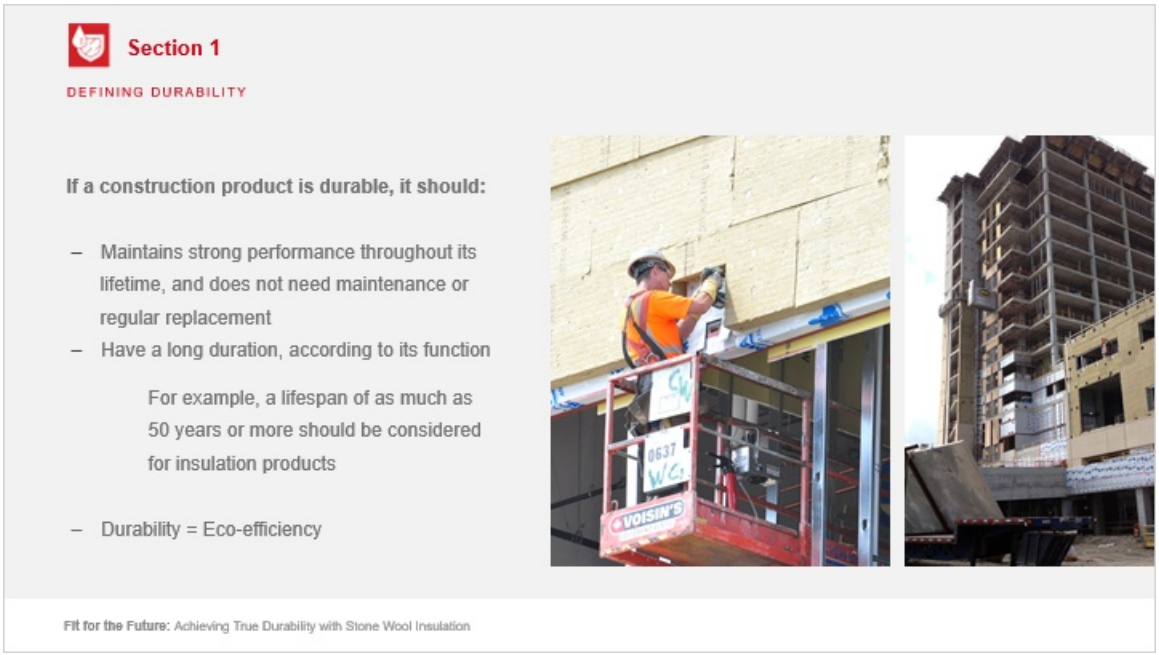
Notes:

What do we really mean by the goal of a "durable" building?

Durability can be defined as the ability of a material, system, or building to maintain its intended function for its intended life-expectancy with intended levels of maintenance in intended conditions of use.

As buildings can remain standing for many decades, it's essential that the materials used to construct them will last as well.

1.9 Defining Durability



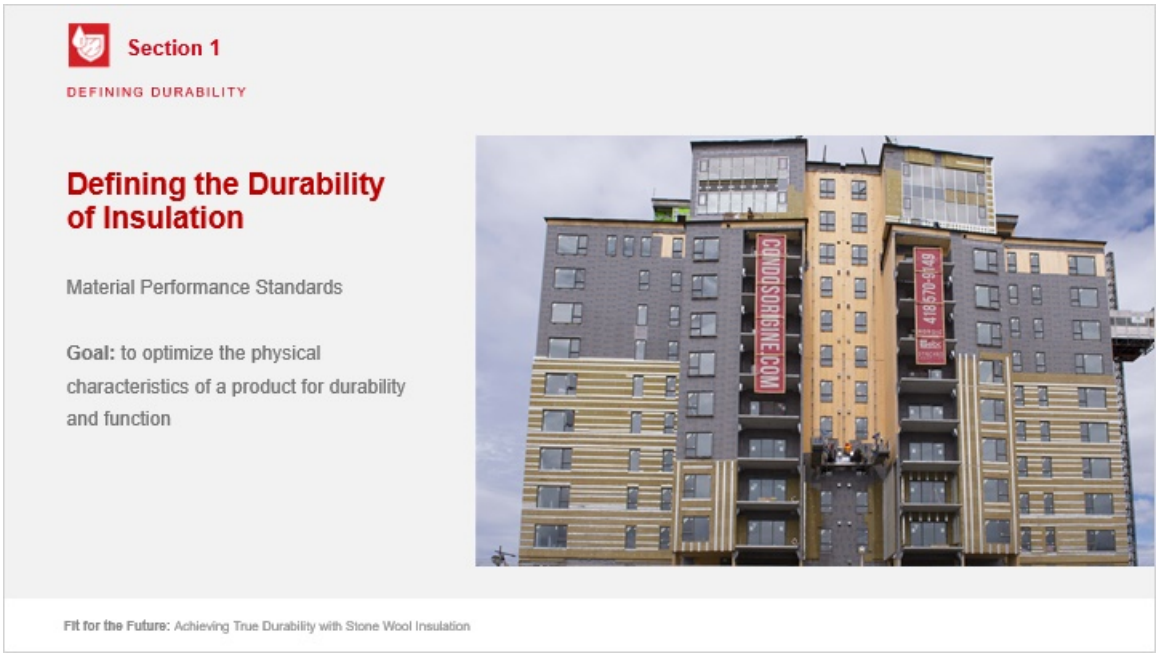
Notes:

If a construction product is durable, it should:

- Maintains strong performance throughout its lifetime, and does not need maintenance or regular replacement.
- Have a long duration, according to its function.
  - For example, a lifespan of as much as 50 years or more should be considered for insulation products.

A durable construction product that maintains a strong performance throughout its lifetime does not need maintenance or regular replacement. A durable construction product thus consumes less resources, creates less waste and its manufacturing impact is spread over long periods of time. Durability supports eco-efficiency and secures progress towards sustainable consumption and production.

1.10 Defining Durability



Notes:

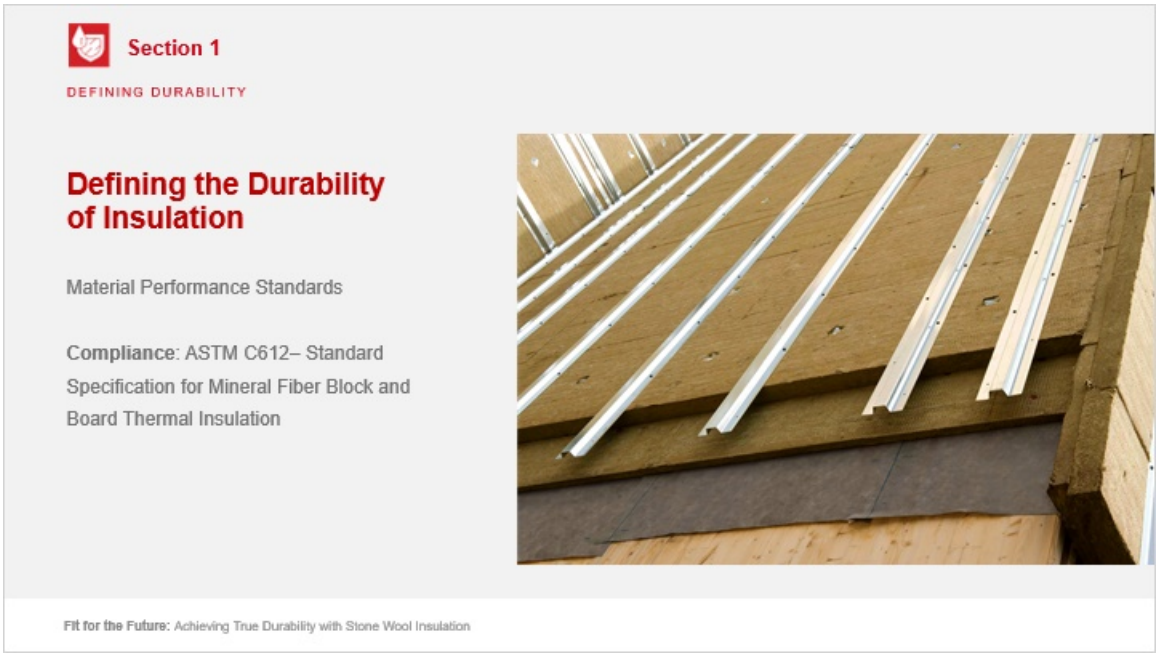
Insulation materials installed during construction usually remain in place for decades. While one can renovate a building for energy efficiency by adding or replacing insulation in some parts, it can be challenging to replace in others (such as cavity walls or below ground). It is therefore important to use a durable insulation product that will perform consistently throughout the building's lifetime.

The main purpose of insulation is to deliver a comfortable indoor environment and low heating and cooling costs. The performance of insulation products is determined by its thermal resistance (R-value).

This represents how well the insulation product can resist the heat that goes through it. Another important parameter for selecting durable insulation products is fire safety. Insulation products can have a significant impact on the fire safety both during and after construction. It is thus important that the fire safety properties of the insulation do not deteriorate over time.

Material performance standards offer a third-party way to compare attributes of insulation performance and make the best and most durable insulation choice.

1.11 Defining Durability



Notes:

Each type of insulation will have a general compliance standard. Mineral fiber block and board insulation is covered in ASTM C612.

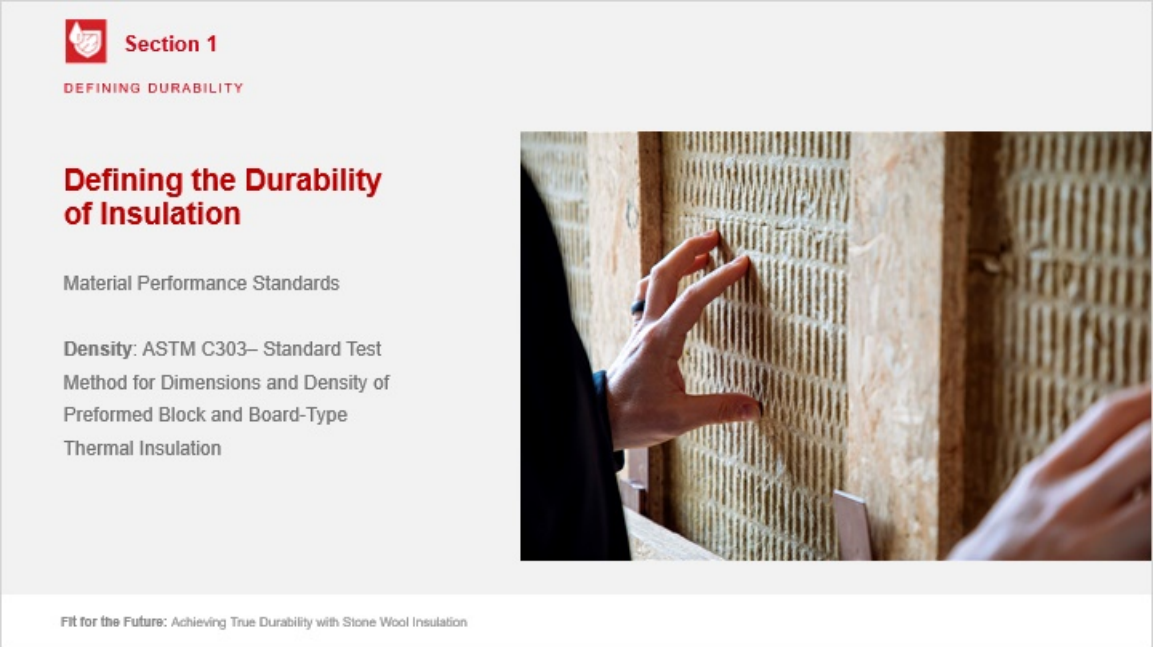
This classification is based upon the maximum use temperature, maximum apparent thermal conductivity, minimum compressive resistance, maximum linear shrinkage, maximum water vapor sorption, and maximum surface burning characteristics for the insulation.

The types are defined as Types I to V. There are two categories: Category 1 - no compressive resistance properties are required, and Category 2 - minimum compressive resistance properties are required.

ASTM C612 also lists requirements for linear shrinkage, water-vapor sorption, surface-burning characteristics, odor emission, corrosiveness to steel, rigidity, and shot (non-fibrous) content.

Mineral fiber block and board insulation that are rated under ASTM C612 have earned a satisfactory performance rating under all the tests included in the standard. This sets the bar for basic levels of expected performance.

1.12 Defining Durability



Notes:

ASTM C303 describes and tests the dimensions and density of block and board insulation. Dimensional measurements of thermal insulation are essential in determining compliance of a product with specifications. Density measurements of the tested insulation are useful in determining compliance of a product with specifications, and in providing a relative gage of product weights. For any one kind of insulation, some important physical and mechanical properties, such as thermal conductivity, heat capacity, and compressive strength bear a specific relationship with its density.

Again, it is important to remember that these analyses allow for optimizing the physical characteristics of the product, to in turn optimize its durability and function.

1.13 Defining Durability

Section 1

DEFINING DURABILITY

Defining the Durability of Insulation

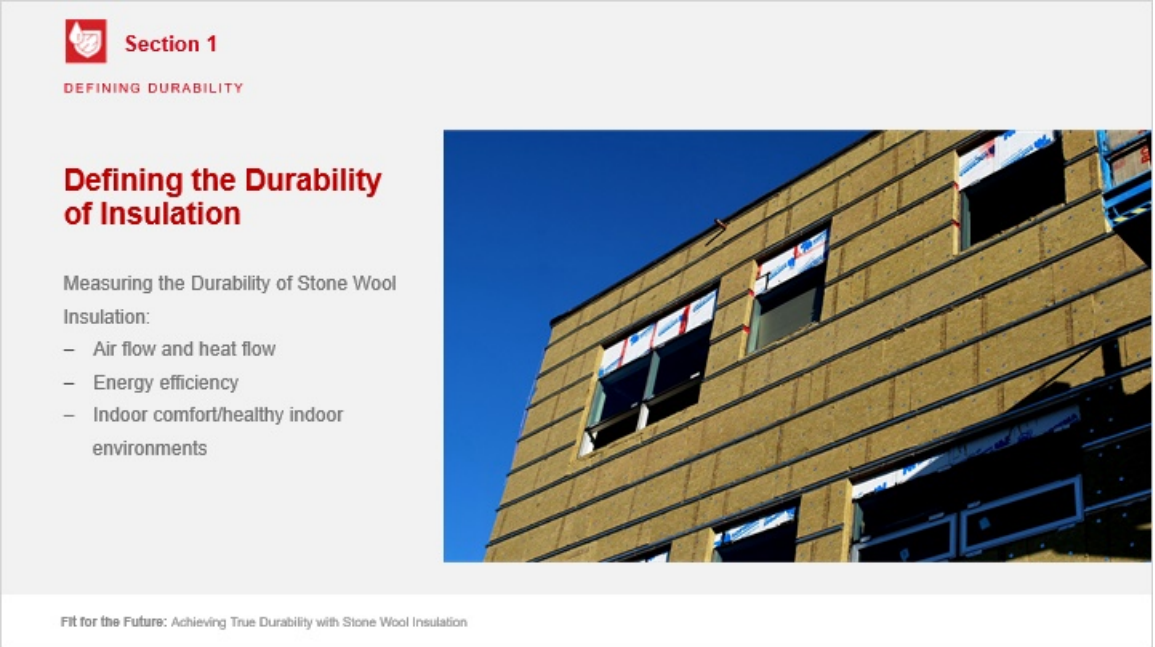
Material Performance Standards

Thermal Resistance: ASTM C518– Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

Notes:

ASTM C518 analyzes the thermal conductivity (k-Value) and thermal resistance (R-Value) of an insulation product. These values can be used to determine energy losses through a material. This test is used to satisfy R-Value regulations for insulation materials.

1.14 Defining Durability



Notes:

Quality stone wool insulation products will have a satisfactory performance under ASTM C612, C303, and C518. However, if a product is durable, it can endure continued use over a long period, maintaining a constant performance.

Stone wool's constant R-value helps avoid unexpected increased heating and cooling expenses caused by insulation capabilities degrading over time. The thermal performance of an insulation product over time can best be measured by real-life sampling. This refers to extracting samples from existing buildings and measuring the thermal resistance (R-value). Should the product continue to have the same value as before installation, its thermal performance should be deemed as durable.

In some cases, different types of accelerated aging tests can be used to determine durability. Data from such tests should always be treated with caution as the quality of data from such tests can vary widely and may be unreliable. Real-life sampling has proven that stone wool's thermal performance remains constant over time. The consistent thermal performance of walls, floors and the roof is crucial to ensuring that a building is not suddenly facing increased bills for heating or cooling after several years of use.

Stone wool insulation has a unique physical structure, which keeps its shape and toughness despite changes in temperature or humidity. This dimensional stability means its performance is unchanged, decade after decade, ensuring maintenance savings throughout a building's lifetime. Stone wool insulation uses its unique fiber structure to adapt to all types of irregularities, leaving no gaps in the insulation layer and no sagging. The unique fiber structure also prevents no gaps developing between boards over time. This helps keep heat or fresh air in, preserving indoor comfort. This also helps with temperature maintenance: Temperature maintenance can dramatically reduce heating, cooling, and ventilation costs, and reduce a building's carbon footprint.

1.15 Defining Durability

Section 1

DEFINING DURABILITY

Threats to Insulation Durability

Corrosion

ASTM C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

ASTM C665 – Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

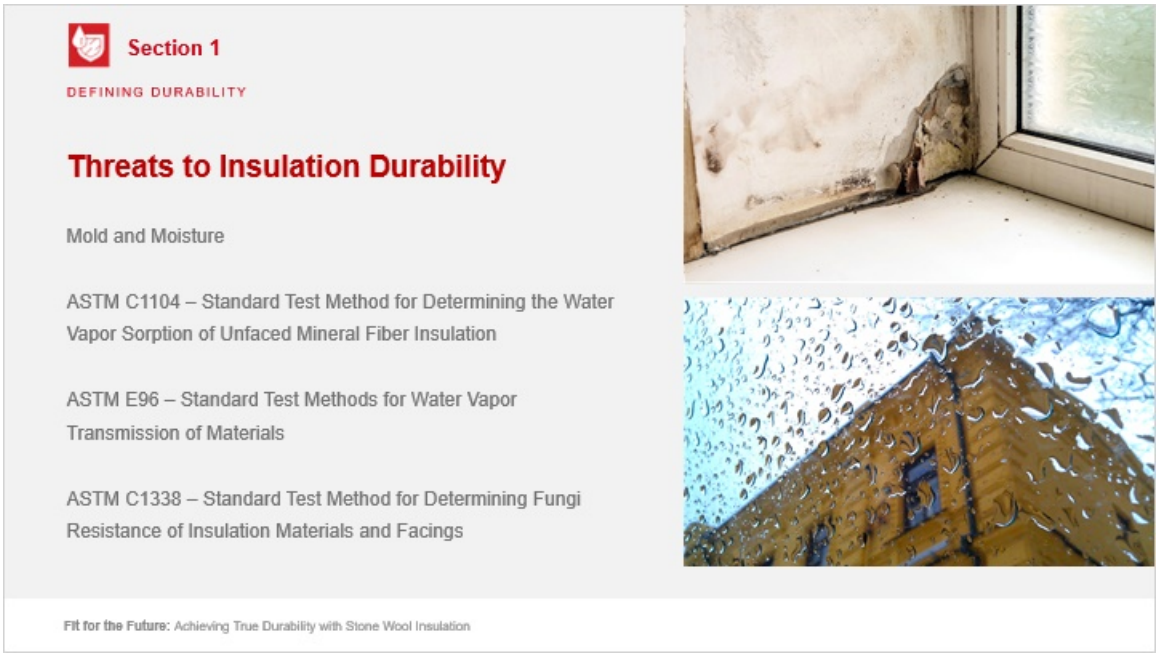
Notes:

Corrosion is defined as the destructive and unintentional degradation of a material caused by its environment. A common type of corrosion is rust, which affects iron and steel structures. When exposed to moisture, some types of insulation products can release components that increase corrosion on metal surfaces.

Corrosion of metal structures, for example, steel deck roofs, can lead to extensive damage, sometimes even resulting in the collapse of the structure.

Stone wool does not promote corrosion, and will not be impacted by corrosion. Stone wool is tested for corrosion against ASTM C795 and C665

1.16 Defining Durability

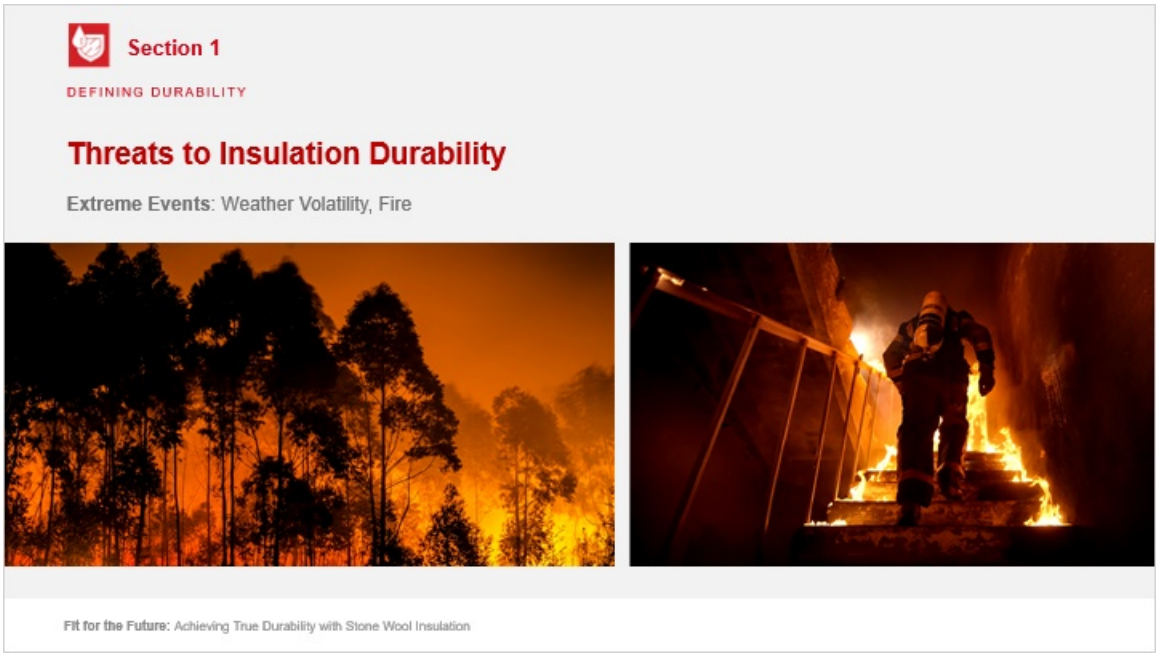


Notes:

When it comes to buildings, moisture can often be the cause of major problems, including mold, rot and corrosion. In construction projects, it's essential to select insulation materials that do not absorb moisture if they are exposed to water. A inorganic, vapor permeable insulation with excellent drying potential helps avoid mold and mildew, caused by high humidity levels, particularly in moist rooms such as bathrooms and kitchens.

Stone wool is water repellent, meaning it resists water absorption. Water repellency is one of the key properties of stone wool insulation. Stone wool insulation is a non-hygroscopic material, meaning it does not take up and retain moisture from the air. As a result, under normal circumstances, moisture has no influence on the product's thermal and structural performance. At the same time, there is no influence on the product's durability either, so its ability to withstand wear and pressure remains unaffected. If stone wool insulation does get wet, it will retain its original properties if allowed to fully dry out. It is also mold resistant and will not promote the growth of mold or fungi.

1.17 Defining Durability

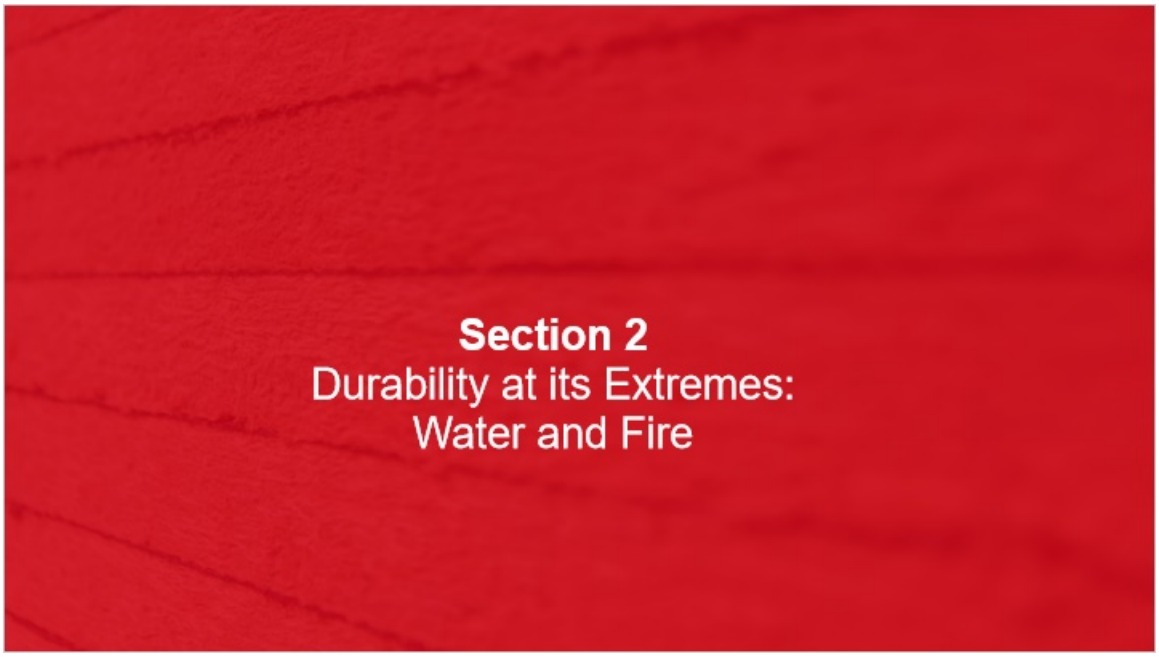


Notes:

Most conceptions of durability deal with how a product will perform on an average day in a building. The best insulation is one that can satisfy all of these benchmarks through it's expected life of 50 years or more.

However, to truly be a long term, lasting material, a product must be able to confront extreme weather events such as flooding, and hazards like a fire, and not endanger a building.

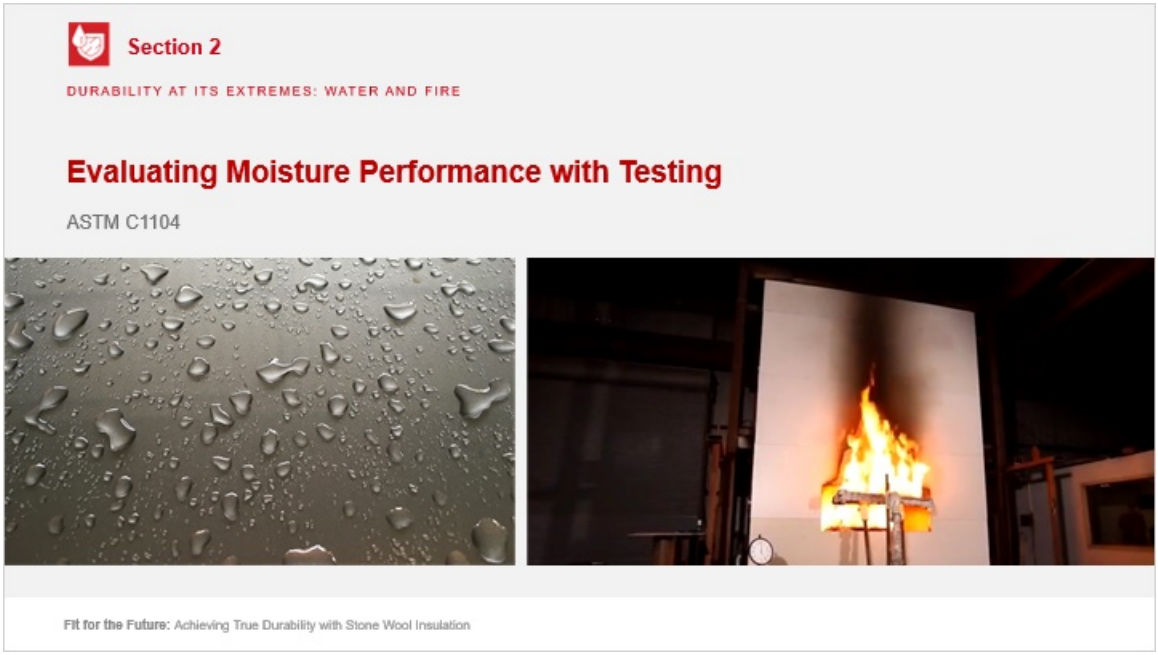
1.18 Section 2



Notes:

Section 2 Durability at its Extremes: Water and Fire

1.19 Durability at its Extremes: Water and Fire



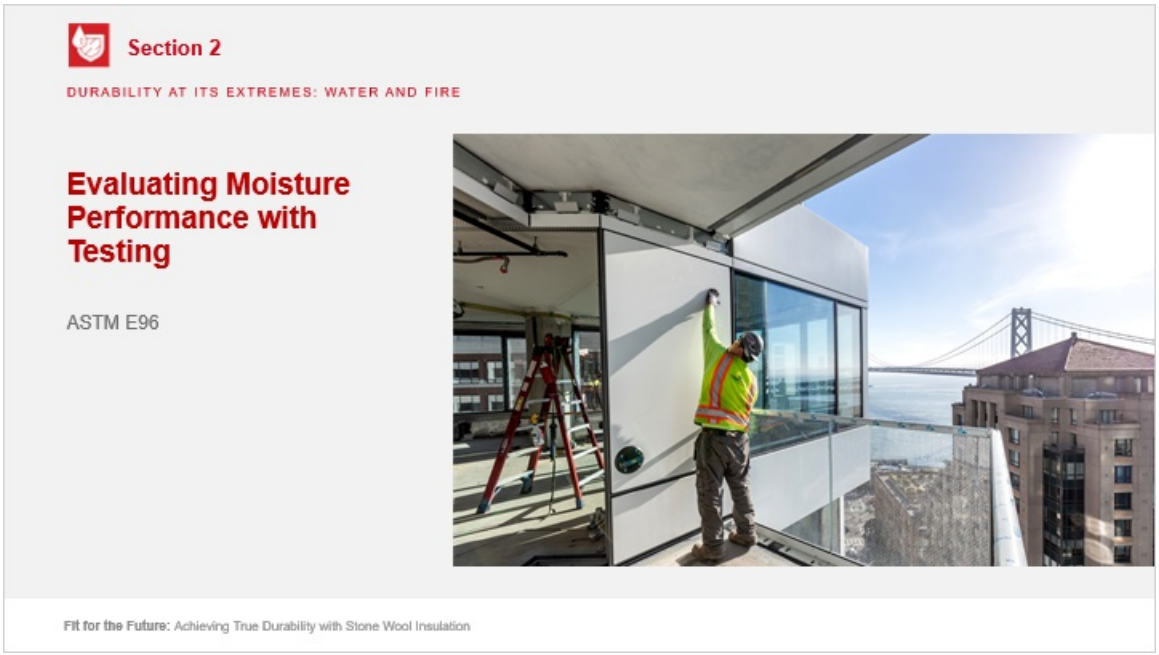
Notes:

The presence of water in an insulation product will significantly deteriorate its insulation properties. An insulation product that stays free from moisture has a more constant overall thermal performance. Thermal performance is determined by the thermal resistance R-value, which is a measure of temperature difference and shows how much the material resists to a heat flow.

Evaluating the moisture performance of insulation begins with analyzing how increased moisture content affects the makeup of the insulation. The sorption of water can result in an increase in weight and a resultant potential degradation of the properties of the insulation.

ASTM C1104 offers a way to assess how insulation material behaves around moisture. This test method determines the amount of water vapor sorbed by mineral fiber insulation exposed to a high-humidity atmosphere. A higher absorption by the insulation can lead to compromised performance.

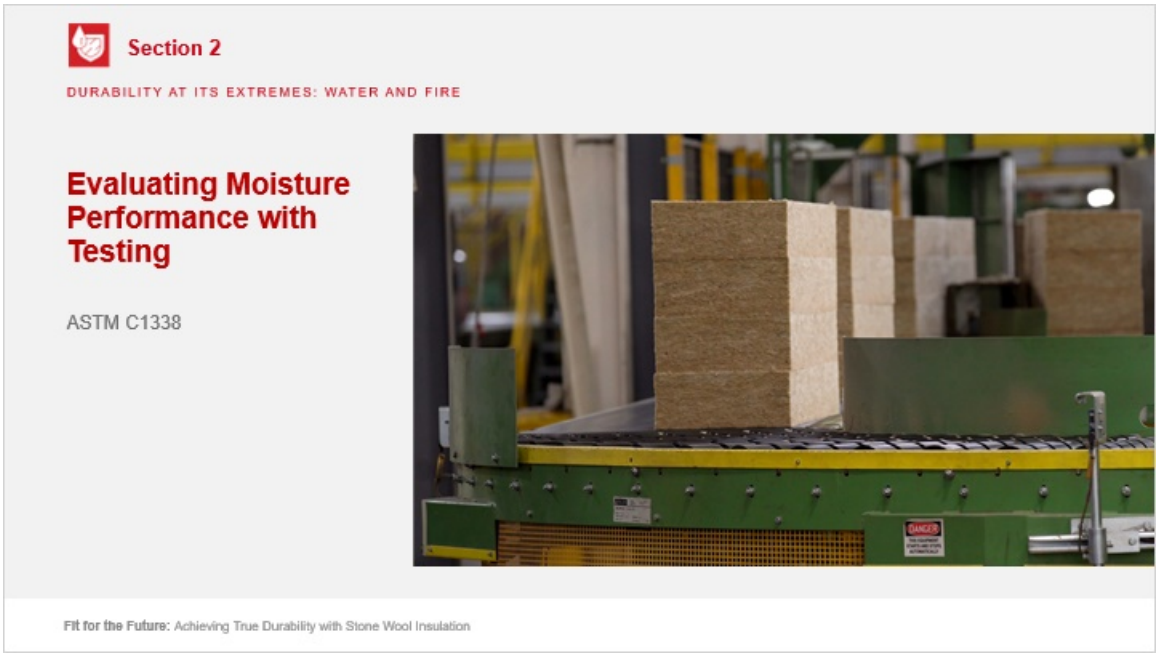
1.20 Durability at its Extremes: Water and Fire



Notes:

ASTM E96 offers another window into how insulation reacts to moisture. ASTM E96 compares transmission of water vapor at different relative humidities. It offers a window into vapor resistance of insulation. This allows for analysis of how insulation may perform in high humidity environments versus lower humidity environments.

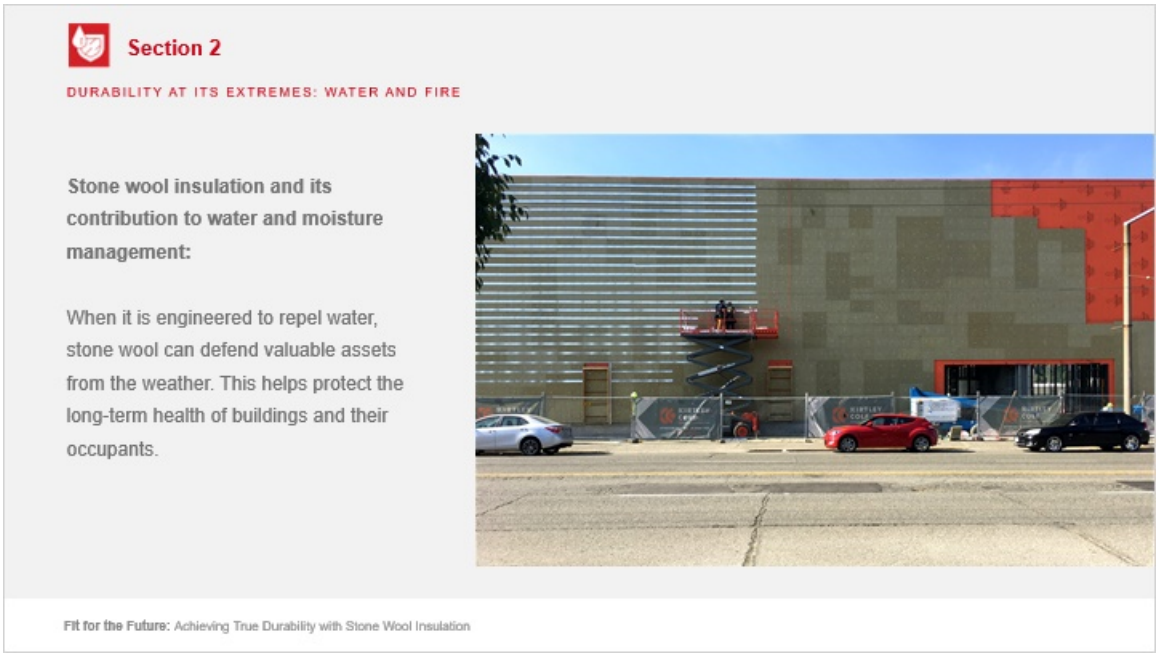
1.21 Durability at its Extremes: Water and Fire



Notes:

ASTM C1338 looks at how resistant insulation is to fungal growth. This analysis is especially important where insulation will face constant exposure to moisture and high relative humidity, conditions that promote fungi. Insulation that does not resist fungal growth can lead to decay in the structure and generate serious health concerns for building occupants.

1.22 Durability at its Extremes: Water and Fire



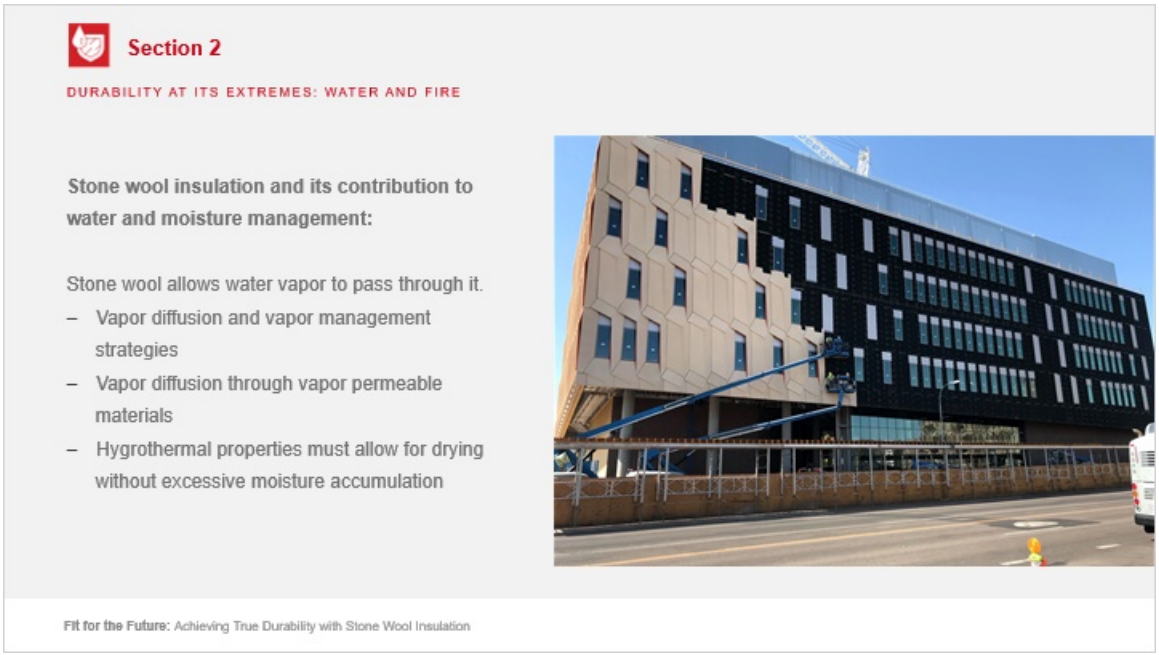
Notes:

When it comes to buildings, water can often be the cause of major problems, including mold, rot, and corrosion. In construction projects, it's essential that insulation materials do not absorb moisture if they are exposed to water.

Stone wool insulation is one of these materials. Water repellency is one of the key properties of stone wool insulation.

Stone wool insulation has a unique physical structure, which keeps its shape and toughness despite changes in temperature or humidity. This dimensional stability keeps its performance unchanged, decade after decade, ensuring maintenance savings throughout a building's lifetime. Additionally, a water repelling light oil is mixed with the fibers during stone wool's production process, making it able to repel water. The inherent water-repellent properties of these ingredients provide stone wool with an excellent ability to resist water absorption and moisture effects.

1.23 Durability at its Extremes: Water and Fire



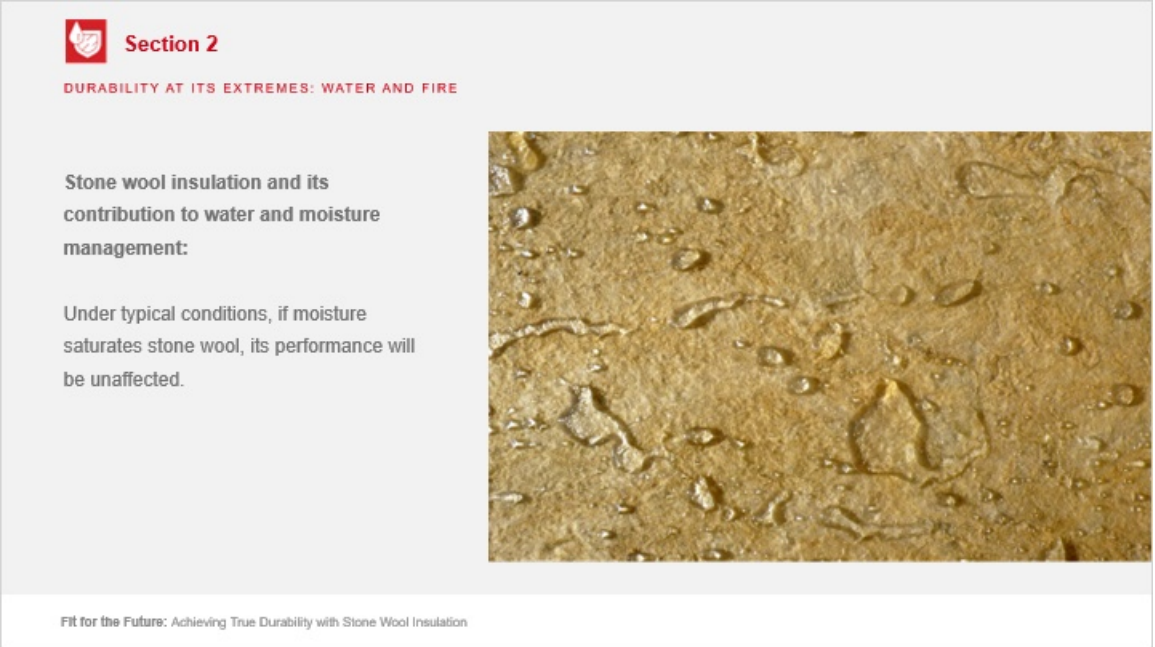
Notes:

Stone wool is vapor-permeable, which means it allows moisture to pass through walls and out of the building. A non-organic, vapor permeable insulation with excellent drying potential such as stone wool also helps avoid mold and mildew, caused by high humidity levels, particularly in moist rooms such as bathrooms and kitchens. This protects buildings against rot, mold, and humidity damage. It also protects against moisture intrusion during construction, allowing any moisture that inadvertently contacts the insulation to quickly dry out before the assembly is completed.

The permeability of stone wool bolsters its durability performance, meaning stone wool does not suffer from humidity, as samples collected from real buildings have proven. Stone wool is a 98 percent porous material, meaning it is an open material, unlike a closed-cell structure. This is why it is defined as vapor permeable.

To compare vapor permeable insulation, which allows for diffusion, to vapor impermeable materials is similar to wearing a breathable and waterproof jacket instead of a regular plastic raincoat. The difference lies in the fact that, if you sweat, the fabric will allow the vapor to pass through and dry out. With a regular plastic raincoat however, you will remain sweaty unless you take it off.

1.24 Durability at its Extremes: Water and Fire

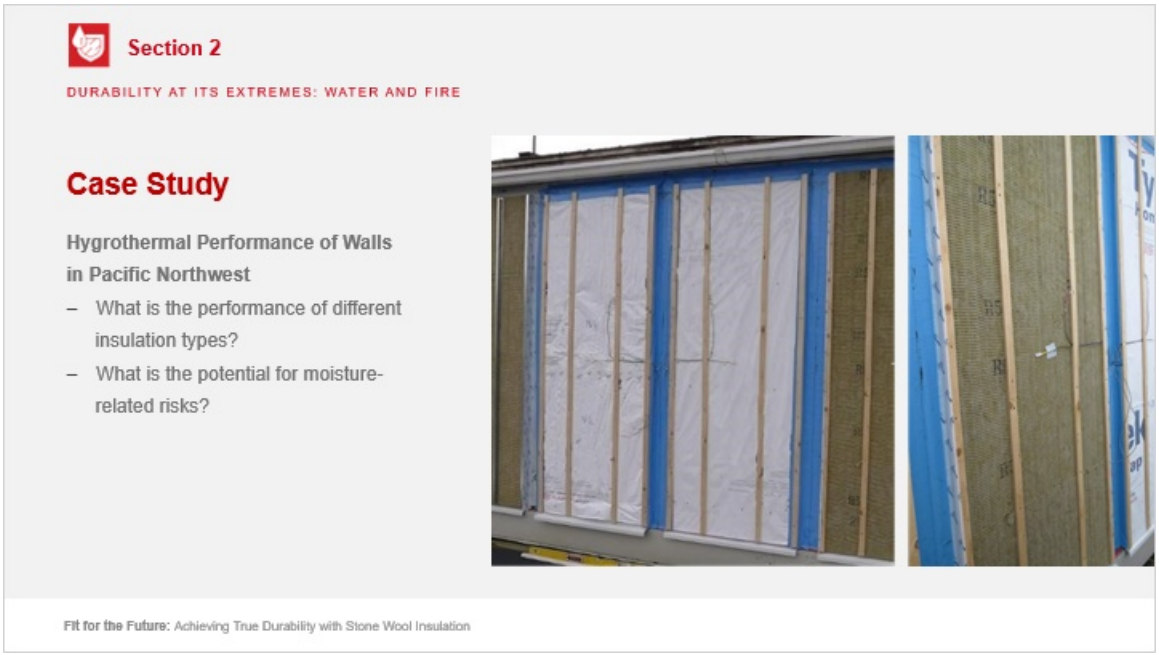


Notes:

As part of a structure that separates the indoor and outdoor environments, stone wool is designed to act under different temperatures. Any moisture present will naturally and quickly migrate to the cold external side of the material and evaporate, if the boundary is open and ventilated, as in ventilated facade systems, for example.

In general, building structures should be designed in a manner that avoids build-up of moisture, and allows the drying of excess water. If this is not the case, moisture will gather as a thin layer of water on the external surface of the insulation layer and will likely also evaporate, but at a slower rate. This means that the product will essentially be left dry and its thermal performance will remain unaffected. In all cases, care has to be taken that the other construction layers and materials are not damaged.

1.25 Durability at its Extremes: Water and Fire



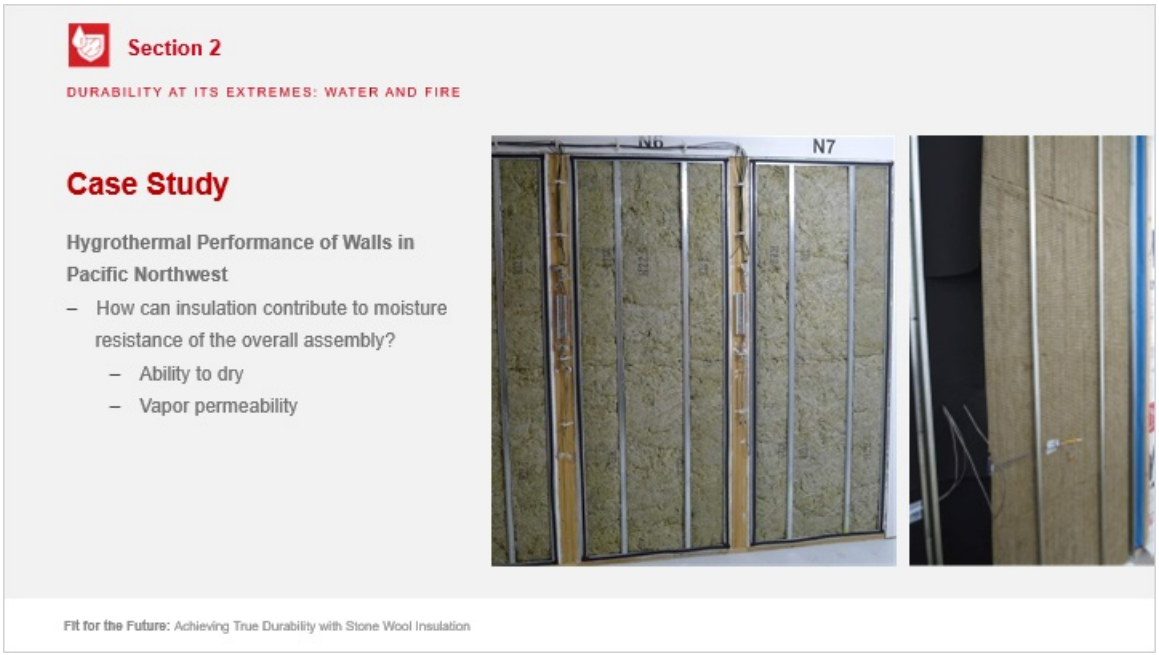
Notes:

A multi-year hygrothermal comparison was conducted on three steel stud wall assemblies, using three different types of continuous exterior insulation. The purpose of the study was to evaluate the performance of exterior insulation in the Pacific Northwest climate and compare the actual, on-site performance of the different insulation types, while also assessing the potential for moisture related risks. An additional hygrothermal analysis was conducted on multiple residential type wood framed assemblies in the Pacific Northwest climate. The primary purpose of the study was to assess the hygrothermal performance of a flow-through assembly; secondary analysis compared performance of fiberglass insulation.

The assemblies were constructed on both the North and South orientations of the test facility. Each test wall was outfitted with a series of temperature (T), relative humidity (RH), and wood moisture content (MC)2 sensors; and continuously monitored throughout the full testing period.

Testing would look at performance under standard conditions and temperatures and durability after a unique event from direct contact with water, mimicking a leaking window during a severe rain storm. Was the threshold for mold growth reached? How did the insulation maintain its performance?

1.26 Durability at its Extremes: Water and Fire



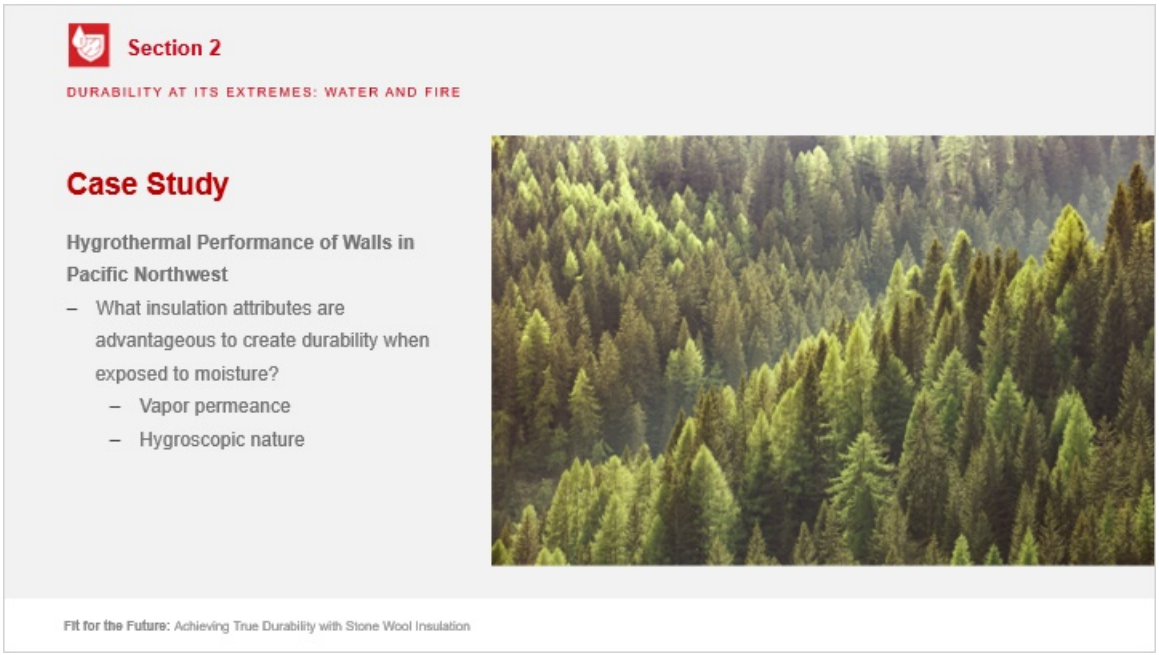
Notes:

Testing found, first, that the higher its capability to dry, the better and more durable the insulation will be.

Overall, the hygrothermal performance analysis indicates that using stone wool insulation resulted in a lower risk for moisture accumulation when compared to assemblies using foam insulation. This is due to the high vapor permeance of stone wool insulation, which enables the assembly to dry out approximately twice as fast, when compared to foam assemblies. Moreover, under intentional water insertion into the assembly which would be representative of leaks that may occur, mainly at penetrations and connections, the stone wool assembly has a demonstrates a significantly higher drying capability over the other assemblies.

Using a vapor permeable stone wool solution enables higher drying potential and lower risks of moisture accumulation when an assembly is subjected to water penetration (such as leaks at windows and connection details).

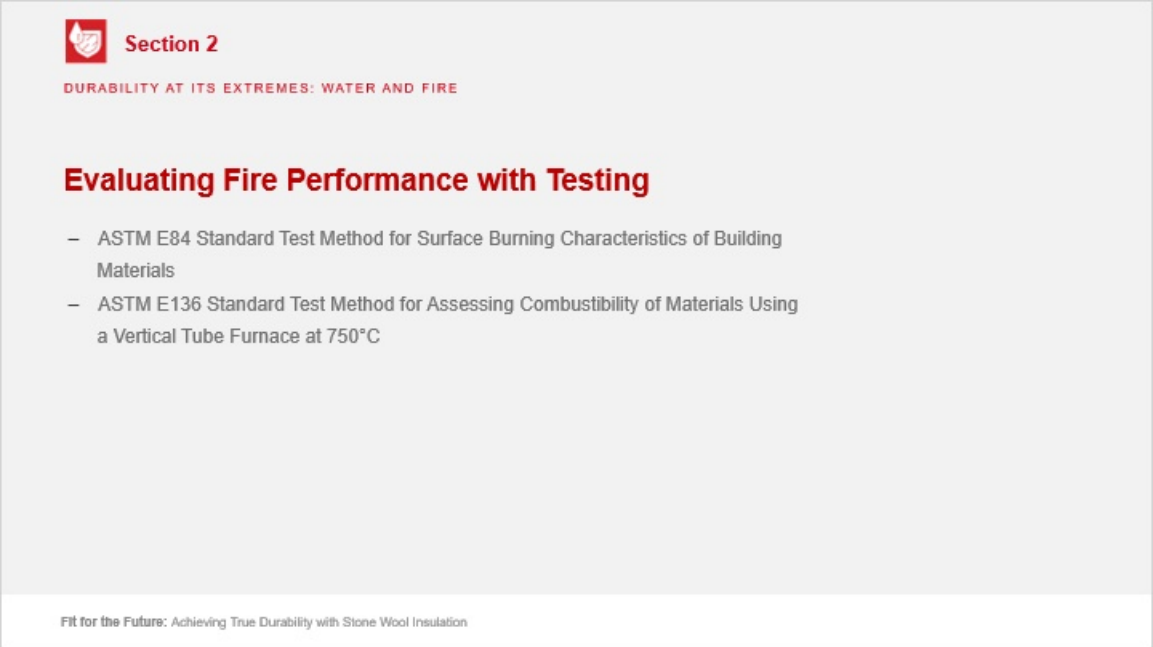
1.27 Durability at its Extremes: Water and Fire



Notes:

The insulation analysis in the Pacific Northwest - a wet, cool, and humid environment - showed the benefits of a vapor permeable insulation, which improved the systems ability to dry and can maintain better performance in the face of the challenging Pacific Northwest environment. This keeps the entire wall healthy for a longer period of time. Additionally, insulation that is repellant to water, or that has a durable structure unaffected by the presence of moisture, maintains better performance in the face of challenging environments.

1.28 Durability at its Extremes: Water and Fire



Notes:

In land-scarce urban areas, more and more people are working and making their homes in high-rise buildings. These structures can be brilliant solutions to the challenge of safely housing a growing population. But if a fire strikes in a high-rise, the consequences can be very serious.

Insulation products can have a significant impact on the fire safety of a construction. It is thus important that the fire safety properties of insulation do not deteriorate over time. An ideal insulation will be noncombustible, which improves the fire resistance of construction elements, resulting in extra time for safe escape in case of a fire. The fire resistance properties of insulation should be verified to remain unchanged during the life of the building.

ASTM E84 assesses the surface burning characteristics of a building material.

The best insulation for fire performance should earn a 0/0 flame/smoke, meaning that it has minimal to no impact on flame spread and zero to minimal contribution to the creation of smoke.

ASTM E136 determines the combustibility of an individual building material. Any material which passes ASTM E136 is classified as noncombustible. To aid in the performance of a wall assembly against fire, an insulation should be classified as noncombustible.

1.29 Durability at its Extremes: Water and Fire

Notes:

Noncombustible insulation materials, such as stone wool, play a crucial role in improving the fire-resistance of buildings, boasting good thermal properties that help limit the spread of fire and assist in ensuring a safer environment for all residents.

Additional fire performance tests include NFPA 285, ASTM E119, ASTM E2307, and NFPA 275. Combining these tests allows for a clearer picture of how individual products will perform in the event of a fire and how the assembly of a wall or ceiling works in concert during a fire.

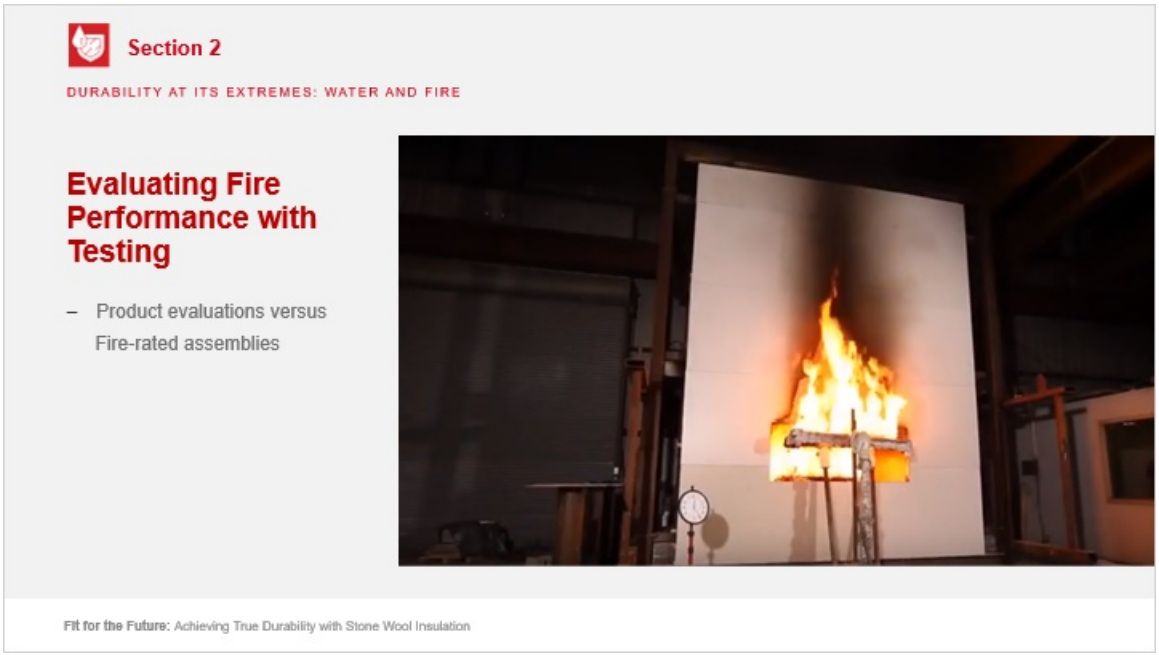
NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components, provides a test method for determining the fire propagation characteristics of exterior wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components.

ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, is intended to evaluate the duration for which the types of building elements, acting together, contain a fire, retain their structural integrity, or exhibit both properties during a predetermined test exposure.

ASTM E2307 Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multistory Test Apparatus, takes the analysis of ASTM E119 and expands it, applying it to taller building assemblies. This test method provides for the following measurements and evaluations: the movement capacity of the perimeter fire barrier, the loadbearing capacity of the perimeter joint protection, the ability of the perimeter fire barrier to resist the passage of flames and hot gases, and the transmission of heat through the perimeter fire barrier.

Finally, NFPA 275, Standard Method Of Fire Tests For The Evaluation Of Thermal Barriers, looks specifically at qualifying the fire performance of a thermal barrier, to evaluate its ability to prevent ignition from a standard fire exposure or delay its occurrence. In this test, only the thermal barrier, rather than the entire assembly, is evaluated.

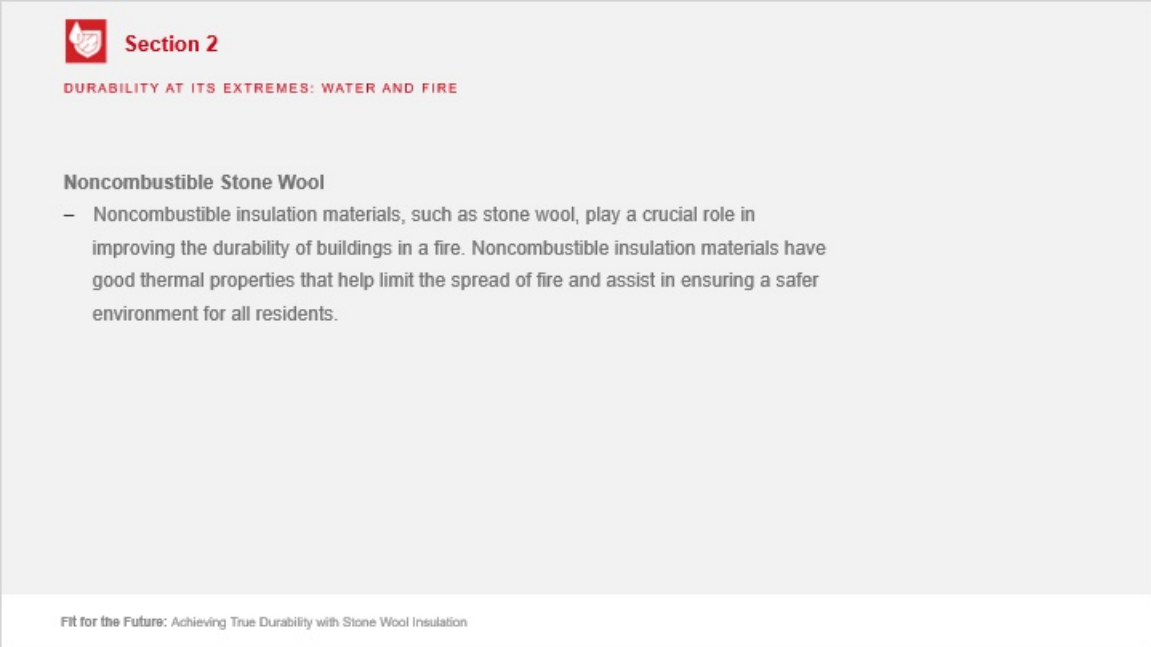
1.30 Durability at its Extremes: Water and Fire



Notes:

It is very important to note that fire-rated assemblies must be tested together as a whole to be designated as a “fire-rated assembly” - from framing, insulation, barriers, and cladding. An individual product, like insulation, may be classified as noncombustible, but the presence of that single component does not guarantee a good fire performance from the entire building assembly.

1.31 Durability at its Extremes: Water and Fire



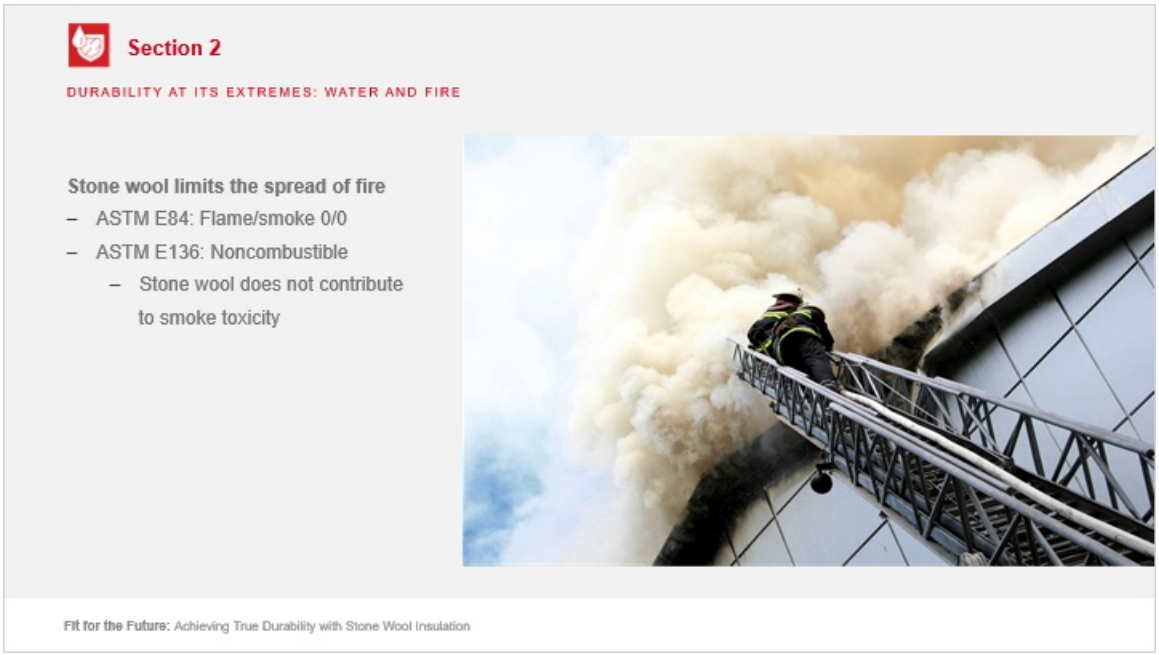
Notes:

How does stone wool insulation perform in the case of a fire?

Noncombustible insulation materials, such as stone wool, play a crucial role in improving the durability of buildings in a fire. Noncombustible insulation materials have good thermal properties that help limit the spread of fire and assist in ensuring a safer environment for all residents. Stone wool insulation is a key component in fire-rated assemblies tested per ASTM E119 and perimeter joint containment systems tested to E2307.

There is an added level of design freedom when using noncombustible insulation in assemblies, as these materials do not trigger new testing requirements or evaluations when updating insulation levels. Stone wool's fire performance properties are also advantageous in cities, where designing for close lot line considerations is a must and where added fire protection is often needed to prevent fire spread between buildings.

1.32 Durability at its Extremes: Water and Fire



Notes:

Construction products and building elements made with stone wool have been proven to be fire resistant.

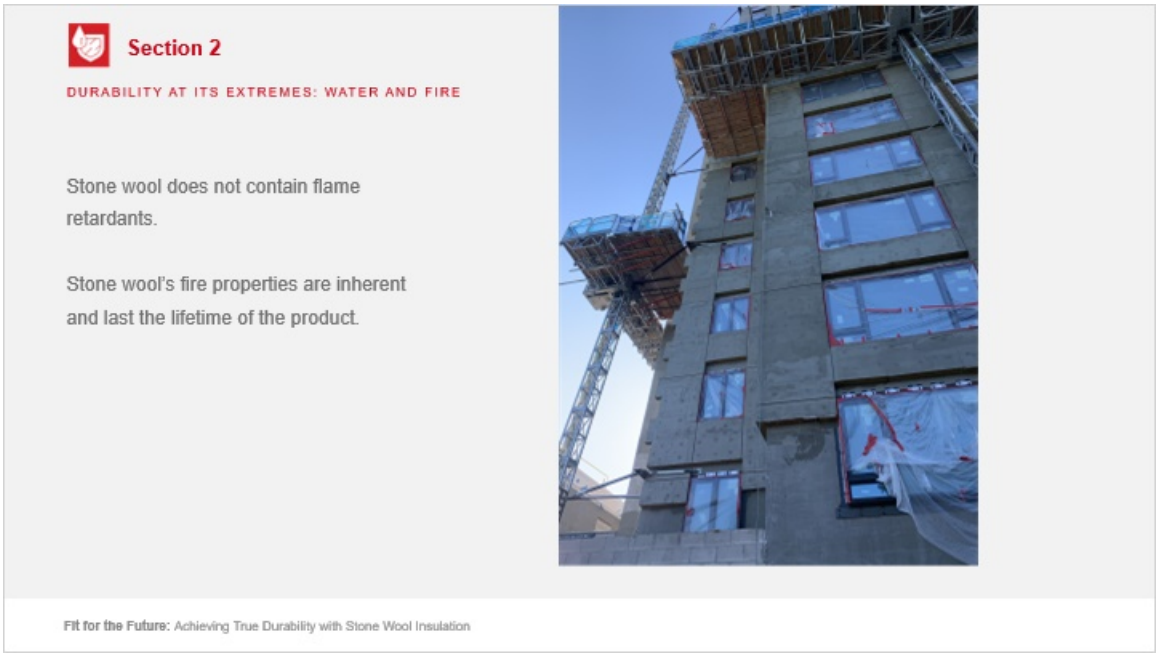
Stone wool is typically classified as a noncombustible material, which means it has minimal or zero contribution to the spread of fire. Stone wool insulation will not ignite when exposed to flames and can prevent fire from spreading to other materials. By limiting fire spread, stone wool also contributes in assuring the safe escape of buildings' occupants and first responders' intervention.

Stone wool insulation helps to ensure the integrity of the building structure and to reducing the transfer of heat to another space for long periods of time (over 90 minutes in many cases) during a fire.

These characteristics stem from stone wool's very high melting point (over 1,832°F) and excellent thermal insulation properties. Stone wool is a natural fire barrier and is often used to protect combustible elements as well as steel structures from fire that gives residents more time to evacuate the building and to firefighters a safer environment to extinguish the fire and rescue people.

Inhaling toxic smoke from fires can be extremely dangerous and is the cause of most fire-related casualties. In sufficiently high concentrations over a long enough time, toxic smoke creates hazardous health conditions for people exposed to it and may impede their ability to rescue themselves from the fire. Various tests have shown that stone wool does not produce significant amounts of toxic smoke and makes a negligible contribution to fire toxicity in comparison to other insulation materials. This is also due to the very low organic content of stone wool insulation (approximately three percent, compared to up to 100 percent in other products).

1.33 Durability at its Extremes: Water and Fire



Notes:

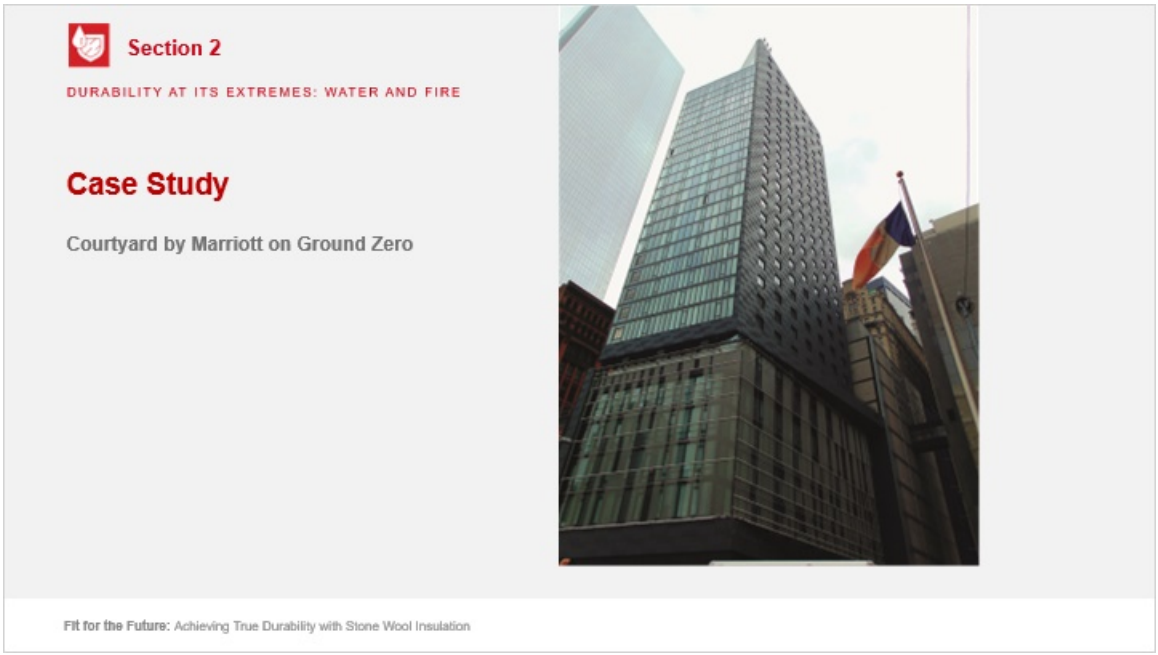
Flame retardants are chemicals that are added or applied to materials in order to slow or prevent the start or growth of fire. They have been used in many consumer and industrial products since the 1970s, to decrease the ability of materials to ignite. Although there are many types of flame retardants, research has shown that some of the chemicals can have a negative impact on health and environment. Additionally, while flame retardants may delay ignition, once a fire has started, they have little effect. Much of the toxic smoke development seen in fires is due to the flame retardants.

Stone wool is naturally fire resistant, which means that flame retardants are not needed.

Stone wool's fire properties are built to last.

The fire safety performance of stone wool lasts a lifetime, with no maintenance required. A FIW München durability study revealed that stone wool samples retained the same mechanical and thermal properties and thus fire resistance, more than 55 years after installation.

1.34 Durability at its Extremes: Water and Fire



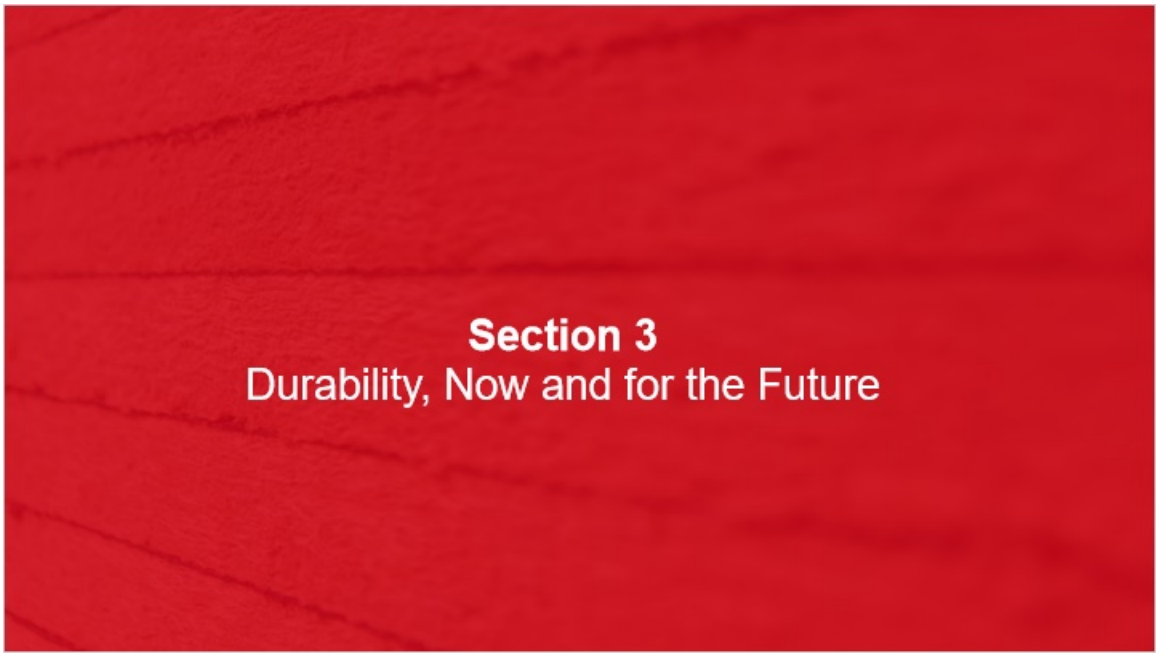
Notes:

So that a Manhattan hotel could meet both fire safety standards and New York City's ambitious energy targets, stone wool insulation was chosen as part of a fire-resilient solution for the inner and outer walls.

With the safety of guests being their number one priority, Marriott selected fire-resilient insulation for the exterior walls of its 31-story Courtyard by Marriott hotel on Ground Zero. The walls also had the added benefit of enhancing thermal and acoustic comfort both within each room and in the communal spaces.

Additionally, stone wool aided in meeting energy profile goals. New York City has set itself the ambitious target of halving CO2 emissions by 2030. Around 75 percent of greenhouse gas emissions in the city come from buildings, 90 percent of which are from heating and cooling. Stone wool insulation had the added advantage of highly energy-efficient performance, on top of certified fire performance.

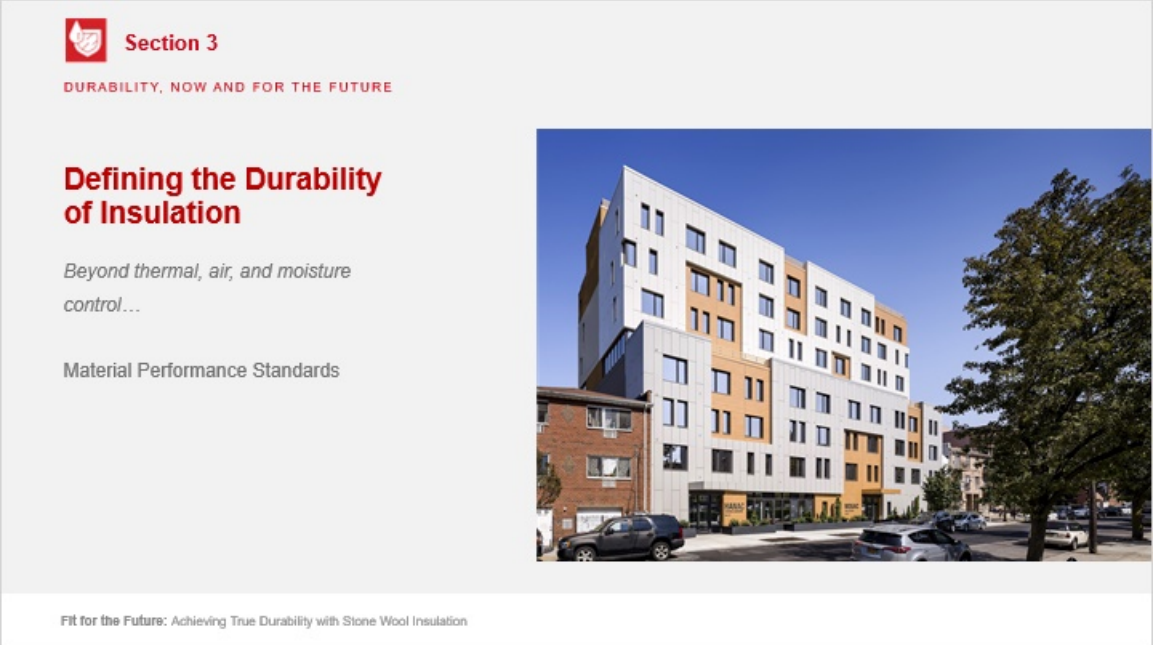
1.35 Section 3



Notes:

Section 3 Durability, Now and for the Future

1.36 Durability, Now and for the Future



Notes:

If a product is durable, it can endure continued use over a long period, maintaining a constant performance.

Durability is an important factor when selecting a construction material for your house. A durable construction product will last the lifetime of the building, and will not require maintenance.

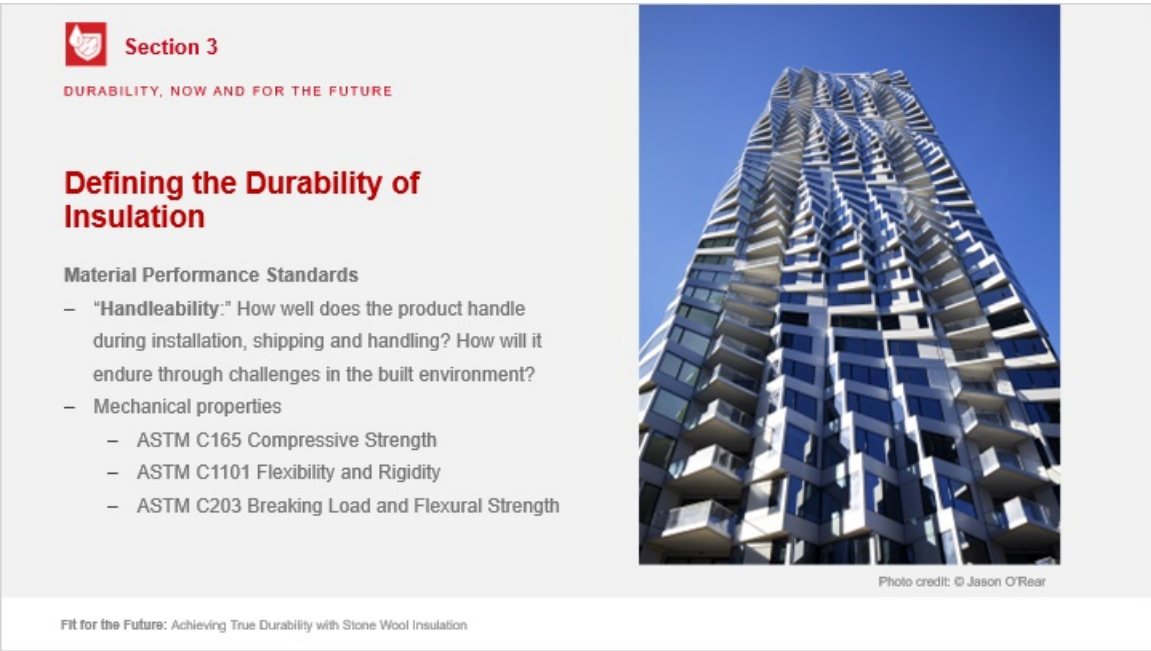
There are two main aspects of durability

If a construction product is durable, it should:

Maintain a constant performance in all important aspects (such as thermal, mechanical, or fire resistance).

Have a long duration, according to its function (for example, a lifespan of as much as 50 years or more should be considered for insulation products).

1.37 Durability, Now and for the Future



Notes:

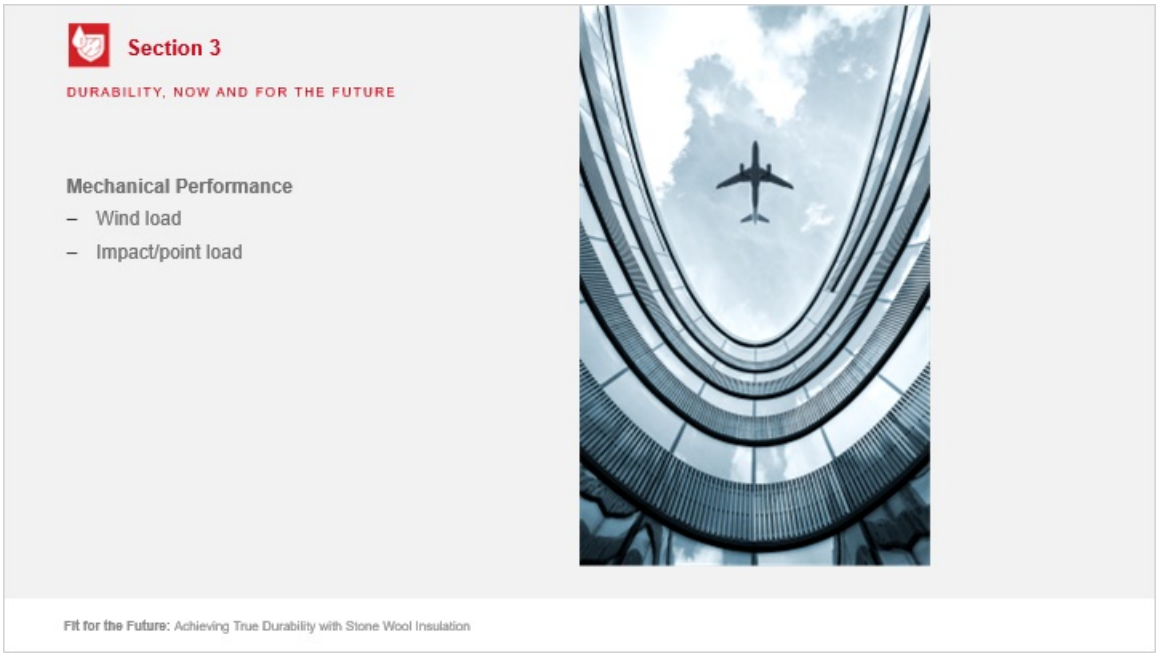
The mechanical performance of an insulation product should be designed in accordance with the application the product will be used for. It is important to consider the type of construction, the use, and the surrounding conditions, to make the most informed decision on the mechanical performance needed.

Compressive strength analysis (ASTM C165) reveals how different types of thermal insulation behave under compressive load. This test is particularly useful where insulation may experience foot traffic or repeated handling and impacts. This can also provide a lens into how insulation types may weather creep, fatigue, and repeated cycling.

ASTM C1101 tests and compares insulation, classifying it on a scale from flexible to rigid. This classification is useful in establishing installation and application characteristics of insulation. More flexible insulation can adapt to unique sizes and applications but may have trouble retaining its structure under repeated pressures; rigid insulation can maintain shape but needs to demonstrate how it reacts to impact.

ASTM C203 addresses impacts: its test methods are to be used to determine the resistance of some types of preformed block insulation when transverse loads are normally applied to the surface. Values are measured at the maximum load or breaking point under specified conditions or specimen size, span between supports, and rate of load application. Flexural strength is also tested under C203.

1.38 Durability, Now and for the Future



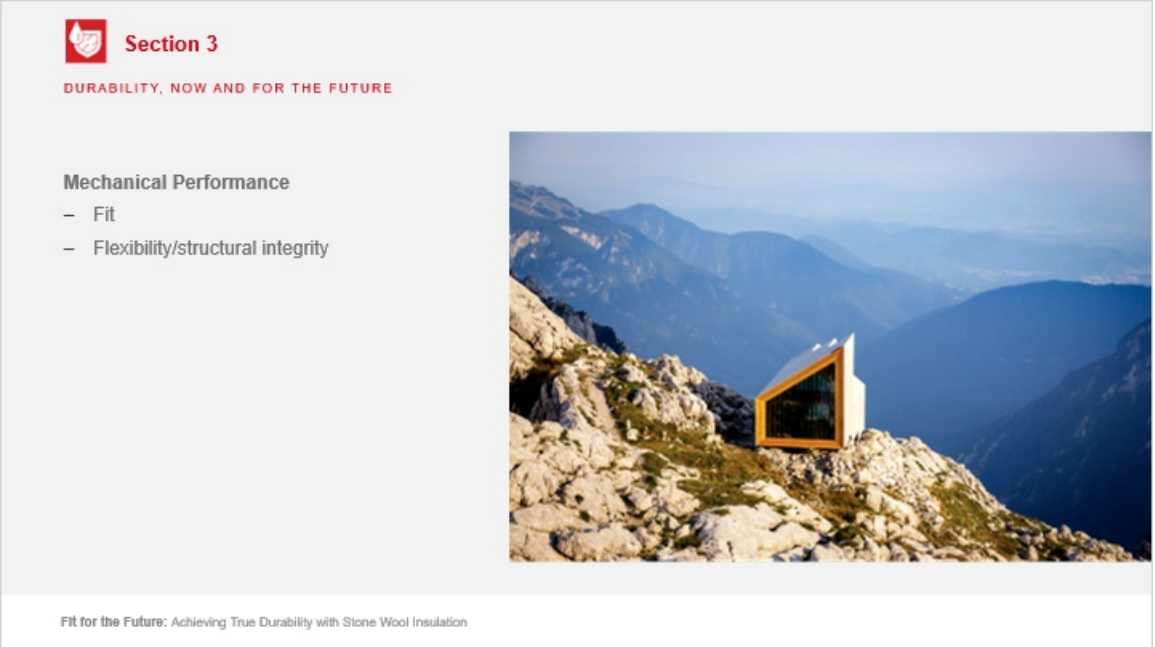
Notes:

Buildings react to wind load as a system, with each layer either aiding or detracting from how the structure deals with air infiltration, pressures, and force. Insulation can be designed to improve the resistance of the panel to wind load suction. More dense and more flexible insulation products, like a dual density stone wool insulation, have demonstrated performance in protecting buildings from wind washing, air infiltration, and pressure loads.

When it comes to insulation placed on roofs, insulation is available in a compressive strength that is optimized to best fit the usage. Impacts, or point loads, faced by roof insulation include a permanent point load, such as a PV panel, and temporary point loads, such as the heels of people walking on the roof for maintenance reasons. Insulation that uses a dual density technology, with a more rigid upper crust, which improves mechanical behavior, especially with concentrated loads (point load), by sharing the load on a wider surface portion.

What is unique with stone wool insulation is that its mechanical performance can be designed to fit different types of applications. High compressive strength can only be an advantage in certain types of constructions whilst in others it can lead to poor fit-ability.

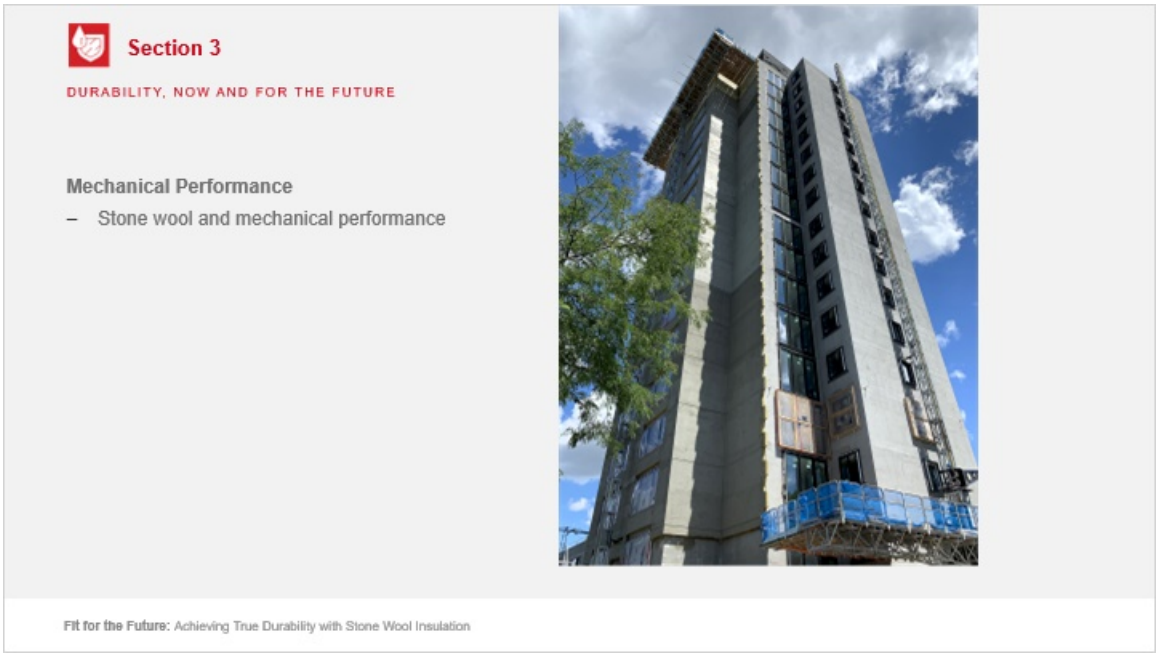
1.39 Durability, Now and for the Future



Notes:

The ability of an insulation to fit and flex must also be weighed when making insulation material decisions; depending on how it will be installed, a balance often needs to be struck between flexibility and rigidity. The inherently fibrous nature of stone wool insulation allows the material to adapt and fit to uneven surfaces and edges. Meanwhile, this flexibility is balanced together with stone wool's natural rigidity, which ensures that the product will remain in place throughout the construction's life. The good fit-ability results in lower heat loss and thus lower heating and cooling costs for the building.

1.40 Durability, Now and for the Future

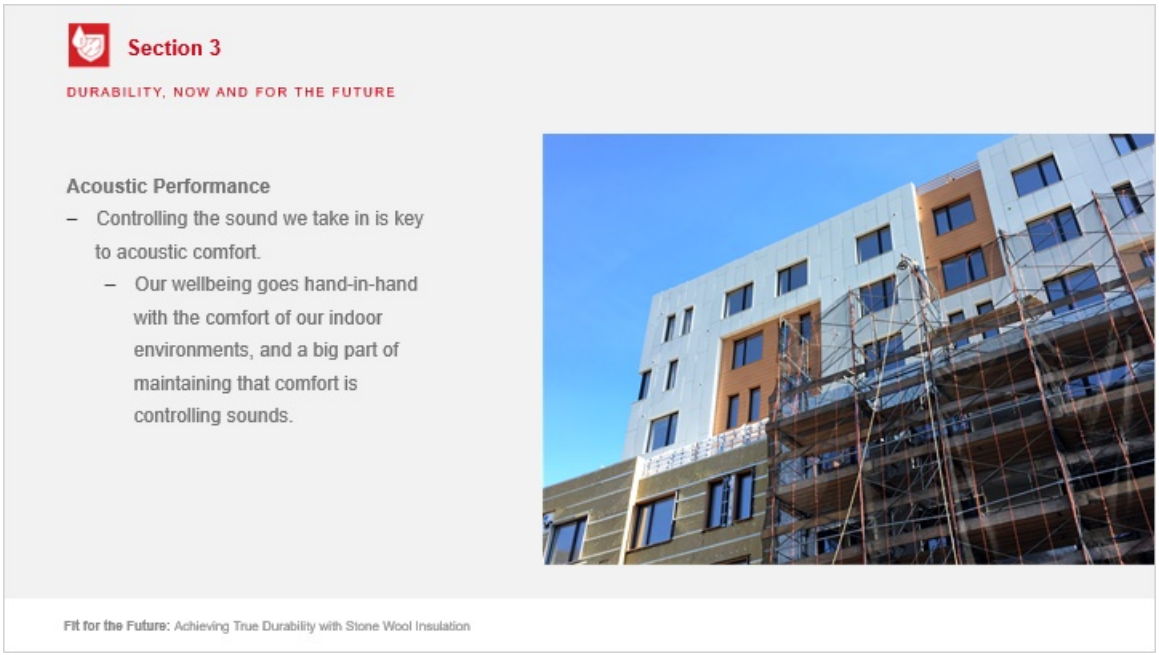


Notes:

Stone wool boards do not shrink, warp or deform over time, and they provide a highly stable substrate without causing undesirable stress, for example, on the render of EIFS or stucco, or on the roofing membrane.

Insulation can also be evaluated based on its structural integrity. Stone wool is characterized as “dimensionally stable”, as the changes in length, width and thickness under specific temperature and humidity variations are expected to be less than one percent. Stone wool insulation is 3 to 5 times the density of traditional batt insulation. This unique physical structure keeps it's shape and toughness despite changes in temperature or humidity. Structural integrity also means that stone wool’s thermal properties, dimensions and thickness do not deteriorate during its lifetime.

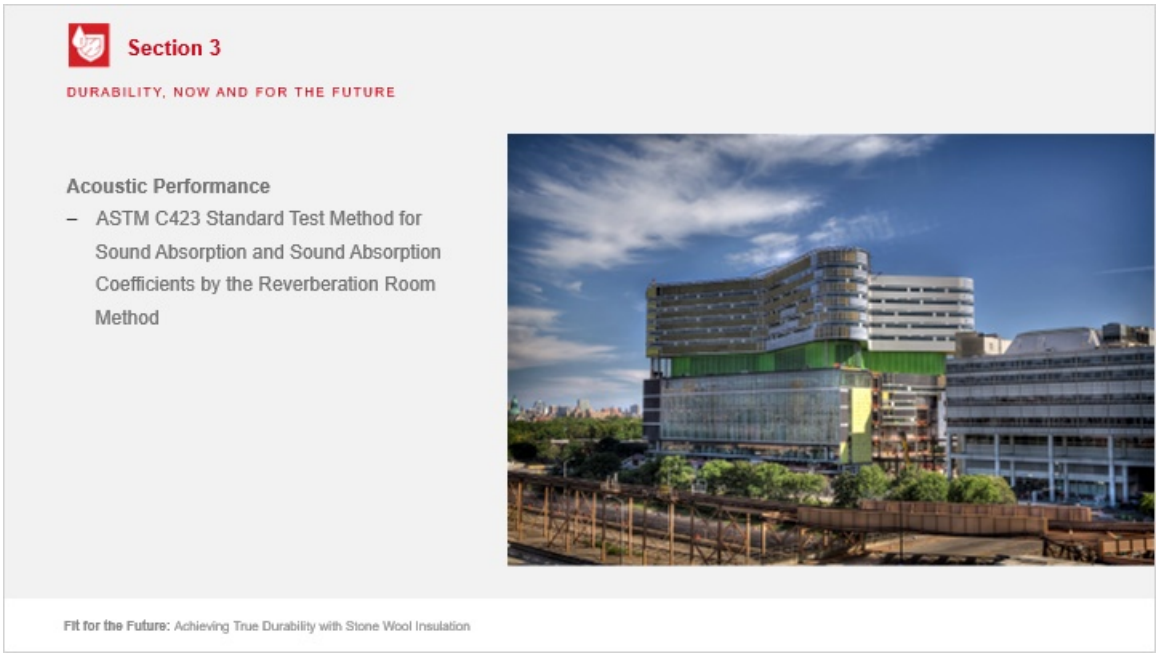
1.41 Durability, Now and for the Future



Notes:

From railways to roadways to airports, good infrastructure is crucial to urban life, which can be very noisy. The resulting ground-borne vibration, traffic noise - and not to mention human noise pollution - all have a serious and negative impact on our wellbeing, especially in densely populated areas. Protection from unwanted noise can have a positive effect on occupant physiology, learning capacity and social behavior. Insulation products that are high-density, which makes them extremely resistant to airflow, can also offer excellent noise reduction and sound absorption, which helps to make even the nosiest infrastructure sound quieter.

1.42 Durability, Now and for the Future



Notes:

ASTM C423 offers a way to compare the sound pressure coefficient and sound absorption of different insulation products. It is one way of predicting how an insulation product can help temper sound transmission inside a building.

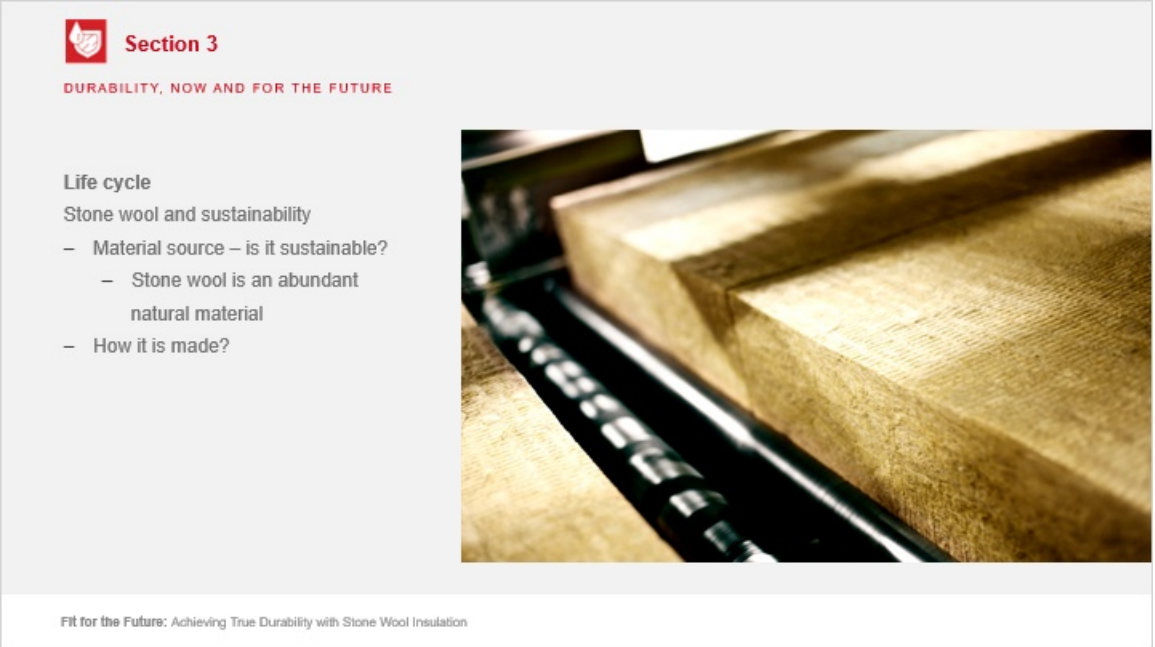
Sound transmission may be measured through either STC, Sound Transmission Class, or OITC, Outdoor/Indoor Transmission Class. STC was originally developed to measure the sound transmission between interior walls. OITC is a newer rating system developed specifically for measuring sound transmission of low- and mid-frequency noises through exterior walls. Both of these ratings look at the performance of the assembly as a whole.

Controlling noise levels at the source is not always possible - but quality sound insulation of the building envelope can offer a valuable solution.

Outside noise from traffic or aircraft - for example - can be significantly blocked out by proper installation in the roof or building façade.

Insulation within a building, meanwhile, can improve privacy and avoid annoyance from sounds in adjacent properties, such as music or footsteps from an apartment above.

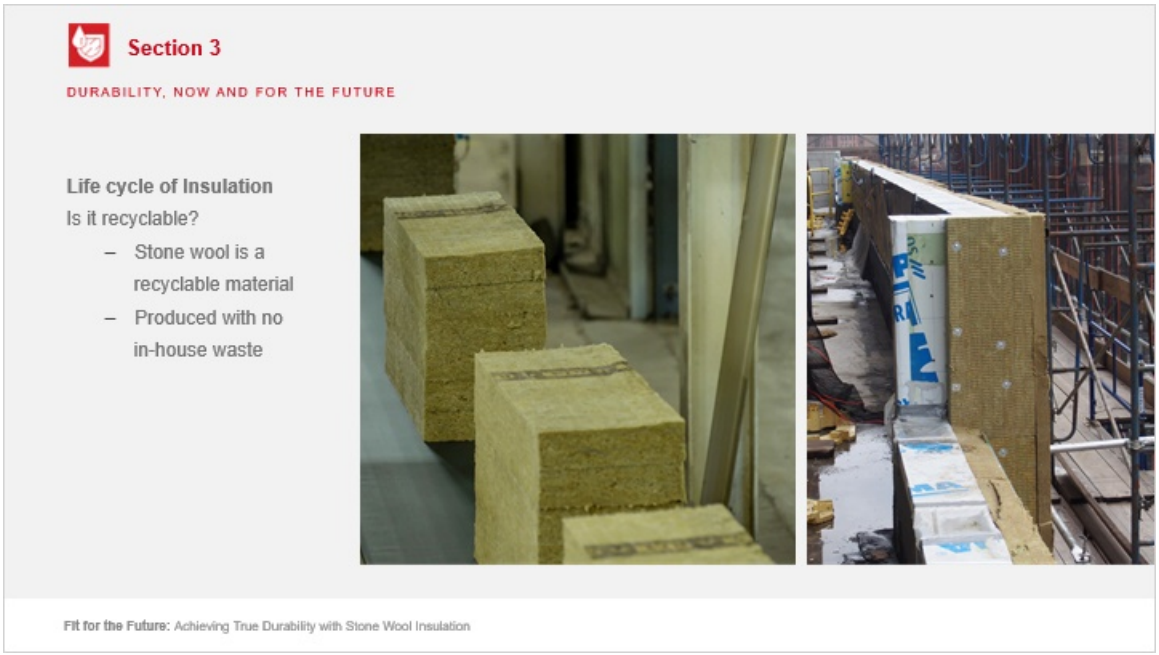
1.43 Durability, Now and for the Future



Notes:

Setting performance aside, if insulation is not available from a sustainable source, it does not represent a durable or efficient solution, regardless of the protective properties it can provide. Many insulation products today are generated from man-made processes or use chemicals in their composition. Stone wool offers an efficient and sustainable alternative. Rock is one of the most abundant raw materials on the planet. Also known as mineral wool, stone wool is created by spinning molten rock and minerals with steel slag to create a cotton-candy-like wool product that is then made into batts or boards. Certain manufacturers have developed stone wool technology in a way that allows waste from other industries, as well as their own processes, to be sourced as an alternative raw material.

1.44 Durability, Now and for the Future

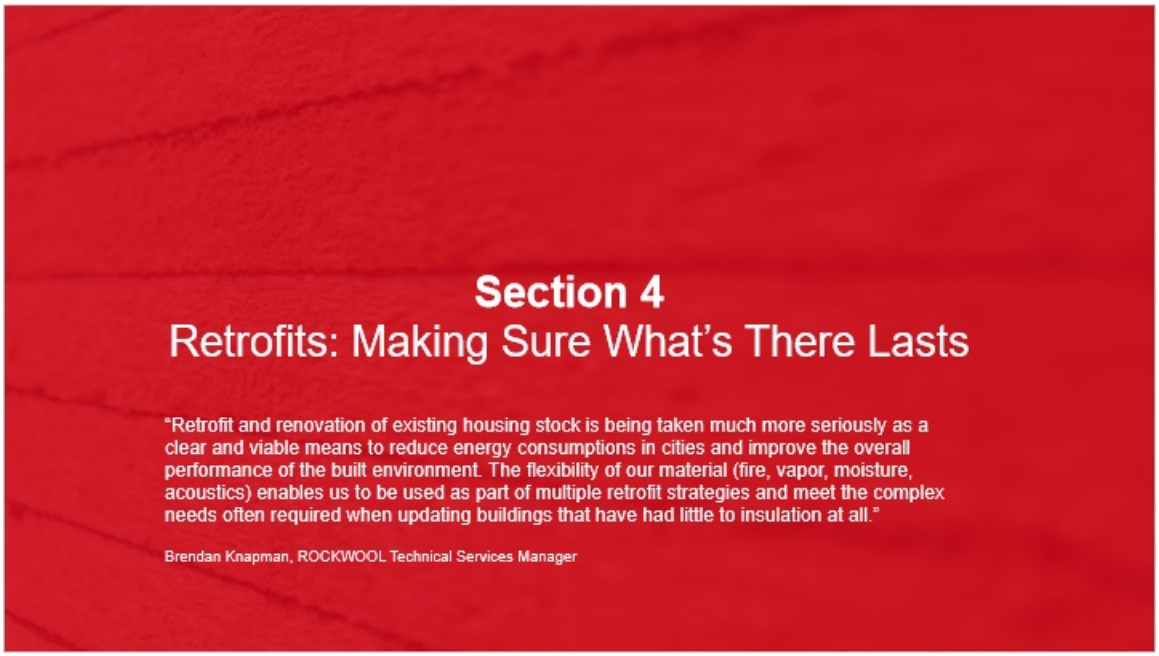


Notes:

The building sector produces a third of all waste, much of which ends up in landfills today. So it is important to prevent our building products from becoming waste during their lifetime.

Stone wool is a recyclable material that produces no in-house waste.

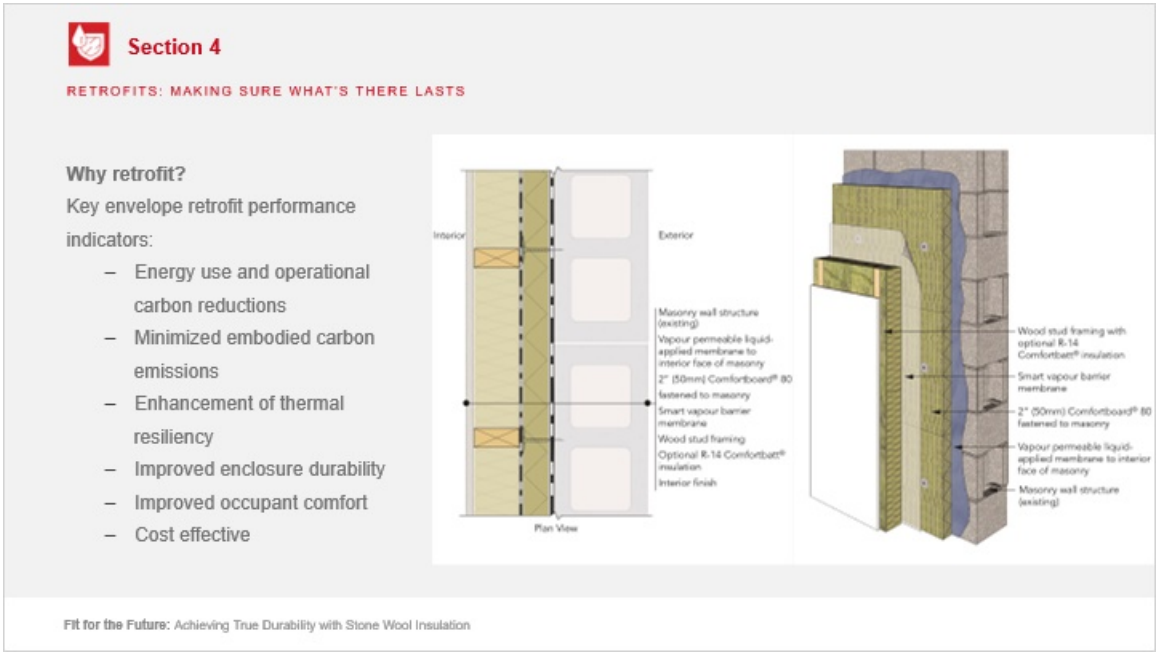
1.45 Section 4



Notes:

Section 4 Retrofits: Making Sure What's There Lasts

1.46 Durability, Now and for the Future



Notes:

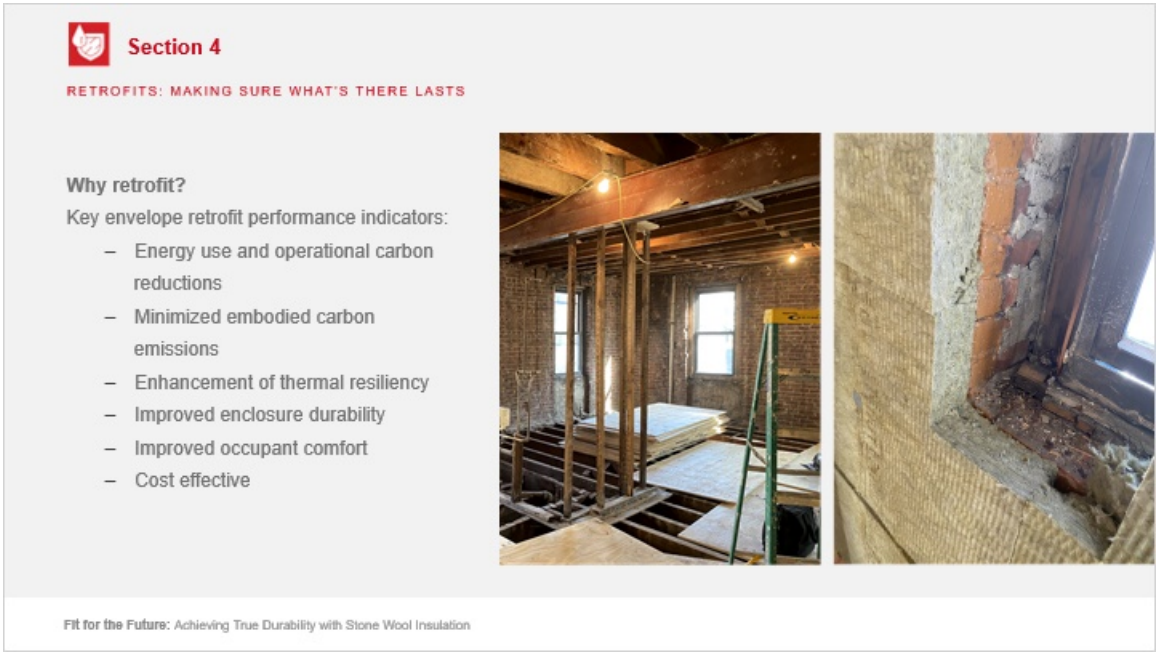
If a product is durable, it can endure continued use over a long period, maintaining a constant performance.

Durability is an important factor when selecting a construction material a project, whether new construction or retrofit. A durable construction product will last the lifetime of the building, and will not require maintenance. As buildings can remain standing for many decades, it's essential that the materials used to construct them will last as well.

Globally, existing buildings account for approximately 30% of final energy demand and CO2 emissions. Typical renovation rates are 1-2% of the building stock per year, with an average energy use intensity (EUI) reduction of less than 15%. However, to reach sustainable development and climate targets, EUI reductions should be between 30-50%.

In addition to energy and emissions conservations, building retrofits improve occupant health and comfort. In many cases, existing buildings are poorly insulated and leaky, resulting in excess heat loss and reduced thermal comfort. Mechanical systems are often outdated and inefficient, requiring consistent maintenance. Given the expense of real estate in many cities, the cost of retrofits makes sense. With people spending more of their time indoors, indoor health and comfort can be a priceless attribute that can be crucial for building renewal investment.

1.47 Durability, Now and for the Future



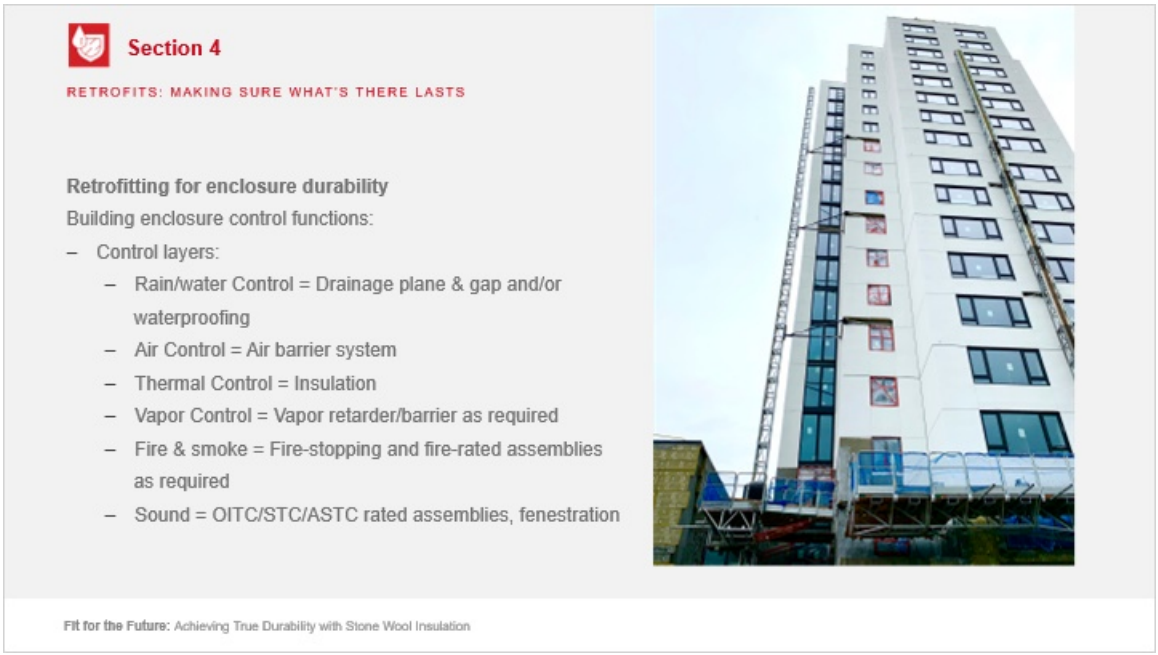
Notes:

In all climates, the building enclosure has a major impact on the total energy use of the building.

Generally speaking, the type of energy conservation methods that are selected for a building retrofit, are going to be dependent on performance indicators such as

- How much energy and operational carbon is decreased.
- Select ion of materials and products that minimize the embodied carbon attributed to the measures.
- With climate change in mind, providing added thermal resiliency.
- Ensuring the envelope enhancement will improve the durability of the building enclosure.
- Making sure the occupant comfort is improved; often a major concern with older buildings.

1.48 Durability, Now and for the Future



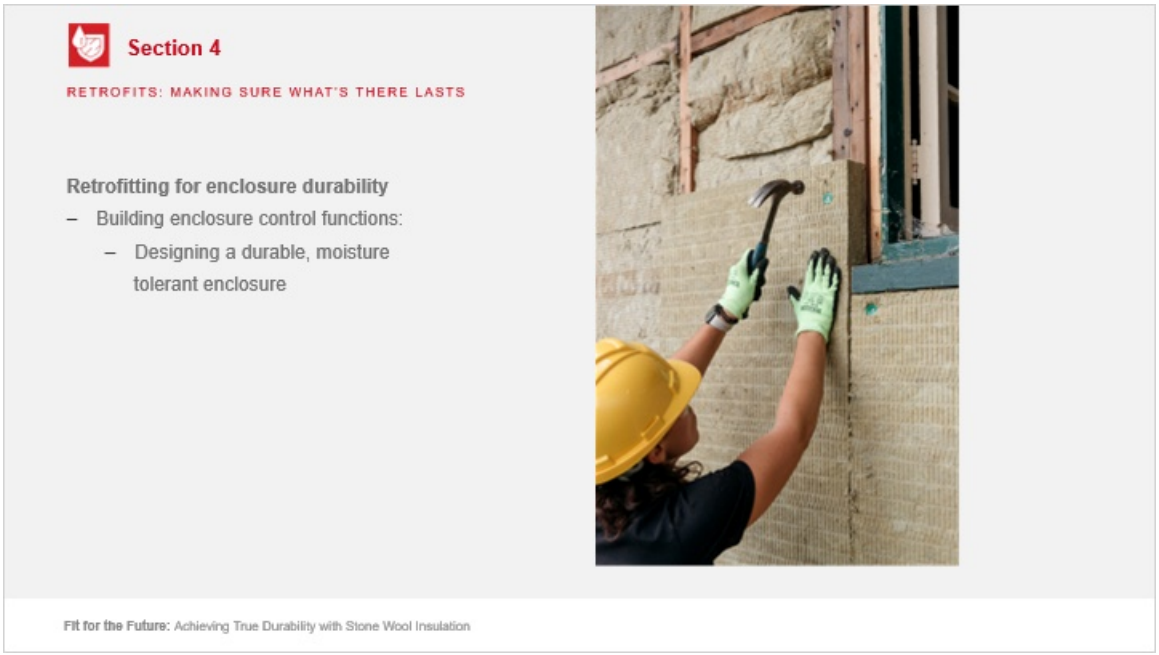
Notes:

Durability is not an intrinsic property of a material, but rather a function of the material and its environment.

The goal is to find a balance between:
Energy savings - Durability & Resilient enclosure - Occupant health & comfort

Each of the building control layers has an important role in how durable the building will be. These layers interact to either support or detract from the combined performance of the enclosure.

1.49 Durability, Now and for the Future



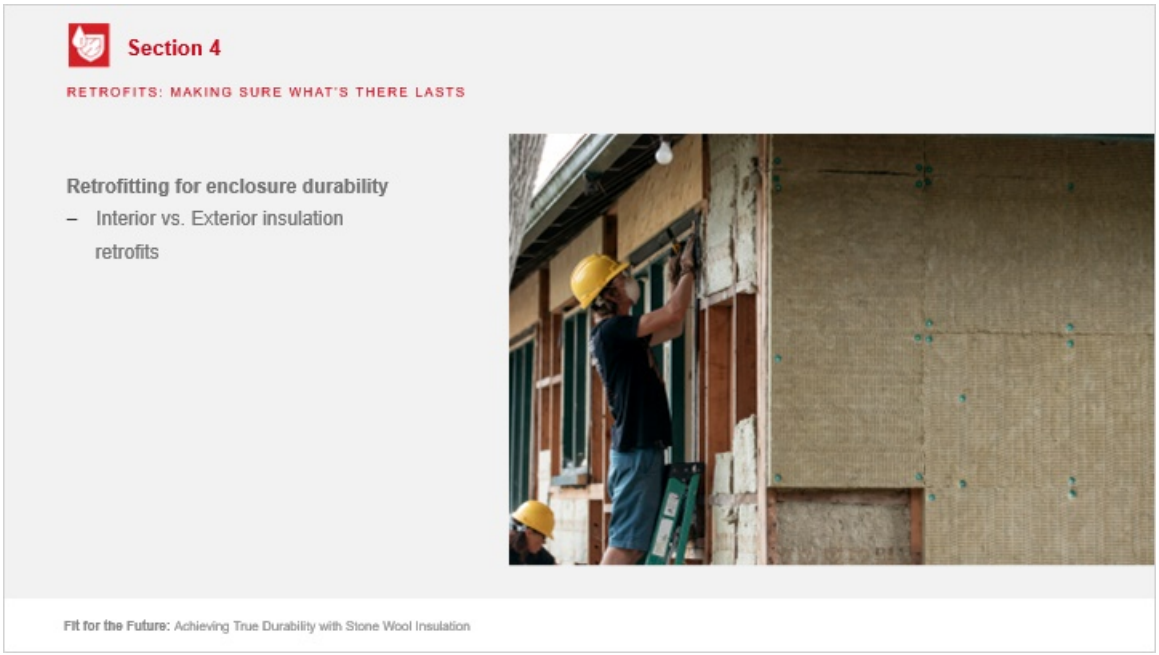
Notes:

Hygrothermal properties of the enclosure must allow for drying without excessive moisture accumulation.

A durable, moisture tolerant enclosure must weigh the following:

- What is the wetting mechanism the wall will face?
- Consider vapor retarder requirements based on climate (interior vs. exterior)
- Consider the permeability rating of all materials (permeable vs impermeable)
- Ensure continuity of control layers
- How is a building allowed to dry after it gets wet? A rainscreen assembly approach typically works best, acknowledging that water may reach past the cladding and allowing a pathway to direct any water to drain out and away from the building.

1.50 Durability, Now and for the Future



Notes:

Once control layers are decided on, how the retrofit will happen must be weighed. Should the construction take place from the interior, or the exterior?

An exterior retrofit is generally more favorable than an interior retrofit because it improves building durability, by reducing the likelihood of cold weather condensation within the structure.

Despite the advantages of exterior insulation, many buildings must be retrofitted on the interior, for reasons such as historic preservation, zoning or space restrictions, or aesthetics.

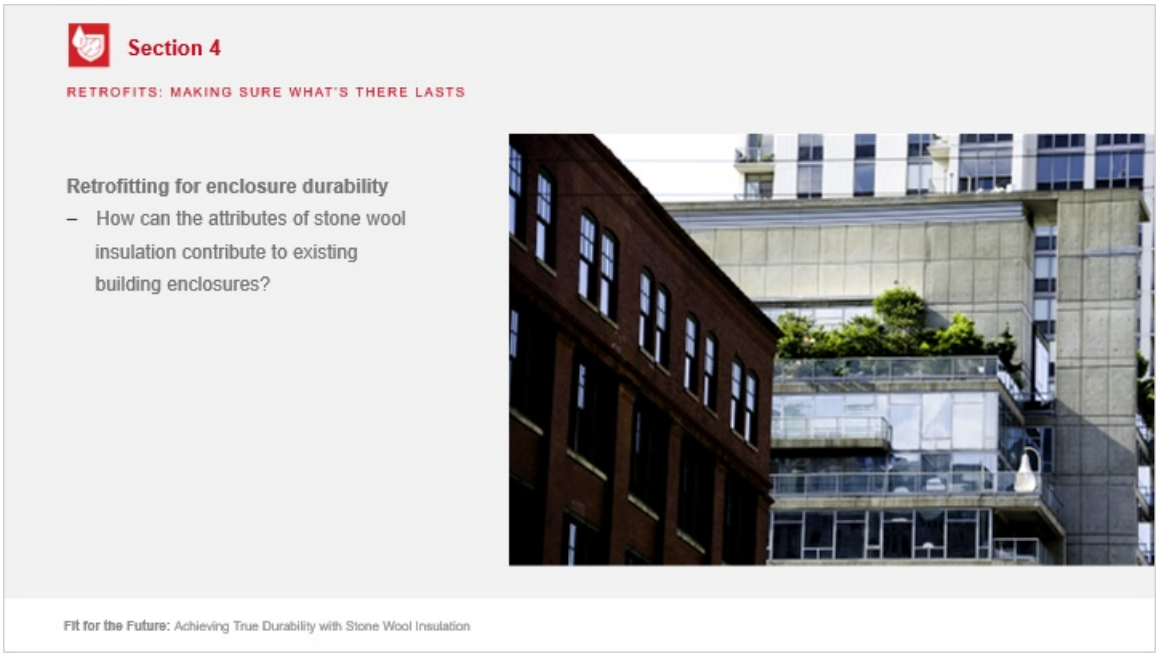
1.51 Durability, Now and for the Future

Notes:

Interior Insulation Retrofits:
Optimal solutions for site with limited lot lines and historic preservation requirements
Durability concerns with changing temperature profile of wall assembly and risk of condensation
Airtightness is key
Occupant disturbance

Exterior Insulation Retrofits:
Exterior insulation reduces potential for condensation
Air tightness is key
Additional structural considerations for added insulation and cladding weight
Requirements for non-combustibility may be of concern
Lower occupant disturbance

1.52 Durability, Now and for the Future



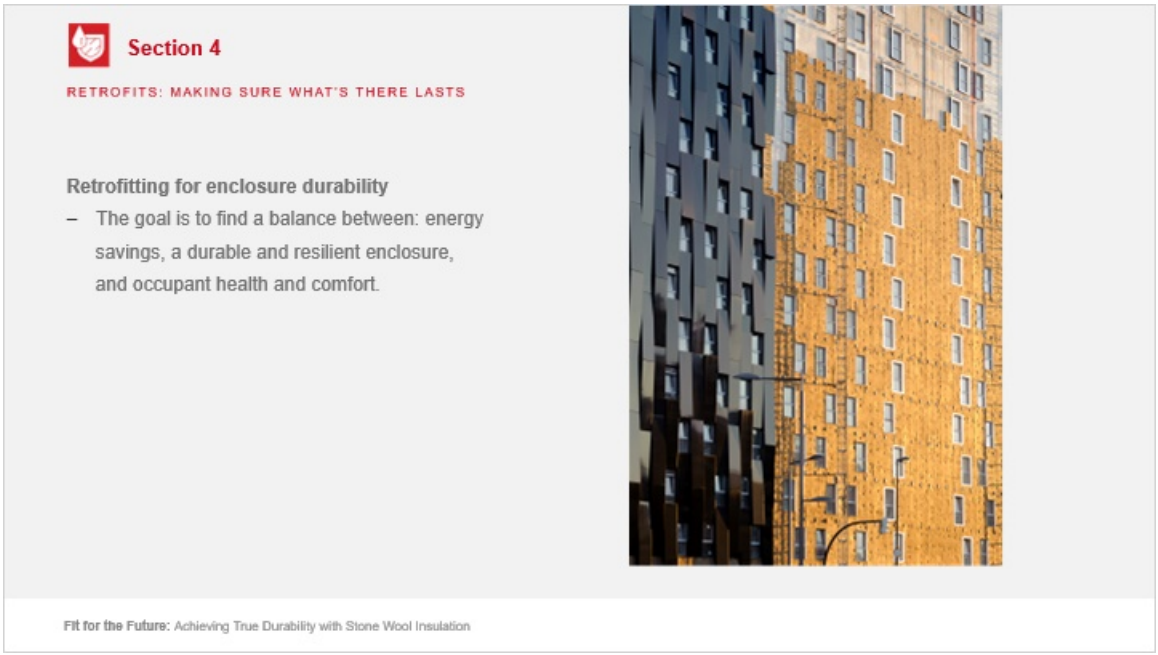
Notes:

Stone wool insulation combines its natural characteristics into building strengths with one ambitious goal in mind: to minimize the human impact on our surroundings, while maximizing the safety and wellbeing of all the people interacting with it.

Stone wool insulation offers a unique combination of attributes in one insulation product:

- Fire-resilience to withstand temperatures above 1000°C.
- Water properties to manage the planet's most precious resource.
- Acoustic capabilities to block, absorb, or enhance sounds.
- Circularity by implementing reusable and recyclable material.
- Durability for increased performance and greater stability with lower costs.
- Aesthetics to match performance with aesthetic versatility.
- Thermal properties to save energy by maintaining optimum indoor temperature and climate

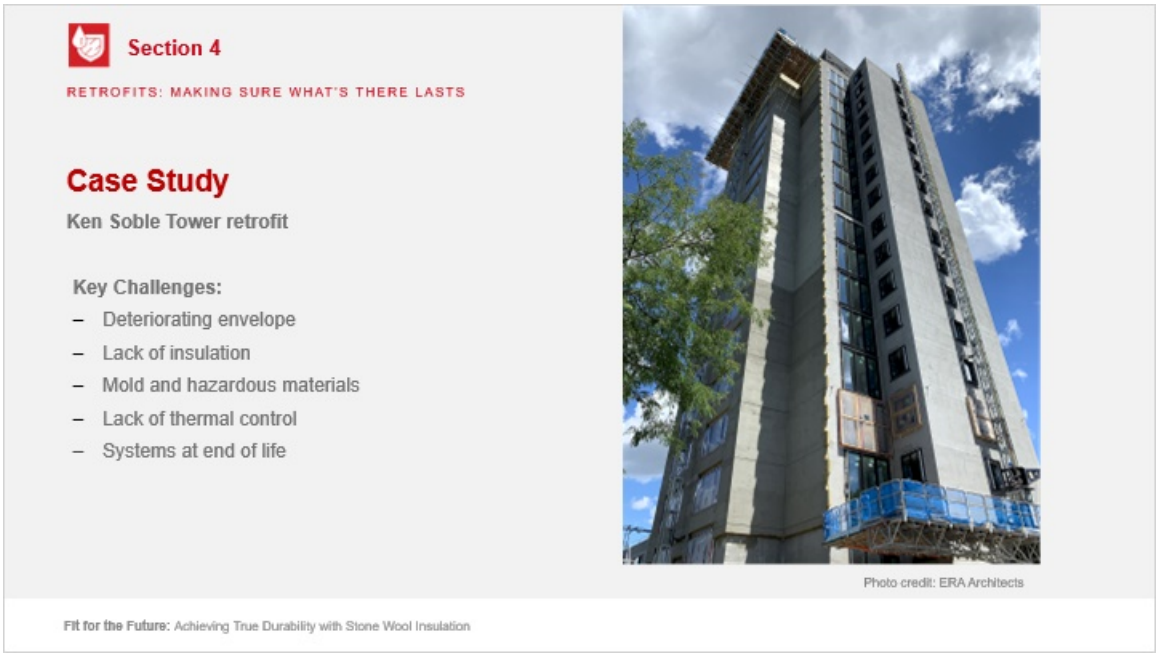
1.53 Durability, Now and for the Future



Notes:

The search for durability is influenced by a combination of things - performance requirements, comfort, longevity, material sources, code requirements, performance requirements, and external forces that impact the building, including climate volatility and hazards. Durable decisions involve making considerations beyond what's simply listed in the code requirement. Rather, durability is planning for a longer term, holistic view of the building. Choosing appropriate materials means considering designs beyond the minimum standard that demonstrate performance of desired attributes - vapor permeability, thermal barrier, action as a water barrier - over their lifetime. The LONG VIEW encompasses retrofits, too: how do we make buildings resilient and improve existing stock? Each is building unique. By picking materials that offer more flexibility, they in turn offer more freedom to create designs that check all the boxes for performance.

1.54 Durability, Now and for the Future



Notes:

Ken Soble Tower Project 500 MacNabb Street Hamilton, ON

The Ken Soble Tower project sought to rehabilitate a post-war apartment building in Hamilton, Ontario. The building was completely upgraded, inside and out, to achieve Passive House standard. The building overhaul would include nearly every facet of the building from the building envelope, mechanical systems, electrical, plumbing, and safety systems to interior upgrades to its 146 units to support aging in place, accessibility, comfort, and overall improvement of the occupant experience.

Envelope:

- Deteriorated balcony slab edges
- Windows
- Masonry repairs required
- Deteriorated roof

1.55 Durability, Now and for the Future

Section 4

RETROFITS: MAKING SURE WHAT'S THERE LASTS

Case Study

Ken Soble Tower retrofit

Goals:

- Ultra-low energy retrofit that maintains affordability
- Reduce greenhouse gas emissions by over 90%
- EnerPhit certified project
- Reduce thermal bridging to enhance indoor thermal comfort and limit heat loss
- Passive climate resilience to extreme conditions
- Fire resiliency
- Adequate ventilation

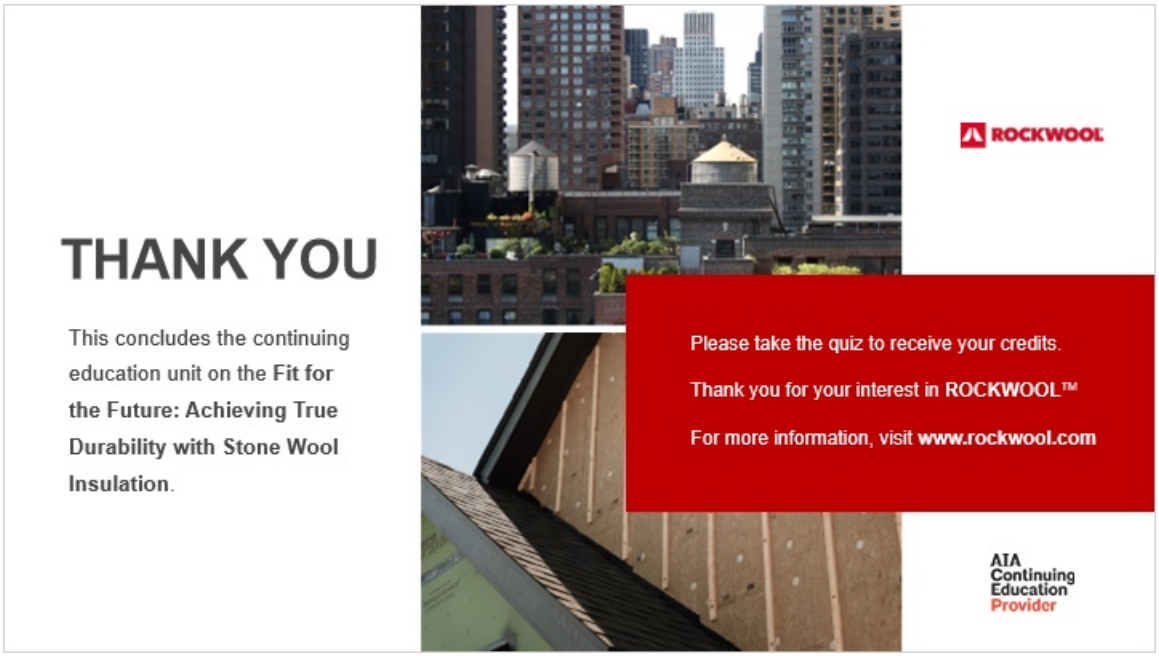
Photo credit: ERA Architects

Notes:

The cladding design includes a six- inch thick stone wool EIFS system. Architects chose this EIFS system due to the non-combustibility (important given the vulnerability of the senior- aged occupants), the excellent moisture control offered by both the stone wool and the unique, built-in drainage layer cut into the back side of the insulation, as well as the liquid applied water resistive barrier used in the EIFS system.

In all, 50,000 sq. ft. of ROCKWOOL stone wool insulation was incorporated into the new façade, helping to realize the R-38 effective R-value required to achieve EnerPHIT Passive house certification, while reducing greenhouse gas emissions by an impressive 94%.

1.58 Thank You



Notes:

This concludes the continuing education unit on the Fit for the Future: Achieving True Durability with Stone Wool Insulation.