The Benefits of Mineral Wool As Continuous Insulation

Course Number: EL409

Thursday, June 21, 2018- 2:15 – 3:15 PM

Learning Units: 1 CEU

A'18 AIA Conference on Architecture 2018
June 21-23, New York City

This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to constitute approval, sponsorship or endorsement by AIA of any method, product, service, enterprise or organization.

The statements expressed by speakers, panelists, and other participants reflect their own views and do not necessarily reflect the views or positions of The American Institute of Architects, or of AIA components, or those of their respective officers, directors, members, employees, or other organizations, groups or individuals associated with them.

Questions related to specific products and services may be addressed at the conclusion of this presentation.

Speakers List

Angela Ogino- Technical Services Leader, Thermafiber, Inc.

Course / Learning Objectives

- Types of Rain Screen Assemblies
- Why Use Continuous Insulation
- ASHRAE R-Value Requirements
- Advantages of Mineral Wool
- Installation Recommendations
- Mineral Wool Insulation LEED Contributions
- Questions & Answers

Continuous Insulation

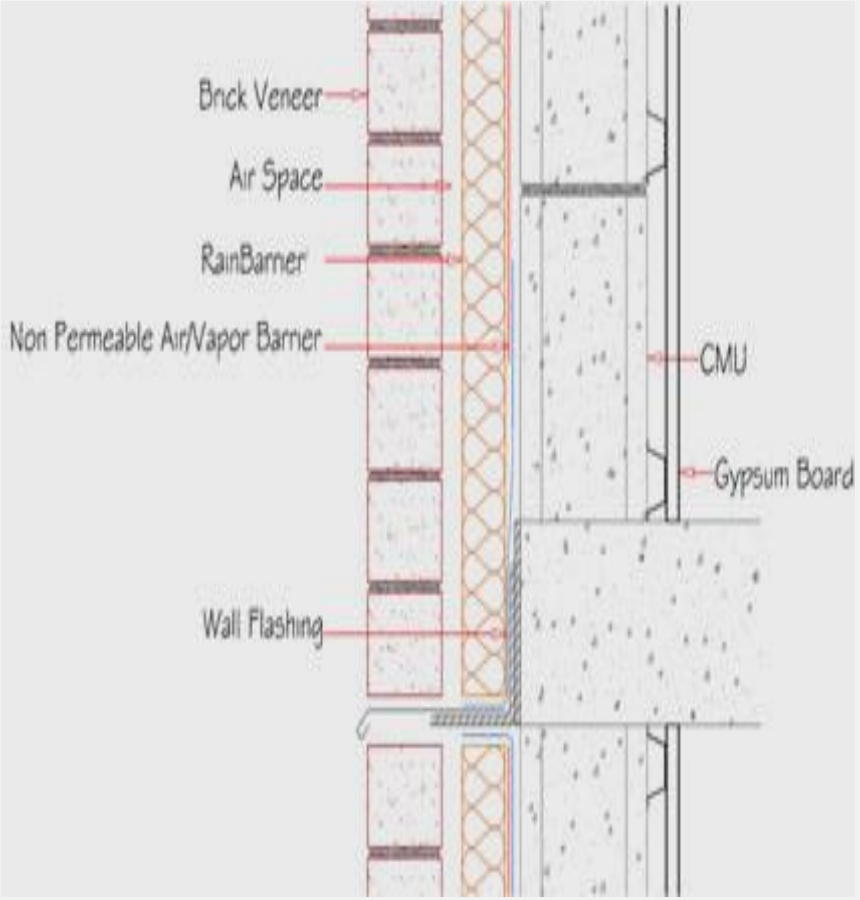
Fort Belvoir Community Hospital, Fort Belvoir, VA

Continuous Insulation Defined

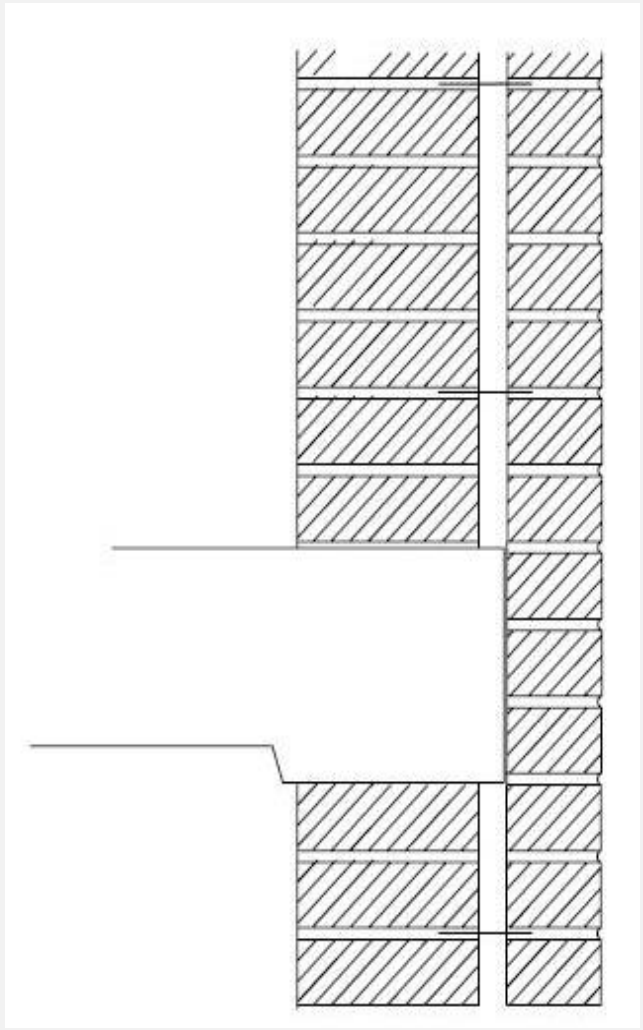
"…*insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior, exterior, or is integral to any opaque surface of the building.*"

Continuous Insulation – Why?

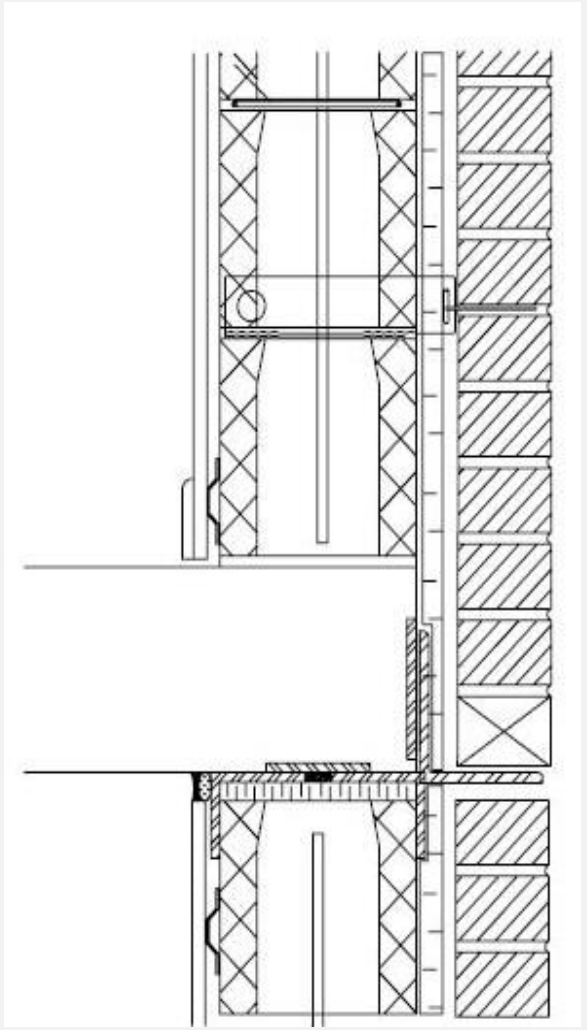
- Eliminates thermal bridging
- Increases overall R-value
- Air and vapor barriers can be installed as a single material adjacent to wall sheathing, allowing for continuity of the barriers
- CI moves the dew point closer to the outer face of the wall, reducing the potential for condensation within the wall



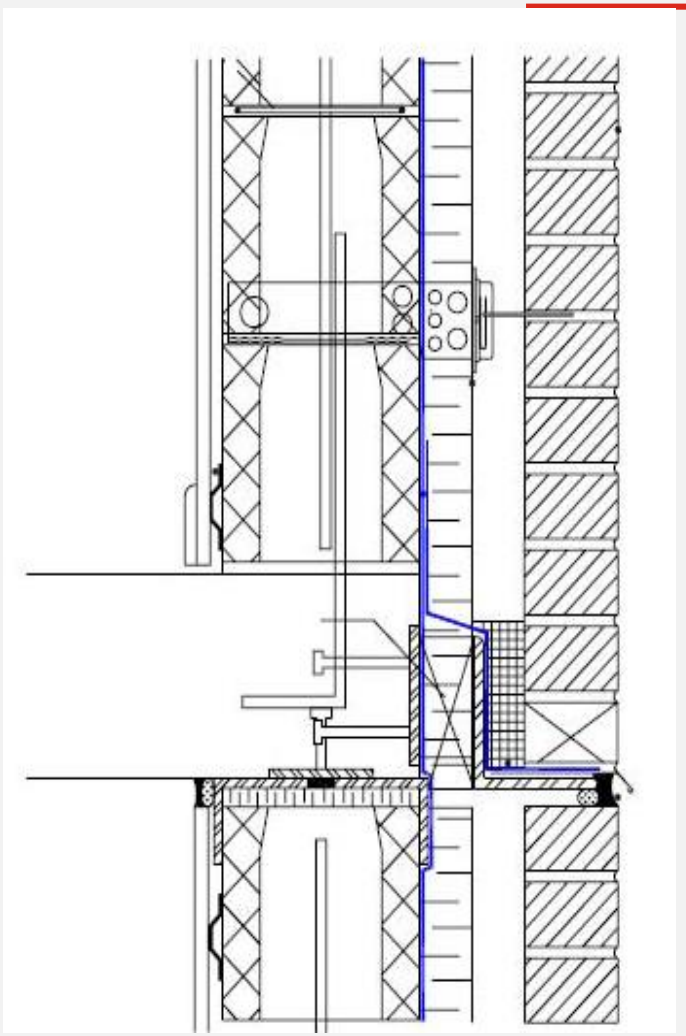
Continuous Insulation Defined



1900s
No Insulation



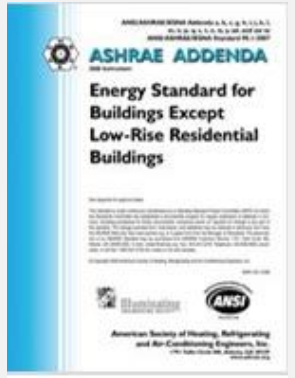
1940-1970s
Limited Insulation



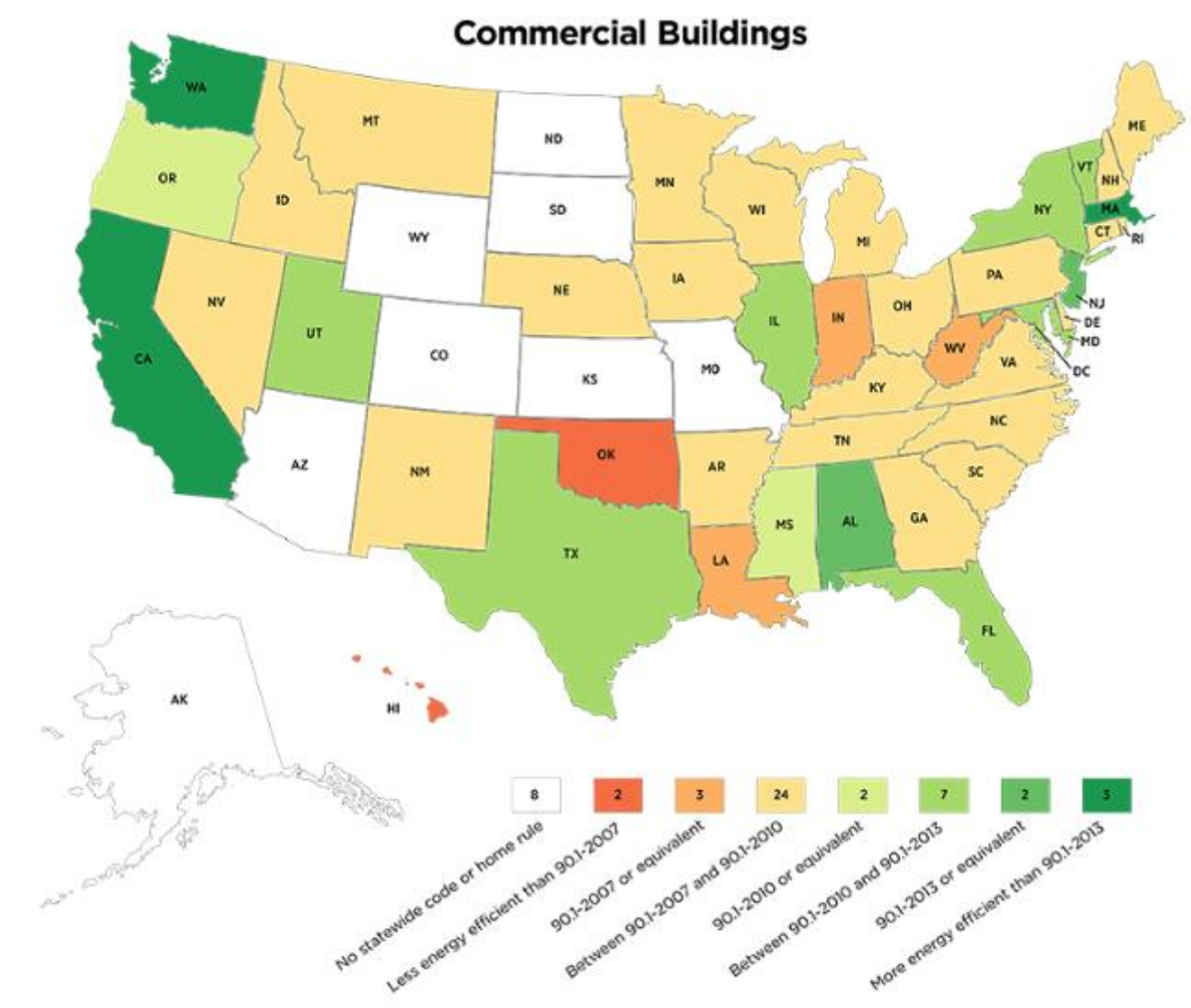
Today's Integrated
Air/Water/Thermal Assembly

ASHRAE 90.1

- ASHRAE Standard 90.1 is a primary baseline building energy codes adopted by states and local jurisdictions to regulate the design and construction of new buildings.
- ASHRAE 90.1 is limited to commercial buildings, while the International Energy Conservation Code® (IECC), addresses both residential and commercial buildings.
- This standard calls for continuous insulation in all zones for steel frame construction and metal-framed buildings.
- The mandatory installation of ci over steel stud framing was first incorporated in the ASHRAE 90.1-1999 edition. Both residential and non-residential steel-framed walls in zones 3–8 required continuous insulation.

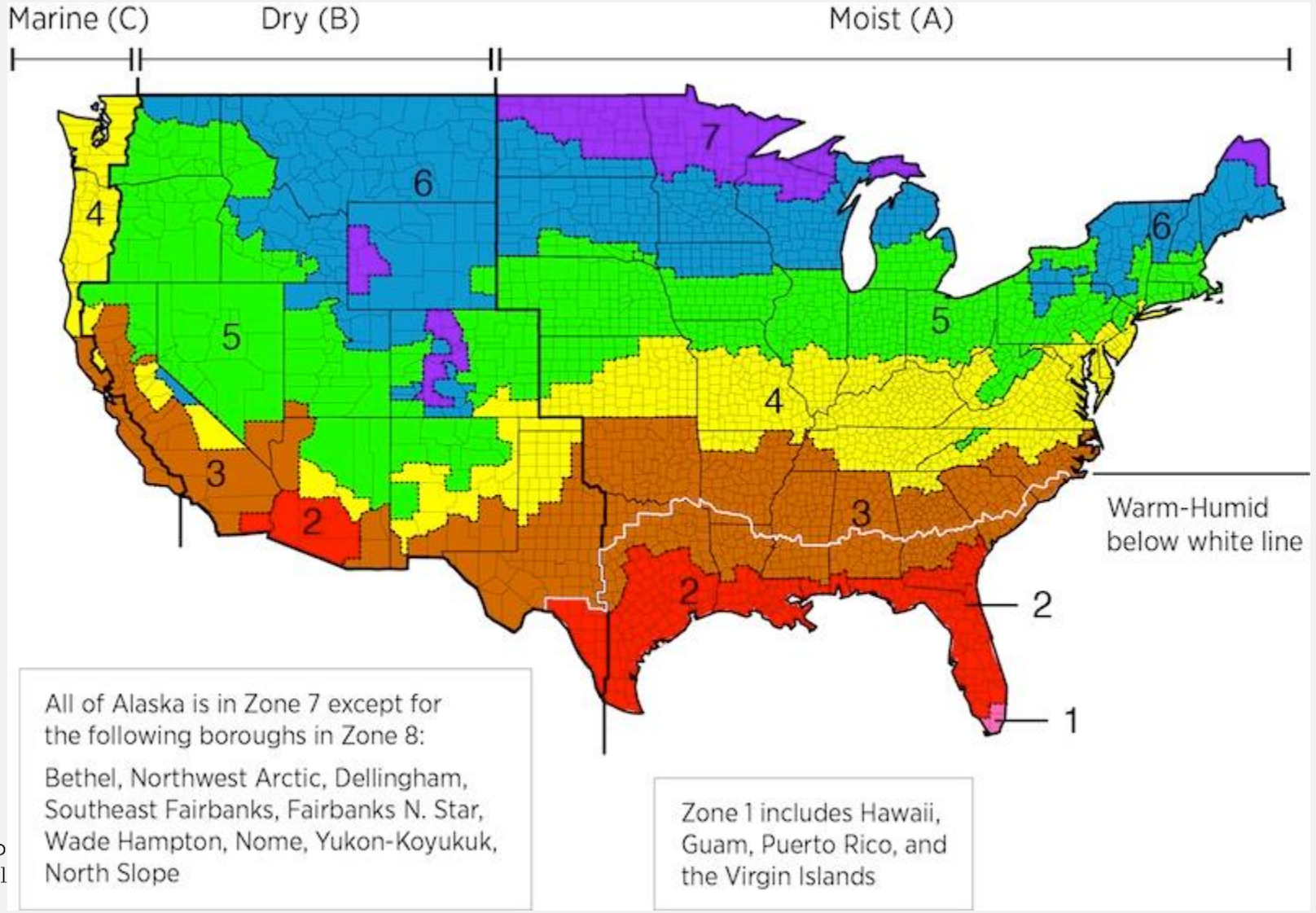


Commercial State Energy Code Status



https://www.energycodes.gov/status-state-energy-code-adoption

United States Climate Zones



http://www.energyvanguard.com/knowledge/us-climate-zones

ASHRAE R-Values

Codes are becoming more stringent. (Red denotes change)

Steel Stud Framing				
	2007 & 2010		2013	
Zone	Non-Res	Res	Non-Res	Res
1	13	13	13	13
2	13	13+7.5	13+3.8	13+7.5
3	13+3.8	13+7.5	13+5	13+7.5
4	13+7.5	13+7.5	13+7.5	13+7.5
5	13+7.5	13+7.5	13+10	13+10
6	13+7.5	13+7.5	13+12.5	13+12.5
7	13+7.5	13+15.6	13+12.5	13+15.6
8	13+7.5	13+18.8	13+18.8	13+18.8

Energy Code Compliance

Paths to Compliance:

Option 1: Prescriptive R-Value

- R-value of insulation ONLY
  - Compliance with prescribed insulation R-value is installed

Option 2: Performance (overall assembly)

- U-factors: U-value of Assembly (above grade)
- C-factors: Thermal Conductance (below grade)
- F-factors: Slab Edge Factors
  - Compliance when assembly meets minimum U-value
  - Requires calculations or testing to demonstrate compliance but offers greater flexibility in system options.

Option 3: Cost Budget Method (ECB)

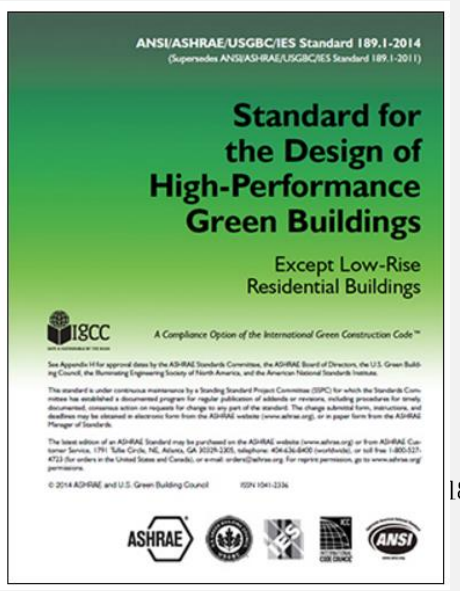
- Annual Operating Cost ($)
  - Comcheck

Beyond the Code

Adding insulation in building envelope = Negative Marginal Cost

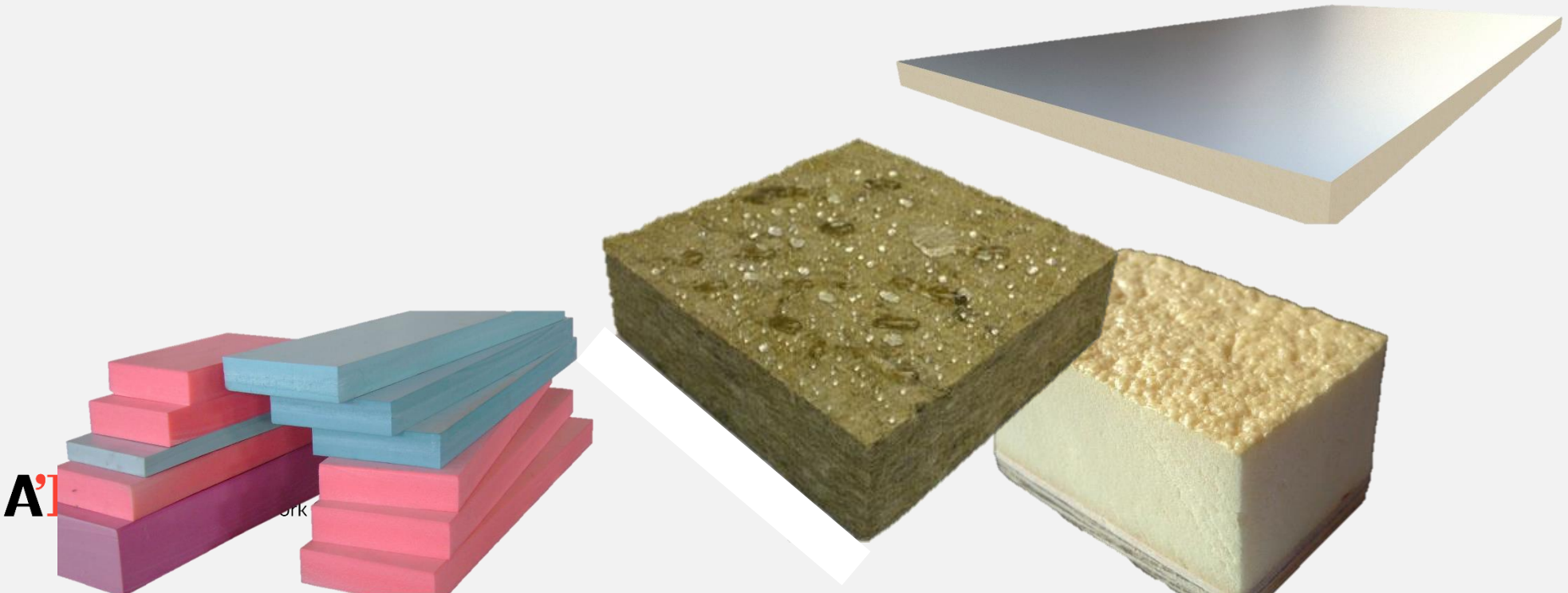
OR

Positive Economic Return over its lifecycle



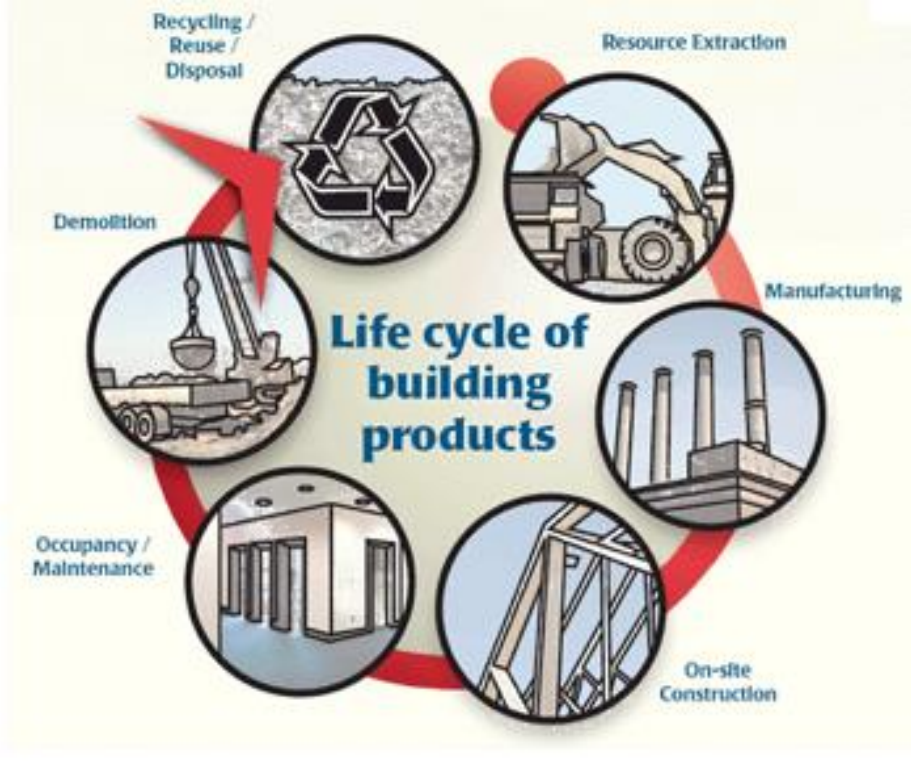
Continuous Insulation Choices

Identified Raw Materials
Embodied Energy
Operational Performance
Global Warming Potential (GWP)
Ozone Depleting Potential (ODP)



Product Sustainability

- Life Cycle Assessment (LCA) is a compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle
- All insulation materials reduce GHG
- Products with HFCs have longer payback period
- Embodied energy
- Rate of energy investment to energy savings



After only one month of use, one pound of mineral wool insulation saves the same amount of energy used in its manufacture.

Mineral Wool Insulation Raw Materials

No HFC or Blowing Agents in Mineral Wool

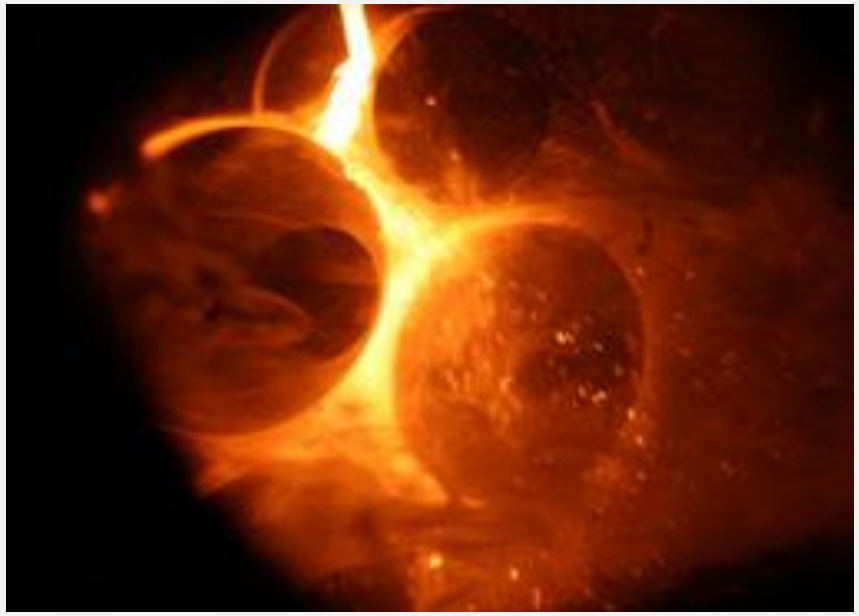
Natural Rocks

Slag

The slag content in mineral wool ranges from 70% to 90% making mineral wool one of the highest recycled contents among all of the continuous insulation products.

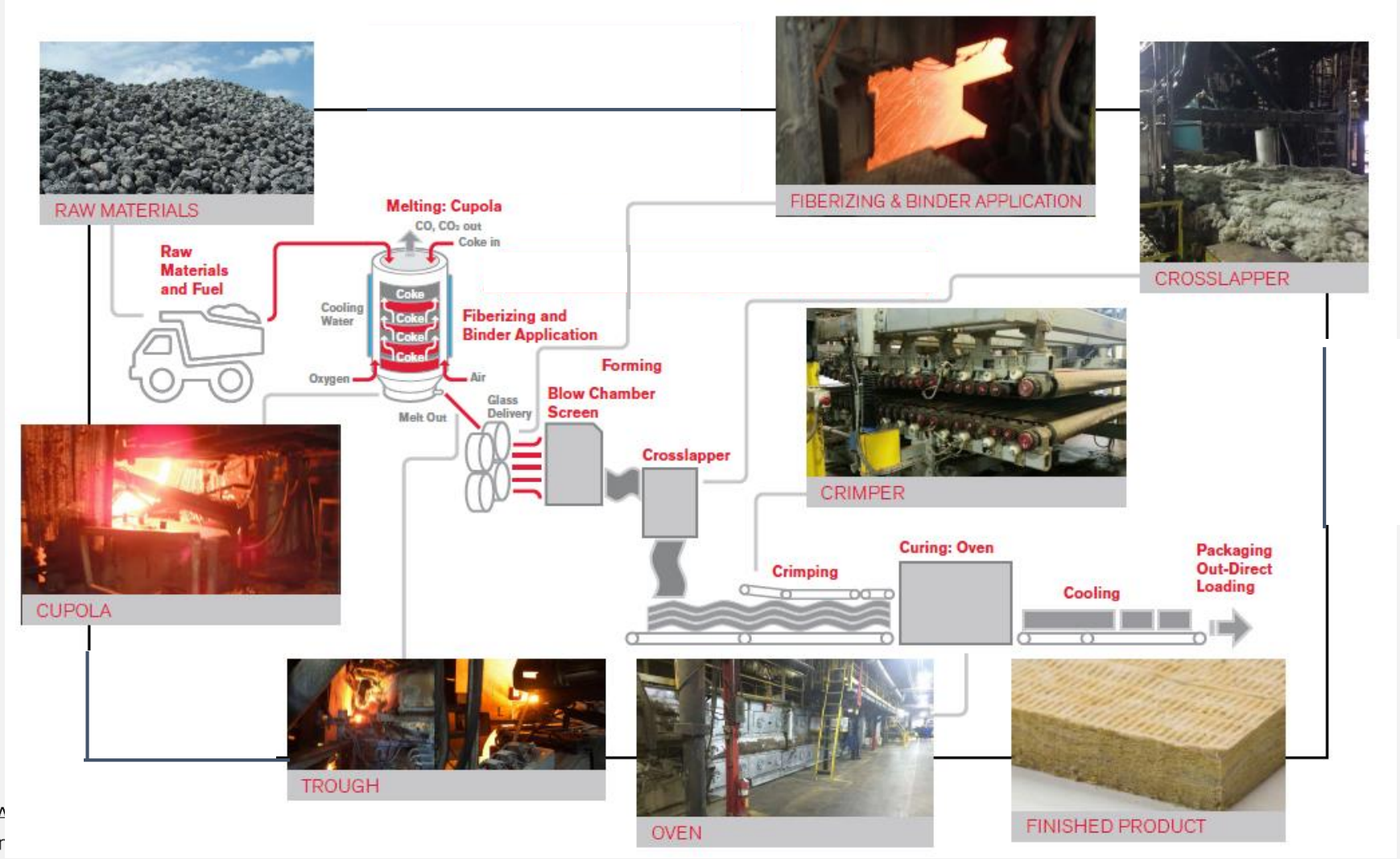
Mineral Wool Manufacturing Process

Rocks are melted in cupola furnace



Lava is spun into fibers

Mineral Wool Manufacturing Process



Mineral Wool Benefits


Museum of the Moving Image, Astoria, NY

Mineral Wool: Standards Compliance

- ASTM C 665 - Non-corrosive, Type I, III
- ASTM C 612 - Type IA, IB, IVA
- ASTM E 136 - Rated Non-combustible per NFPA Standard 220
- ASTM E 96 - Unfaced, 50 Perms as tested
- ASTM E 84 - Flame Spread 0, Smoke Developed 0
- ASTM C 1104 - Absorbs 0.03% by volume
- ASTM C 356 - Linear Shrinkage <2% 1200º F (650º C)

Non-Combustible & Fire Resistant – ASTM E 84

- Mineral wool is non-combustible. In the event of a fire, mineral wool insulation will not burn or release harmful smoke and hot gases. Mineral wool continuous insulation helps protect buildings and improves life safety by preventing fire and smoke from spreading. Smoke protection can be especially critical in high-occupancy buildings, such as schools and hospitals.

- Most foam products are combustible and will become a fuel source in a fire, releasing toxic smoke and hot gases. In high-occupancy buildings like schools, hospitals and offices, the safety of building occupants is an important consideration. As per ASTM E 84 test results, rigid foam rates the worst score possible (450) while mineral wool receives ratings of zero—the best score possible—for both flame spread and smoke developed.

ASTM E 84 Test Results	Rigid Foam	Mineral Wool
Flame Spread #	50 (Class B)	0 (Class A)
Smoke Developed #	450 (Class B)	0 (Class A)

ASTM E 119

5 hours +

2080° F

At 5 hours, mineral wool insulation is still intact.
Test terminated without failure.

6 minutes

1050° F

Glass-fiber insulation melts.

790° F

Zinc melts.

450° F

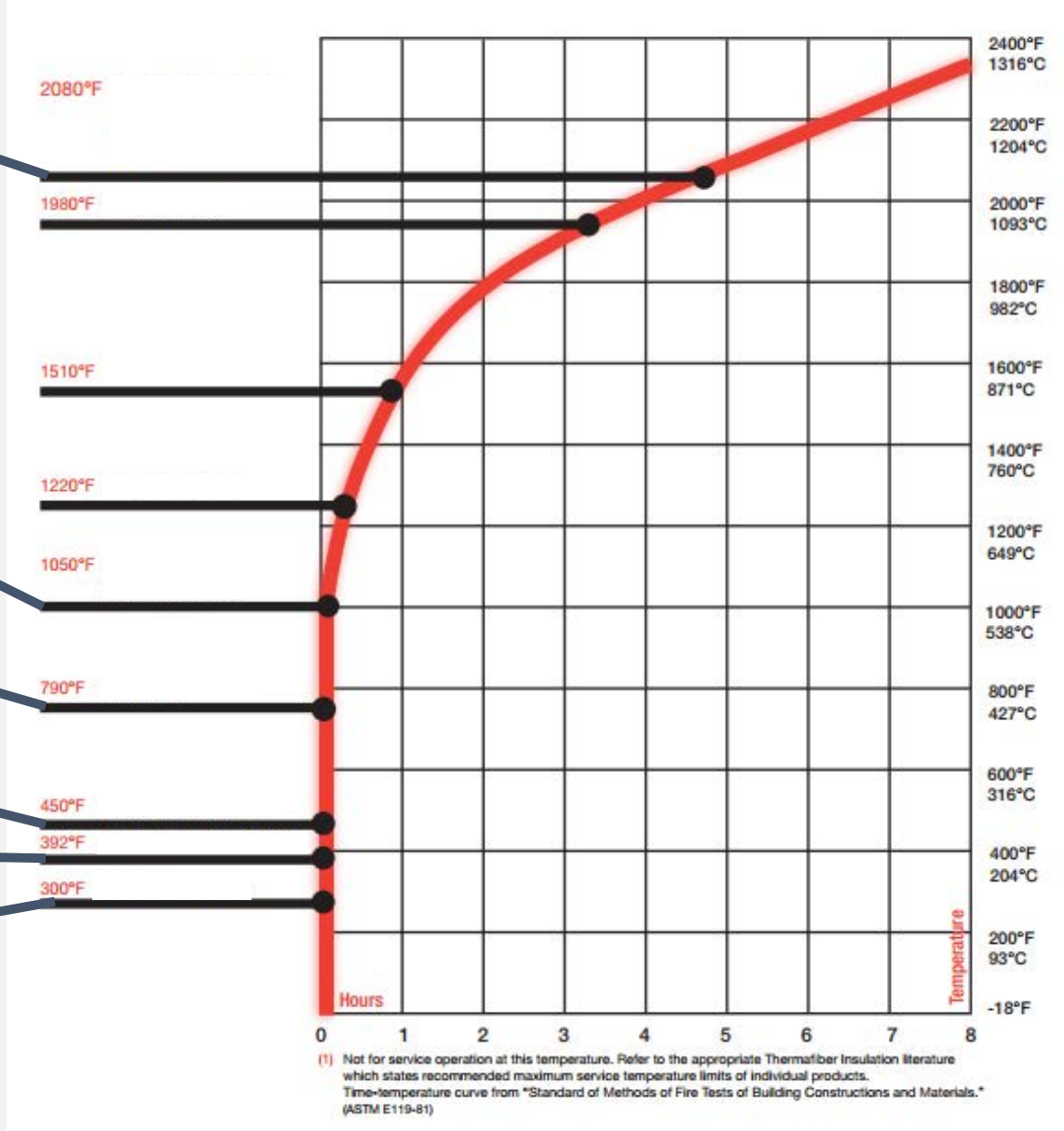
Cellulose pyrolyzes.

392° F

Spray Foam flash point.

300° F

Rigid foam melts.



A'18

Non-Combustible

ASTM E136 - 12

Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

Significance and Use

While actual building fire exposure conditions are not duplicated, this test method will assist in indicating those materials which do not act to aid combustion or add appreciable heat to an ambient fire.

NFPA 285

Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing *Wall Assemblies Containing Combustible Components*

3.3.5 Noncombustible Material

A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. **Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, shall be considered* noncombustible materials.**

NFPA 285

It is used when…

- the IBC requires non-combustible wall construction, **and**
- the energy code requires the building to be wrapped in air/water resistive barriers, often combustible, **and/or**
- continuous insulation, often combustible, **and/or**
- combustible exterior cladding is used.

Ideal for assemblies with combustible claddings and/or WRB's

- Mineral wool is not subject to NFPA testing (since it is non-combustible)
- Mineral wool assists other combustible products pass NFPA 285. According to Hughes Associates, no further NFPA 285 test is needed when:
  - The proposed combustible WRB is covered with min. 2" mineral wool ci
  - The proposed combustible cladding/veneer has previously passed an NFPA 285 assembly test

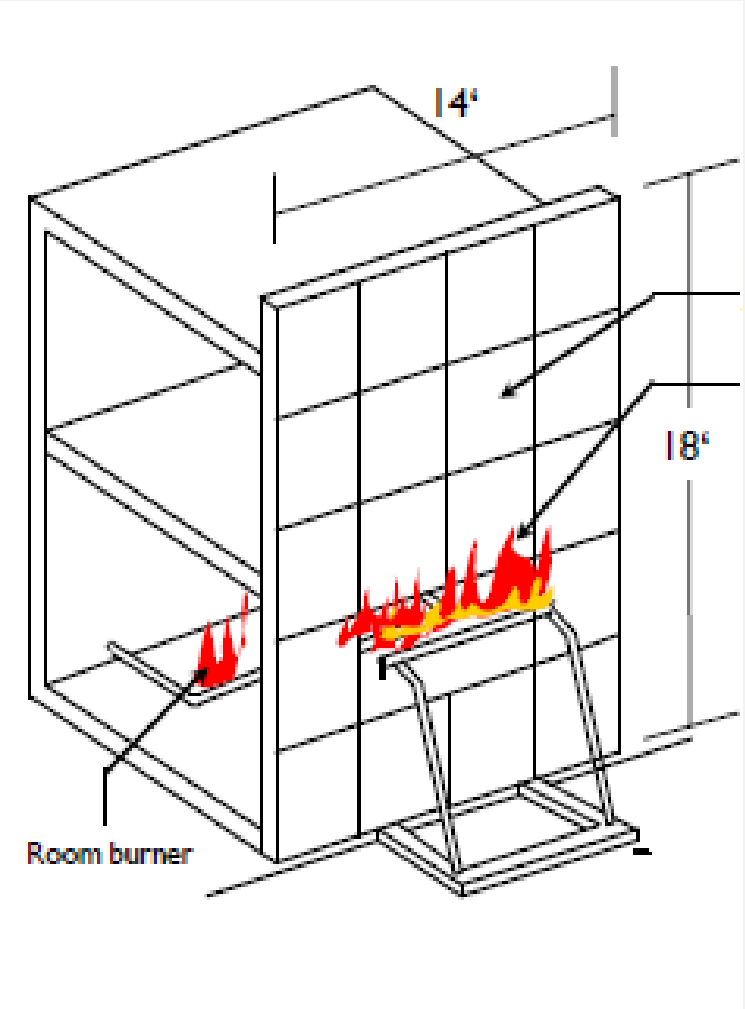
A'18

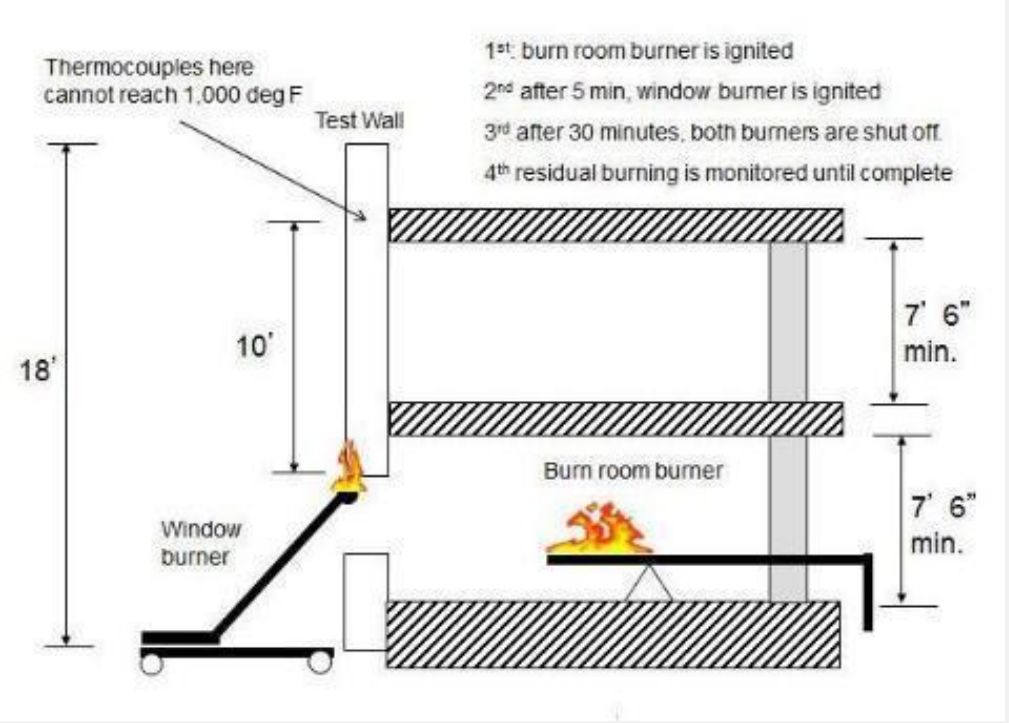
NFPA 285

Wall assembly must:

- Resist flame propagation over exterior face of system.
- Resist vertical flame within combustible core/component of panel from one story to next.
- Resist vertical spread of flame over the interior (room side) surface of panels from one story to next.
- Resist lateral spread of flame from compartment of fire origin to adjacent spaces.

Conducting the NFPA 285 Test





Two-story simulation of a fire

- Room burner is turned on
- 5 Minutes –Window burner #2 turns on
- 30 Minutes -Fire is terminated
- Monitor Distance fire spreads -visually
- Monitor Internal wall temperatures

Intent of NFPA 285

Wooshin Golden Suites Busan, South Korea

- Oct 2010, 38 stories, 202 apartments plus retail
- Started in service room on 4th floor
- Combustible paint on aluminum wall panels fueled fire
- Interior sprinkler system was not effective on exterior

TVCC/Mandarin Oriental Hotel Beijing, China

- Feb 2009, 40 stories, TV center and hotel
- Started by fireworks landing on roof
- Sprinklers not working
- Fire spread on sides top to bottom in less than 13 minutes

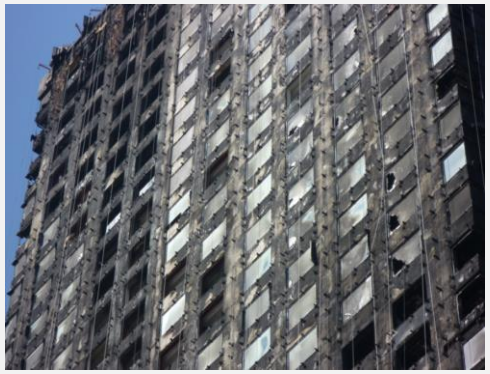
Monte Carlo Resort & Casino Las Vegas, Nevada

- Jan 2008, 32 stories, hotel, 3,000 guest rooms
- Started by welders working on the roof
- EIFS cladding was not the primary fire driver
- Decorative bands made of EPS covered with a non-EIFS coating

Intent of NFPA 285

28-Story Apartment Building in Shanghai

- Façade replacement.
- Welding spark ignited the combustible insulation
- 53 people lost



Sheraton Hotel Shanghai

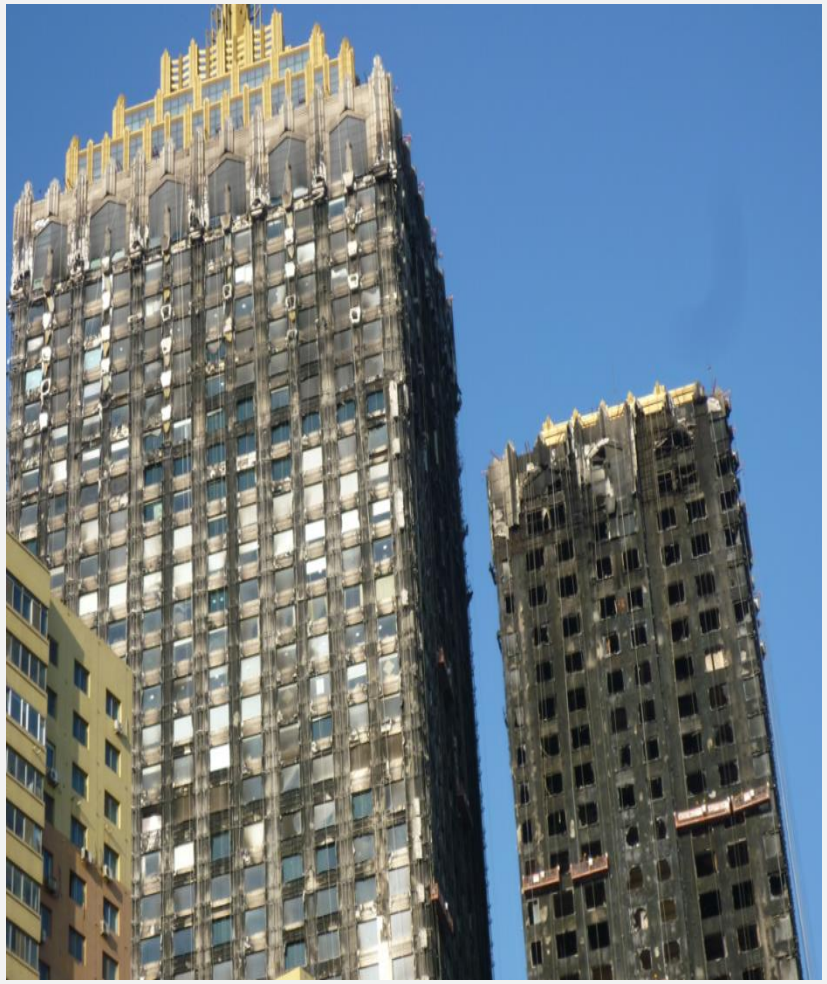
- Fire fueled by combustible insulation
- Façade brackets still visible on the building

Address Hotel Dubai

- Electrical short circuit on the exterior of the14th floor
- New years eve 2015
- Forced code changes in Dubai

Intent of NFPA 285

- For decades, mineral wool has been recognized and used for fire containment in multi-story buildings.
- China's building industry is dominated by foam products; as a result, they have had several high profile and deadly fires directly attributed to the use of combustible insulation. Consequently, China has changed their building code to mandate the use of mineral wool in structures over 26 meters tall.
- This is a photo taken in 2011 of the Sheraton Hotel buildings in Shenyang, China. You can see the fire burned both of these building completely.



R-Value

- Mineral wool insulation reduces the transfer of heat (and cold) through building structures or envelopes by providing a thermal resistance of 4.3 per inch (k-value 0.24).
- Mineral wool is also the most cost effective continuous insulation product; for the same R-value, mineral wool costs 40–60% less per square foot than a comparable foam product.
- Foam products offer R-values ranging from 5–6 per inch of thickness. For an R-10 continuous insulation, a 2"-thick rigid foam product or a 2.5"-thick mineral wool continuous insulation would meet that requirement. In some assemblies, the use of mineral wool can actually offer a higher R-Value without increasing the overall wall thickness.

Retains R-Value

- When mineral wool remains exposed to the weather and is **saturated**, insulating value is reduced; however, if the insulation is dried and not mechanically changed in form, the thermal properties return to their original level.
- Tests were conducted for thermal conductivity ratings per **ASTM C 518** on a dry piece of insulation. The insulation was then submerged in water for a time period (88 hours) that allowed the material to become completely saturated. The insulation was then allowed to dry. When dry, the material was again tested for thermal conductivity ratings.
- The two ratings were compared and the results were identical. In conclusion, the **thermal properties remain intact after exposure to moisture, rain, etc**., when allowed to dry by either natural or accelerated means.

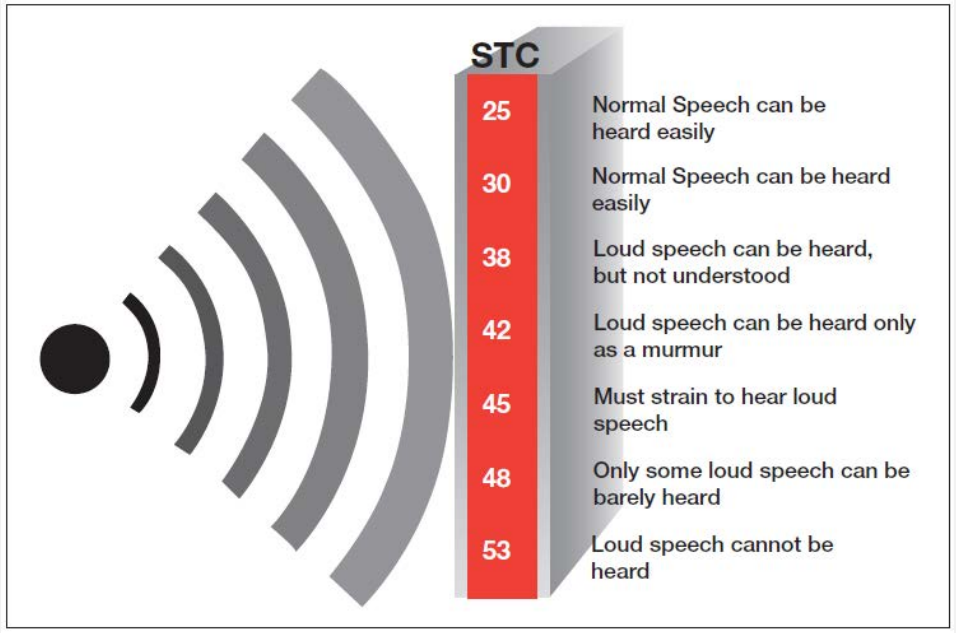
Moisture Resistance

Mineral wool insulation is engineered to repel and drain moisture in continuous insulation applications. It is designed to handle condensation, driving rain, and other moisture that may be introduced into the wall assembly.

ASTM C 1104 - Absorbs 0.03% by volume

Indoor Environmental Quality: Acoustics

- Another attribute that mineral wool products provide is sound attenuation. All mineral wool insulation blocks and absorbs sound passing between partition walls and floor/ceiling applications.
- Assemblies which include mineral wool are capable of providing sound transmission coefficients (STCs) that improve the indoor environmental quality for the occupants of a structure.



Indoor Environmental Quality: Acoustics

- Using insulation with sound control properties on the exterior of the building can help to improve the indoor environmental quality by reducing the amount of noise coming in from outside the building.
- The chart below describes the noise reduction coefficient of different thicknesses of a typical mineral wool. The NRC is a number used for rating how a particular material absorbs sound. It is determined through laboratory testing. **The number ranges from zero (perfectly reflective) to 1 (perfectly absorptive),** and some materials can test above 1.

Coefficients at Frequencies Per ASTM 423							
Thickness	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
1 ½"	.22	.44	.96	1.06	1.05	1.05	.90
2"	.30	.69	1.08	1.01	1.00	1.03	.95
3"	.70	1.07	1.24	1.13	1.07	1.08	1.15
4"	1.03	1.25	1.20	1.05	1.05	1.08	1.15

Durability

Mineral wool continuous insulation

- UV resistant
- Water repellant
- Ideal for open joint façade construction

Other continuous insulation products

- Water repellant
- Cannot be left exposed to UV for extended periods of time

In a testament to the durability of mineral wool, this photo of the Museum of the Moving Image was taken after this insulation had been left exposed for over four months through the New York winter. **This insulation has been exposed to UV rays, rain, sleet, snow and ice, yet it remained intact and in great condition.**

Museum of the Moving Image, Astoria, NY

Durability

Open joint façade system on the Museum of the Moving Image that shows the metal façade panels.

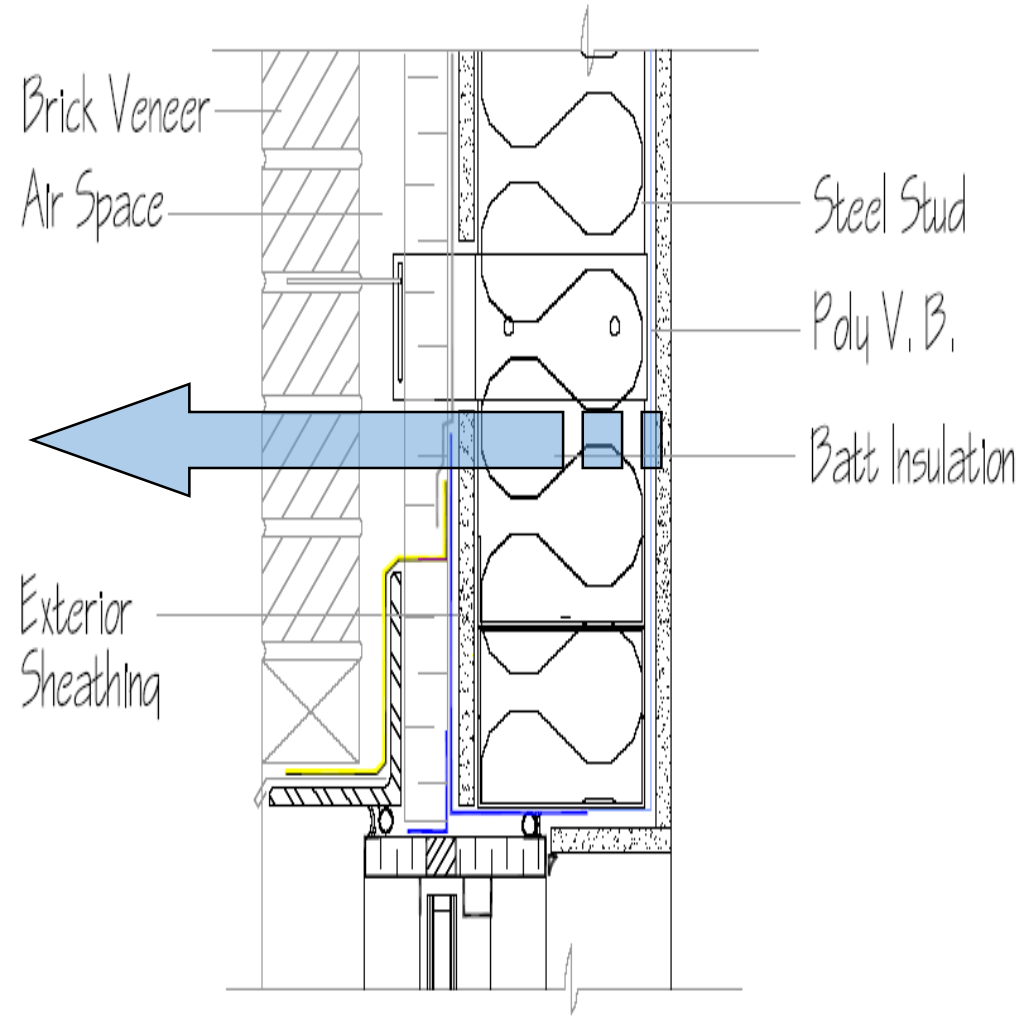
Museum of the Moving Image, Astoria, NY

Aesthetics

- Mineral wool continuous insulation is a naturally dark fiber.
- This dark fiber is used in open joint façade systems to create a shadowing effect.
    - The dark fiber camouflages the open joint and will not detract from the aesthetics of the building.

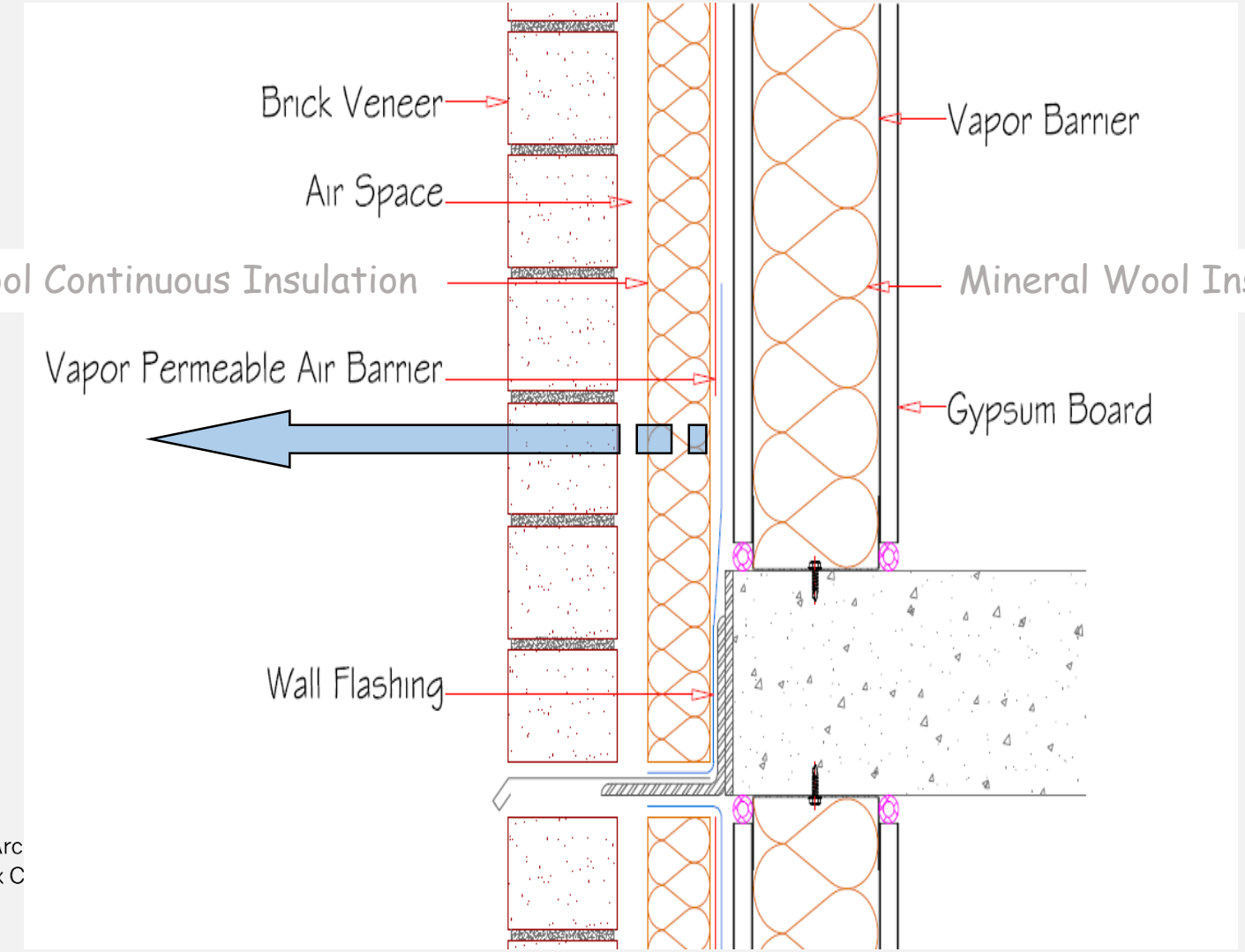
Vapor Permeable

- Mineral wool, as a continuous insulation, lets your building “breathe.”
- As it is air/vapor permeable, it provides better control over humidity, condensation and air quality—plus, its flexibility facilitates positioning the vapor barrier. Mineral wool has a **permeance rating of 50**.
- Unlike mineral wool, other products block airflow, making it more difficult for the building to breathe.



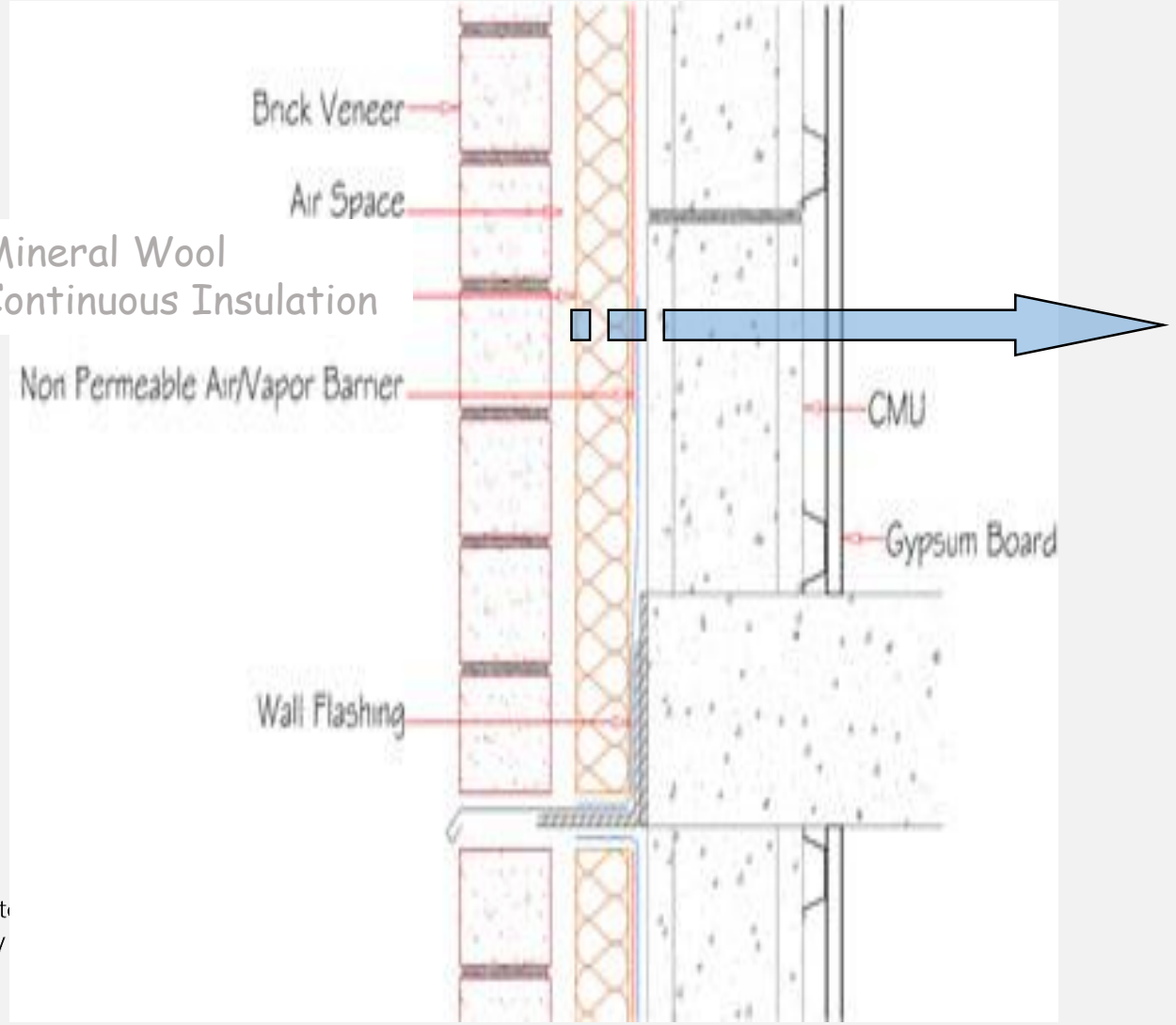
Rainscreen & Cavity Wall Assemblies

Typical Vapor Permeable Wall Design



Rainscreen & Cavity Wall Assemblies

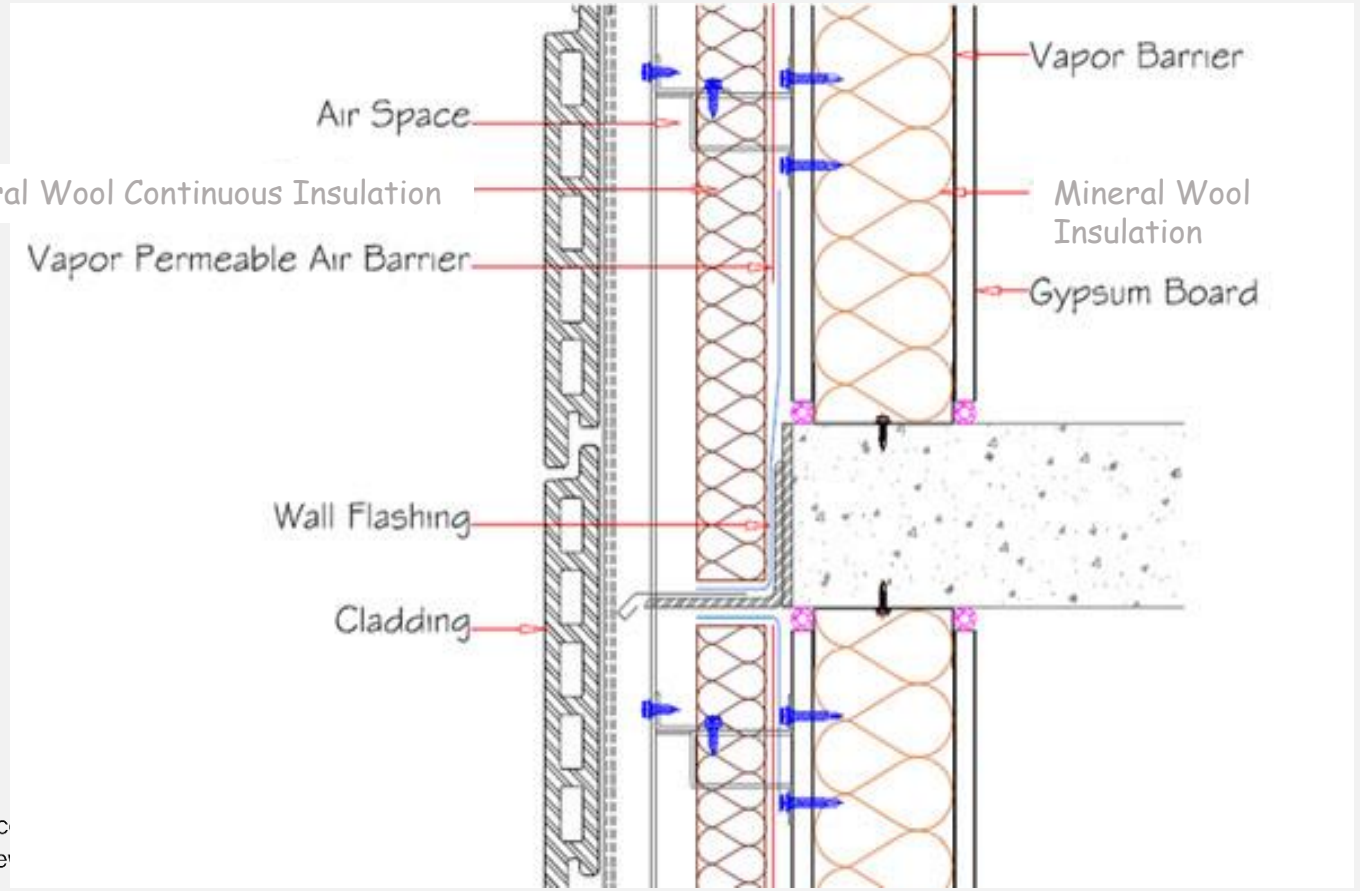
Typical Non –Permeable Wall Design



Open Joint Assemblies

Open Joint Assembly

- The use of UV resistant mineral wool ensures the durability of the assembly and no loss of R-value.



LEED Contribution

Mineral wool continuous insulation is capable of contributing to a number of LEED credit categories:

Energy & Atmosphere Credit 1: Optimize Energy Performance

- Mineral wool helps to minimize the amount of energy needed to heat and cool a building, resulting in reduced greenhouse gas (GHG) emissions. Mineral wool continuous insulation is only one component of the building envelope. Points are awarded based on energy efficiency above ANSI/ASHRAE/IESNA Standard 90.1-2007.

Materials & Resources Credits 2.1 & 2.2: Construction Waste Management

- Mineral wool insulation products can be diverted from the waste stream by removing undamaged material and re-installing it in new projects.
- 50% recycled or salvaged - 1 point
- 75% recycled or salvaged - 1 additional point

LEED Contribution

Materials & Resources Credits 3.1 & 3.2: Materials Reuse

- Mineral wool insulation can be removed from demolition projects and reused in new construction.

Materials & Resources Credits 4.1 & 4.2: Recycled Materials

- With up to 90% recycled content, mineral wool offers an extremely high level of recycled content.

Materials & Resources Credits 5.1 & 5.2: Regional Materials

- Mineral wool is manufactured in the U.S. Check with manufacturers to see if your project qualifies for these credits.

Indoor Environmental Quality Credits 3.1 & 3.2: Construction Indoor Air Quality, Management Plan During Construction

- Many mineral wool products have been evaluated by a third party independent laboratory to certify that emissions are below containment concentration thresholds established by LEED.

LEED Contribution (For Schools Only)

Indoor Environmental Quality Credit 9: Enhanced Acoustical Performance

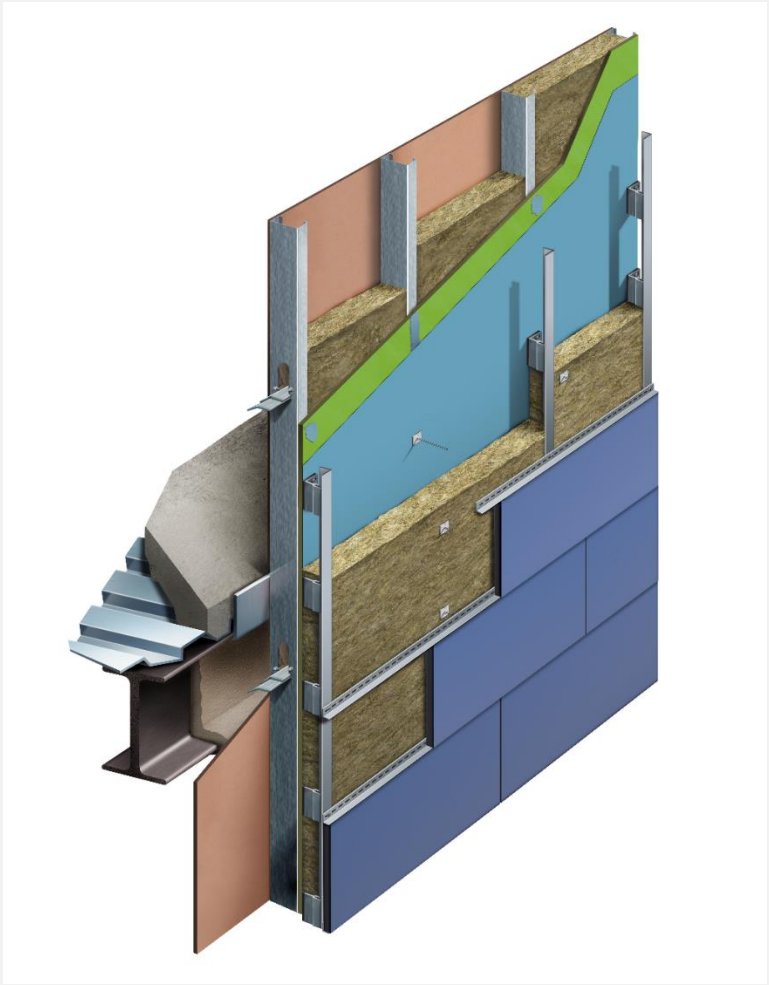
- Mineral wool sound attenuation products absorb sound passing between partition walls and floor/ceiling applications. In wall assemblies, mineral wool continuous insulation products help provide sound transmission coefficients (STCs) that improve indoor environmental quality.

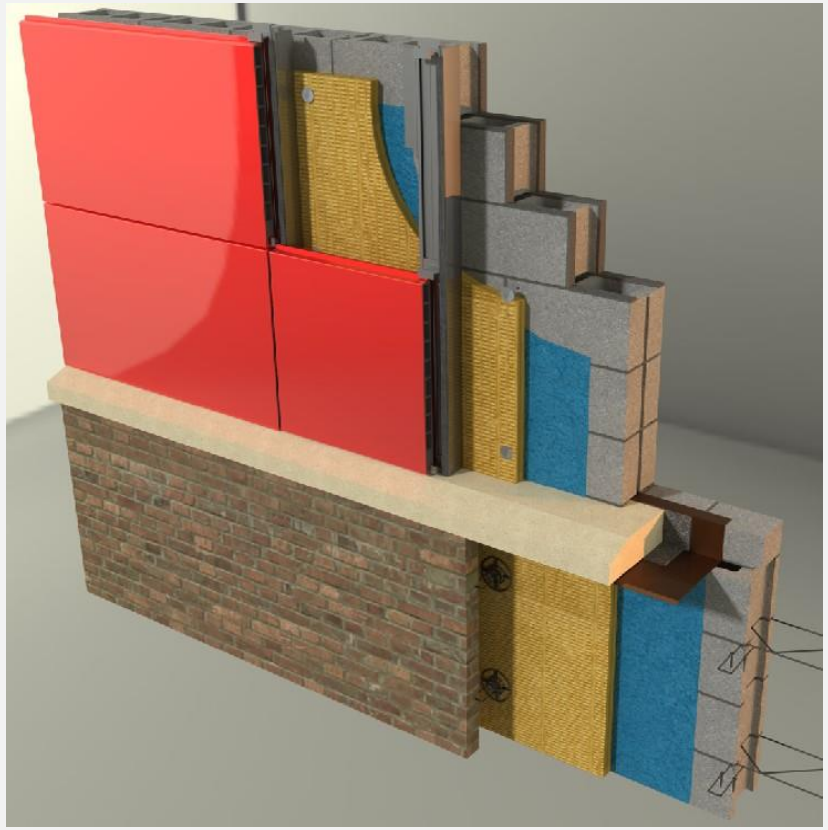
Innovative Design Credit 1:

- Mineral wool products allow LEED design teams the opportunity to achieve exceptional performance above the requirements set by the LEED rating system.

Installation and Use

Installation – Metal Panel Facade





Installation – Metal Panel Facade

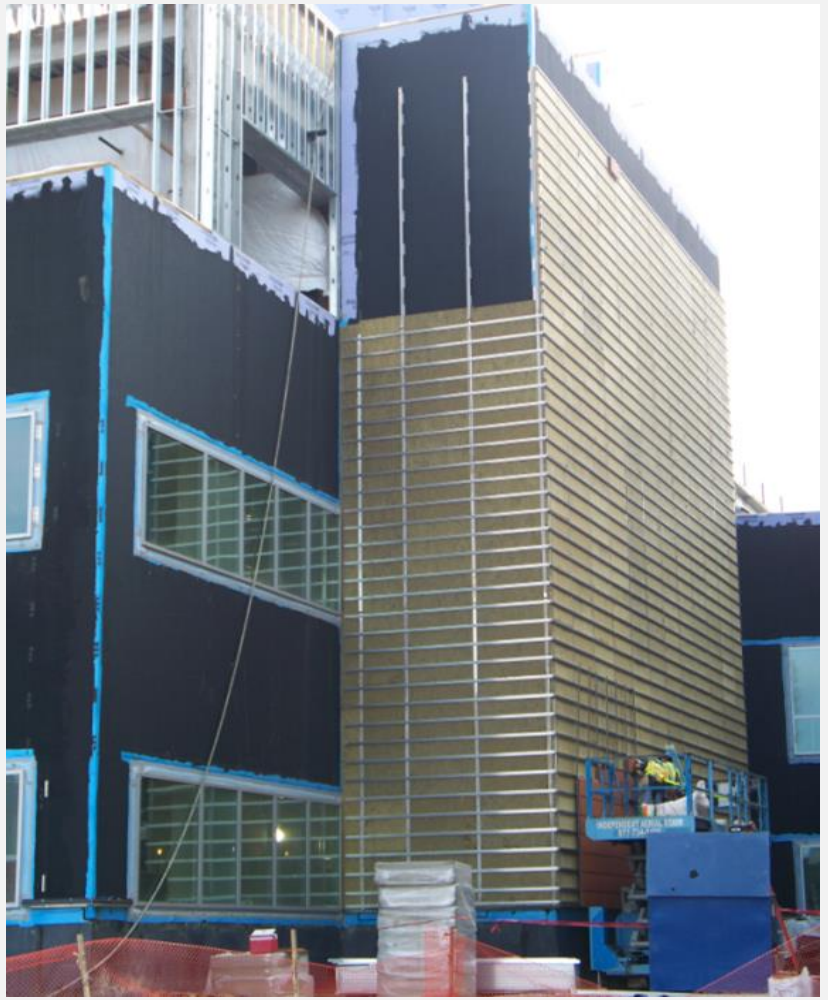
- Mineral wool is a semi-rigid product that is easy to cut and install. Its flexibility allows it to conform to building shapes and construction irregularities. It comes in standard-sized sheets and is easily cut with a serrated knife.
- Rainscreen and cavity wall systems vary greatly from types of hangers to how they are installed. Generally, mineral wool insulation is installed with abutted joints and mechanically secured and attached to the building substrate. Note that the joints do not need to be taped.
- Unlike other materials, mineral wool flexes for a better fit on curved walls and other surfaces.
- Mineral wool leaves a clean, straight edge when cut.

Installation – Metal Panel Facade

Sidney and Lois Eskenazi Hopsital, Indianapolis, IN

Installation – Metal Panel Facade

- Here, we see mineral wool being installed in a steel stud and gypsum board exterior construction.
- The mineral wool is being installed behind the grid structure that will hold the terra cotta façade panels.

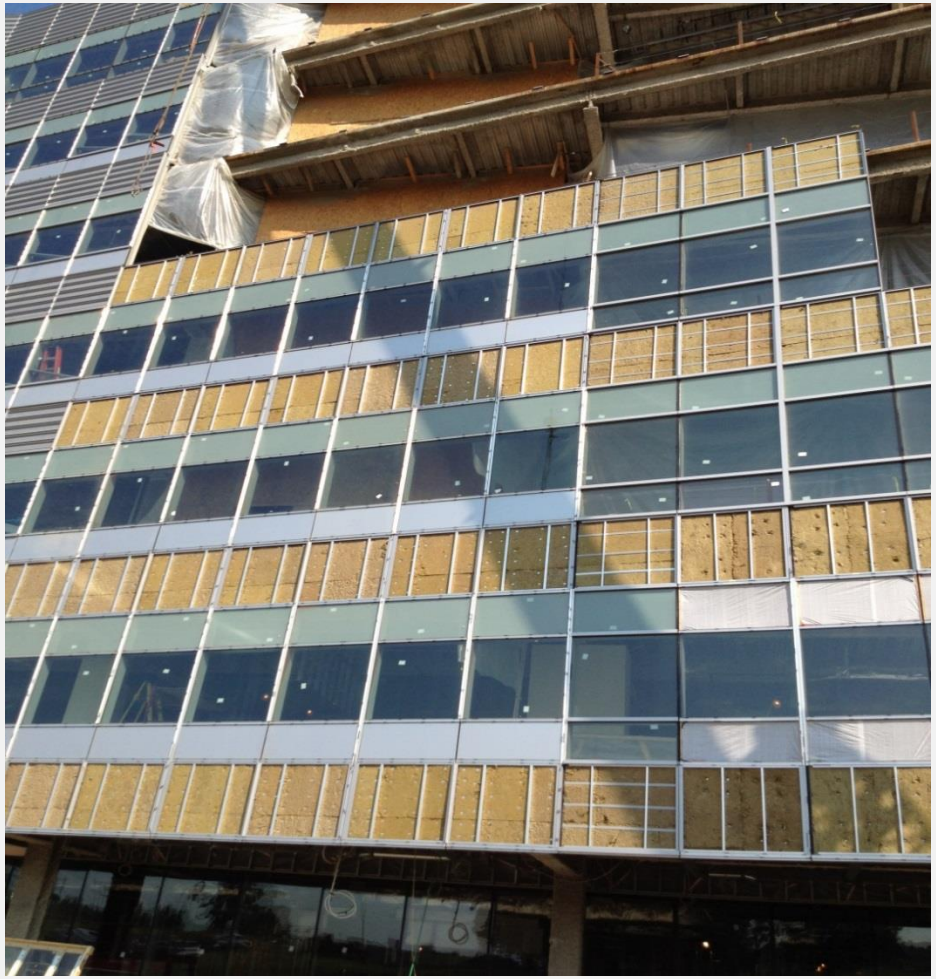


Fort Belvoir Community Hospital, Fort Belvoir, VA

Installation – Metal Panel Facade

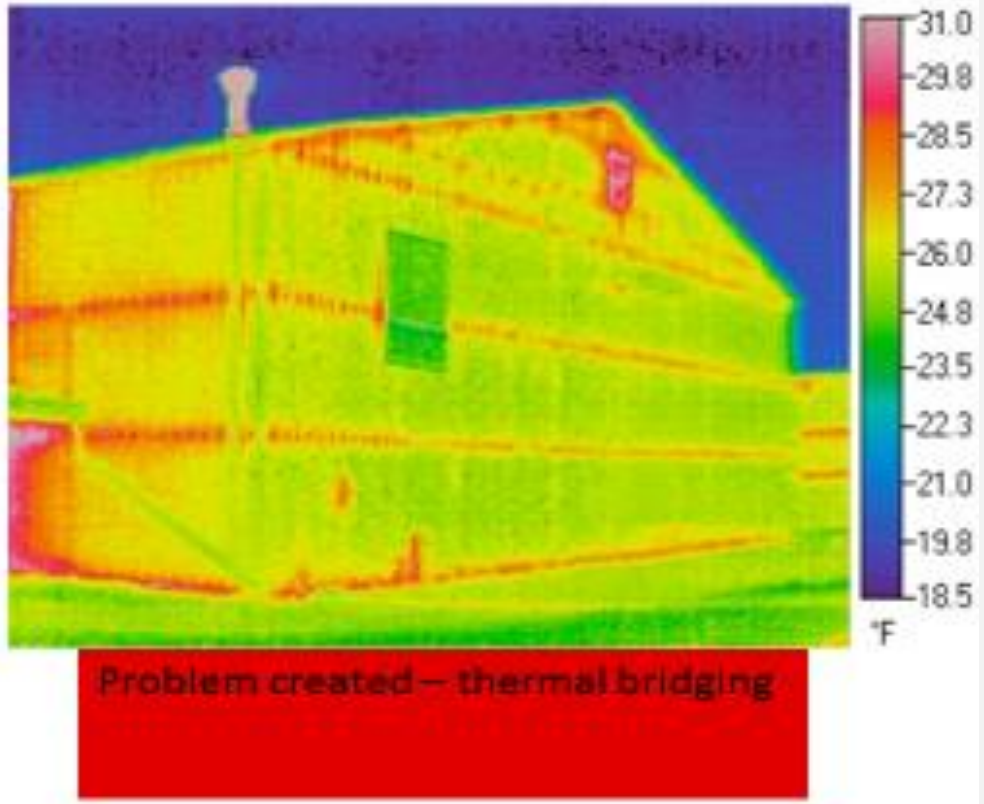
Fort Belvoir Community Hospital, Fort Belvoir, VA

Installation – Metal Panel Facade

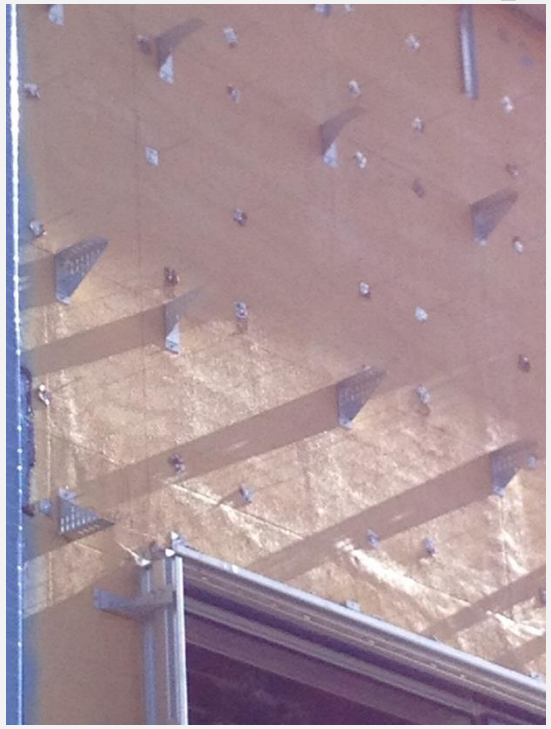


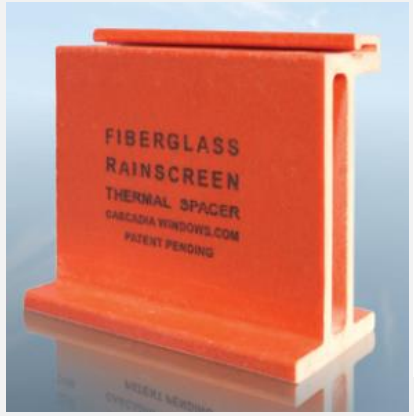
Goodyear World Headquarters, Akron, OH

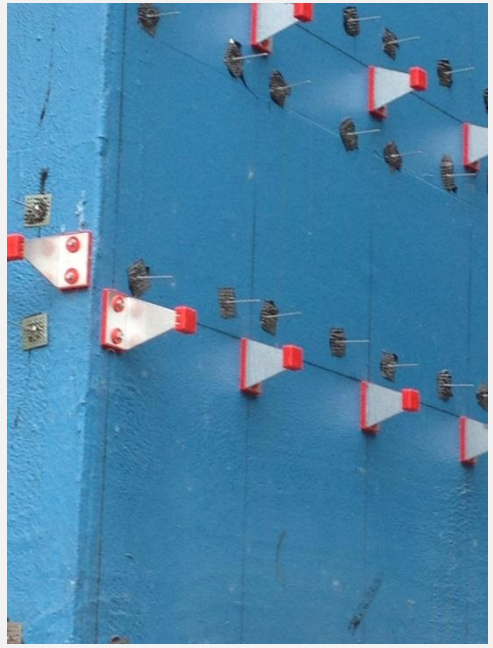
Installation



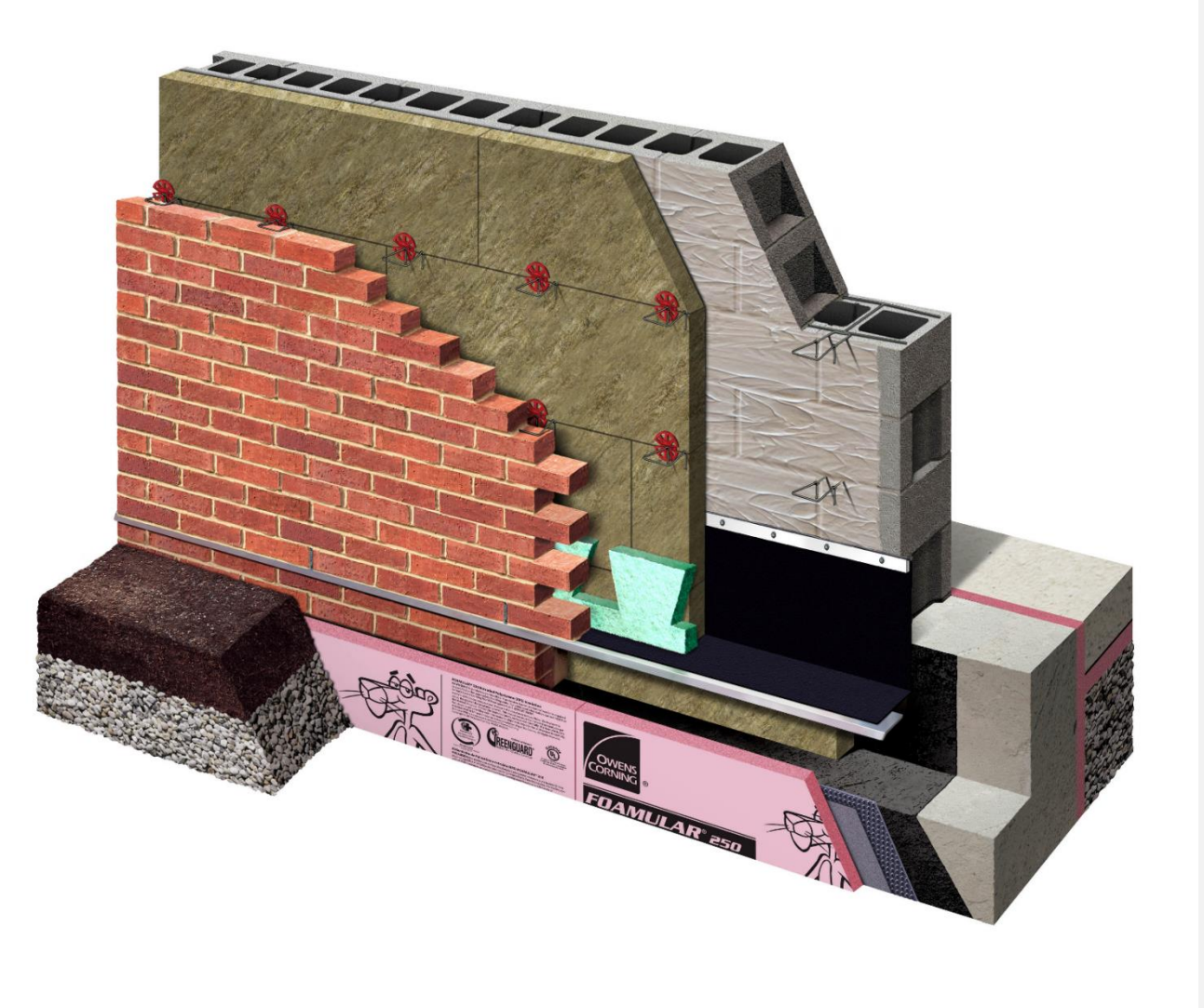
Installation – Clips Minimizing Thermal Bridging







Installation – Masonry Facade



Installation – Masonry Facade

- Insulation is friction-fitted between the wall ties in masonry applications, as shown in the top image. After installing the insulation, secure with a clip, utilizing the center notches to secure directly on the tie as shown.
- If using a flange or flat-style hanger, installation of insulation is friction-fit between ties, forming a seam (a typical size is 16" on center).

Installation – Masonry Facade

The North Quad project on the University of Michigan campus in Ann Arbor, Michigan is a typical masonry cavity wall construction. In this photo, you can see the masons installing the mineral wool insulation in the masonry cavity and securing it with retaining clips that fasten to the masonry wall ties.

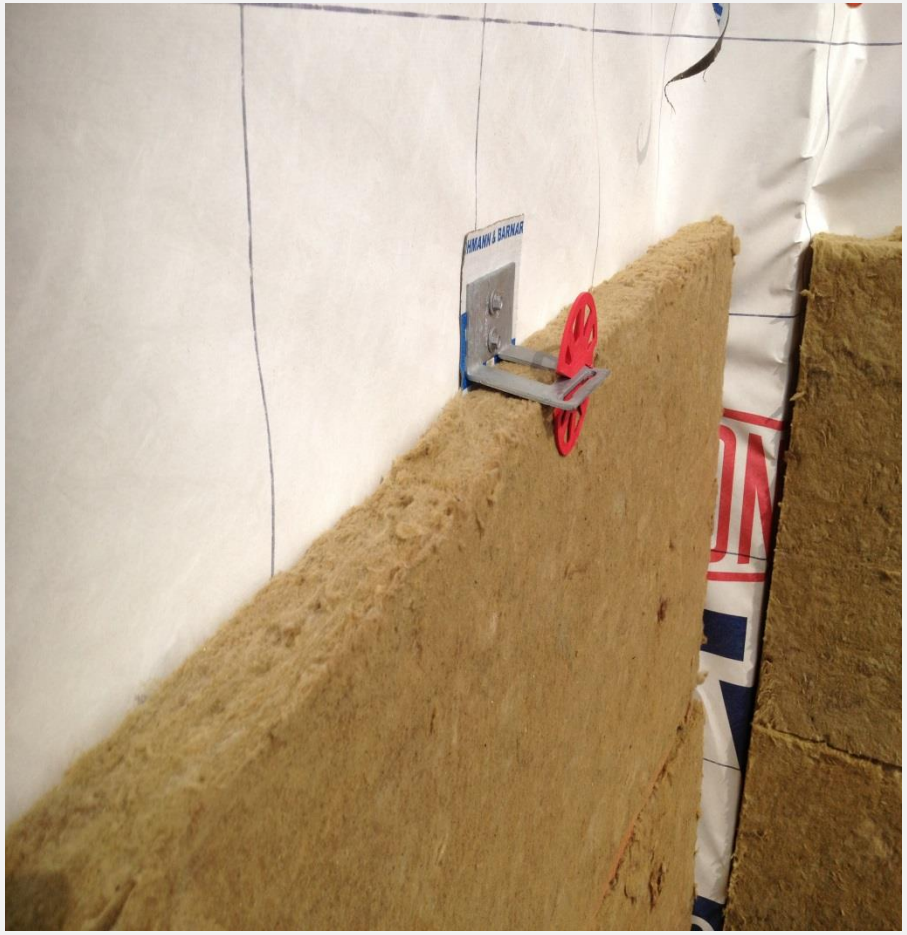
Installation – Masonry Facade

Here, the insulation is fully installed. It can be seen through the unfinished openings below the windows.

University of Michigan North Quad, Ann Arbor, MI

Installation – Masonry Facade

Installation – Masonry Facade



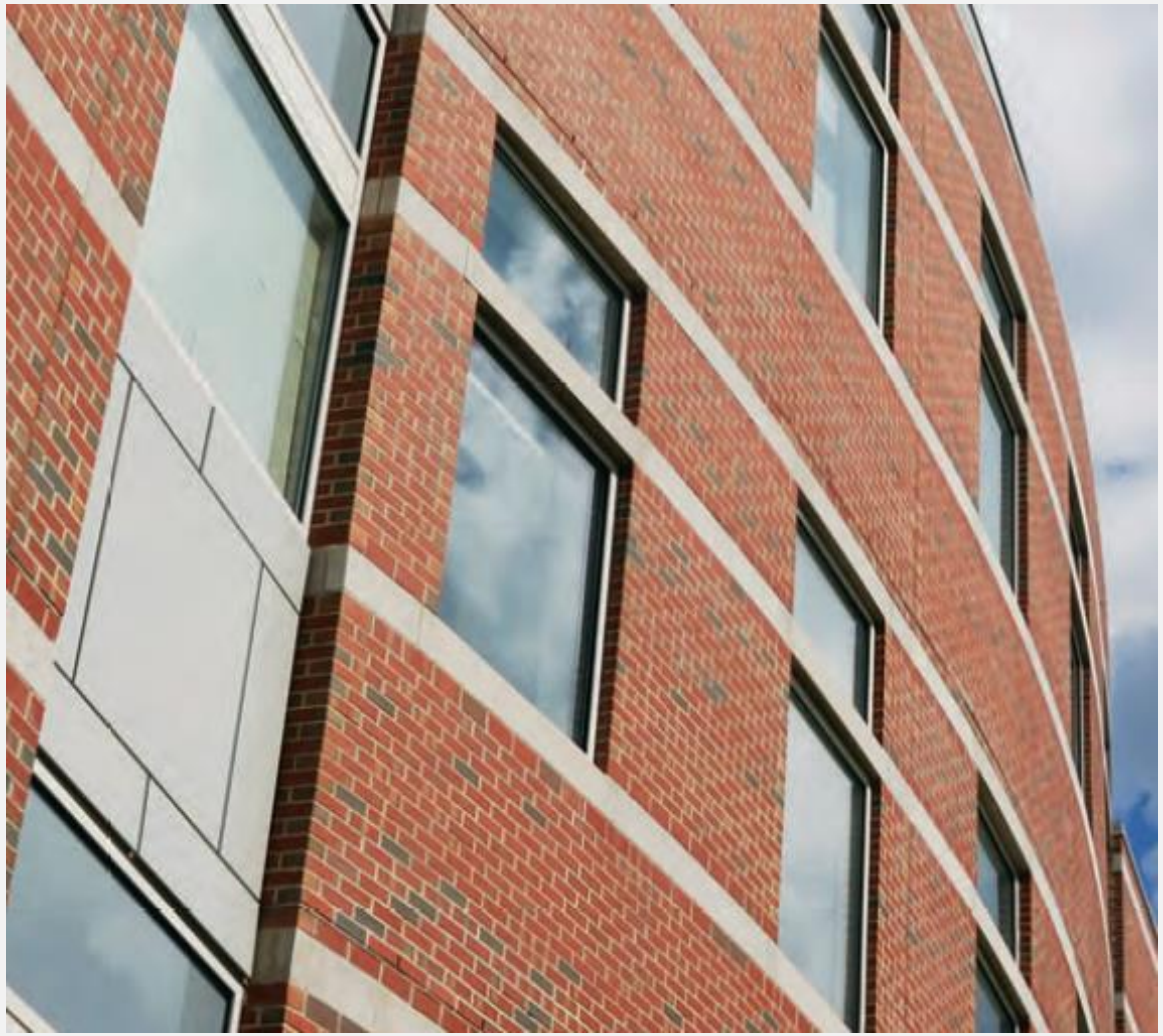
Columbus Commons, Columbus, OH

Installation – Masonry Facade

Safety of Installation

- Mineral wool is manufactured in sizes that are safe and easy to handle on the jobsite.
- It can be safely installed with regular construction scaffolding or mechanical lifts.
- Additionally, mineral wool does not pose any health or safety threats to the insulation installers.

Summary



Important Points

- ASHRAE 90.1 defines continuous insulation as: "*insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior, exterior, or is integral to any opaque surface of the building.*"
- The recently approved ASHRAE standard, 90.1-2010, by the DOE, requires states to be certified by 2013. Certification will confirm that they have reviewed the provisions of their commercial building code regarding energy efficiency and updated their code to meet or exceed Standard 90.1-2010.
- Use of continuous insulation eliminates thermal bridging and can have a dramatic impact on the energy efficiency of a building.
- **The slag content in the mineral wool fiber (ranging from 70–90+%) is the highest recycled content among all the continuous insulation products.**

Important Points

- Mineral wool is the most cost effective continuous insulation product.
- Mineral wool continuous insulation is durable, moisture resistant, flexible, UV resistant, non-combustible with a melt point above 2000°F, and air/vapor permeable.
- Mineral wool is a semi-rigid product that is easy to cut and install, and it can be used in both permeable and non-permeable assemblies.
- Assemblies which include mineral wool are capable of providing sound transmission coefficients (STCs) that improve the indoor environmental quality for the occupants of a structure.
- Mineral wool continuous insulation is capable of contributing to a number of LEED credit categories.

Thank you!