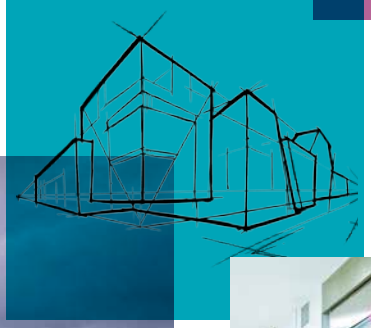
ROCKWOOL™

HIGH-PERFORMANCE
RAINSCREEN SYSTEMS

CAVITYROCK® and COMFORTBATT®

Effective Insulation Solutions – The Future
of High-Performance Rainscreen Systems



Over 60,000 sq. ft. of ROCKWOOL CAVITYROCK® was installed in the Rush University Medical Center's 14-story hospital in Chicago. (Also shown on front cover.) Rush is seeking gold leadership in energy and environment design (LEED®) certification for the new hospital. "From the beginning, it's been designed to use water and energy efficiently and keep down waste. We're using environmentally responsible building materials, and we're recycling as much as we possibly can," says Mick Zdeblick, vice president, campus transformation.*

*http://transforming.rush.edu

The Building Envelope Design using ROCKWOOL [BEDR™] Wall System Philosophy

Evolution of Rainscreen Systems

The primary functions of a wall system* – to protect, facilitate, and/or provide heat, air, rain penetration, movement of moisture, fire, durability, noise, light, strength, and aesthetics – have not changed over the past 40 years. The same cannot be said for the components and design of cavity wall systems, which have undergone a significant transformation in North America.

This change in design requirements is a result of the increased code requirements that are based on changing ASHRAE standards. Increasing requirements also ask for continuous insulation (c.i.) to meet the R-value and U-value requirements of ASHRAE 90.1.

ROCKWOOL is at the forefront of developing wall systems that meet this call for higher energy efficiency, sustainability, durability and better overall performance in commercial buildings.

*Canadian Building Digest, NRC National Research Council Canada

The ROCKWOOL Difference

The R-value of ROCKWOOL insulation does not change over time because stone wool is not produced with blowing agents, which off-gas and result in lower thermal performance. Not only is the thermal performance of ROCKWOOL insulation maintained over its lifetime, but the wall system's thermal performance is maintained because ROCKWOOL products are dimensionally stable.

ROCKWOOL insulation will not slump in stud spacing causing gaps, will not expand or contract due to temperature variances in the rainscreen system, nor is it adversely affected by the presence of moisture in the system, all of which contribute to the optimal thermal performance of a building envelope. ROCKWOOL insulation is made from stone and is non-combustible with an extremely high melting point, making it the safest insulation when compared to both fiberglass and foam plastics.

1970

All insulation in the stud wall with building paper on the exterior. No cavity wall insulation used.

1990

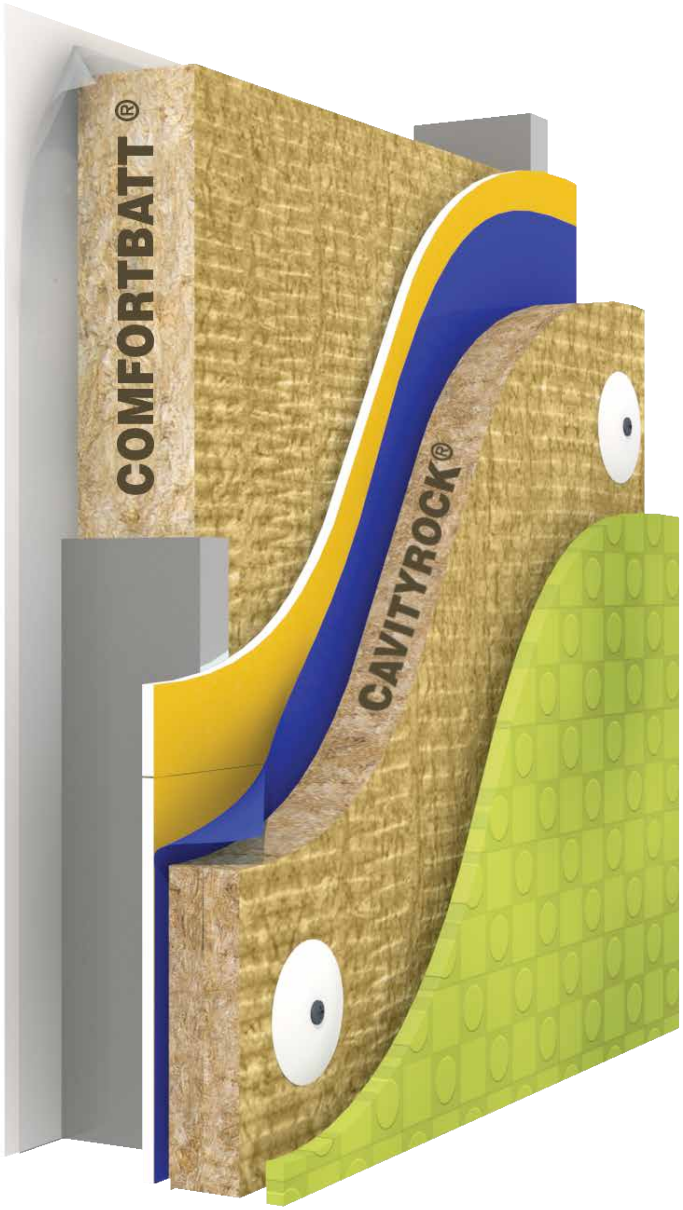
All insulation in the cavity with no insulation in the steel stud. High-performance air/vapor barriers used.

2010

A combination of insulation within the steel stud and cavity. Vapor permeable air barriers used.

The Future of High-Performance Rainscreen Systems

- Stable Long-Term Thermal Resistance
- Sound Absorbent
- Fire Resistant
- Vapor Permeable
- Continuous Insulation
- Environmentally Sustainable



The BEDR™ Wall Rainscreen System

The ROCKWOOL BEDR™ Wall Rainsceen System comprises ROCKWOOL thermal batt insulation in the exterior stud wall cavity (up to 6”), combined with a high-density, semi-rigid ROCKWOOL insulation board (up to 6”) in the external cavity.

ROCKWOOL insulation within the exterior wall stud cavity and the external cavity offers superior long-term thermal efficiency, fire resistance, moisture control, and acoustic performance.

BEDR™ Rainscreen System Zone 4-8

Components: Cladding, Air space, CAVITYROCK®, Permeable air barrier, Exterior gypsum board sheathing, Steel stud, COMFORTBATT®, Vapor barrier, Gypsum board.

Note: In climates dominated by heating degree days (HDDs), the blue air barrier material should be vapor permeable.

ROCKWOOL COMFORTBATT® and CAVITYROCK®–BEDR™ Wall Combination

ROCKWOOL COMFORTBATT®

The COMFORTBATT® product line is a non-combustible, semi-rigid batt insulation range that is designed for exterior steel stud wall applications.

COMFORTBATT® products are available from 2.5" to 8" in thickness and have standard R-values ranging from R10 to R32. Stone wool batt insulation will not slump inside the wall cavity over time. COMFORTBATT® products also provide excellent sound absorption characteristics.

ROCKWOOL CAVITYROCK® products are compatible with numerous framing systems and cladding attachment systems. To learn more visit ROCKWOOL.com

ROCKWOOL CAVITYROCK®

ROCKWOOL CAVITYROCK® products are non-combustible, semi-rigid insulation boards specifically engineered for exterior cavity wall and rainscreen applications.

CAVITYROCK® is available in sizes from 1" to 6" in thickness, in .5" increments. The products available in 1" to 2" thicknesses are mono-density solutions offering thermal resistance of R4.2/in. These products are suggested when lower exterior thermal resistance is required.

The CAVITYROCK® products available from 2.5" to 6" thicknesses are produced with dual-density technology offering a high-density outer layer and a lower-density inner layer. The high-density outer layer offers greater rigidity and water repellency, while the inner layer helps to conform to architectural features. These products offer R4.3/in thermal resistance values and allow the designer to reach higher exterior insulation thermal requirements when necessary.

Why this BEDR™ Wall is a Better Wall

Dimensional Stability

The dimensional stability of an insulation material is necessary for the faultless function of an insulation system. Dimensional changes in materials vary according to their physical properties. Thermal expansion coefficients express the rate at which materials shrink or expand when cooled or heated. ROCKWOOL insulation has a much smaller thermal expansion coefficient than organic insulation materials such as foam plastics.

Poor dimensional stability can cause shrinking, expansion, and buckling of a system's insulation. These actions can lead to thermal bridging, waterproofing breaches, and unpredictable insulation performance.

Material Type	Expansion Co-Efficient 10-6 m/m˚C	Expansion at Temp. Difference of 50°C or 90°F over 10 m./33 ft.
Stone Wool	5.5	3
Concrete	12	6
Steel	12	6
Expanded Polystyrene	70	35
Extruded Polystyrene	80	40
Polyurethane	100	50
Polyisocyanurate	120	60

Water Vapor Permeance

The water vapor permeance of ROCKWOOL insulation allows for increased potential for drying without trapping transient moisture in the assembly. ROCKWOOL CAVITYROCK® and COMFORTBATT® are water repellent yet vapor permeable insulation products, and will allow transient vapors to pass through without restriction. Lower permeable insulations such as foam plastics can work as vapor retarders and can greatly affect the drying potential of many typical building assemblies.

Long-Term Thermal Performance

As the building industry seeks new and innovative solutions that are truly energy efficient, ROCKWOOL leads the way in developing wall systems with excellent long-term thermal performance. This is the result of two inherent properties in its BEDR™ insulating systems – lack of thermal loss due to dimensional changes, and the insulation's ability to repel water, which aids in the control of heat loss and gain.

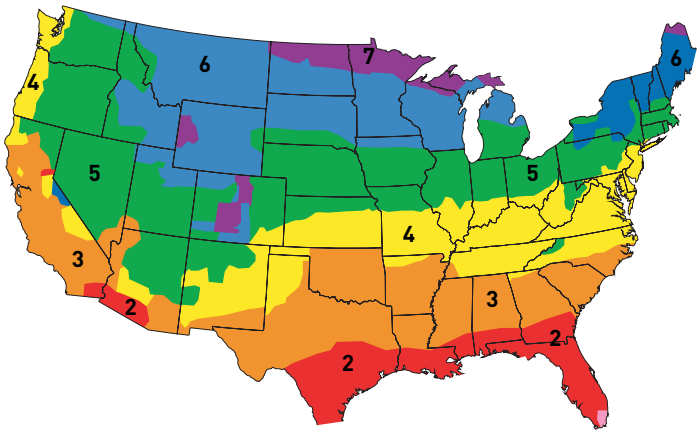
The use of CAVITYROCK® as a continuous insulation (c.i.) results in a BEDR™ wall with higher effective thermal resistance values than foam plastics.

Soleno Project, Montreal, QC
ROCKWOOL CAVITYROCK®

Meeting the Challenges of Today's Climate Zones

ASHRAE – History of R-Value Requirements

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) is an international Society of technical individuals who provide knowledge to the building industry on heating, ventilation, air-conditioning, and refrigeration (HVAC&R). The Society developed ASHRAE 90.1, an energy conservation standard that provides the minimum requirements for energy-efficient buildings. This standard, or an equivalent, is applied today in many states for commercial, government and high-rise building applications. In Canada, look to the National Building Code and refer to section A-5.3.1.2 for information on condensation and energy conservation standards.



ASHRAE Map of Climate Zones

Every rating agency has its own maps that divide regions into thermal or climate zones to tailor codes and standards to what is appropriate for that particular region.

ASHRAE 90.1 2013 All Buildings Non-Residential Specific to Cavity Wall/Rainscreen Requirements by Climate Zone

City/State	Climate Zone	Mass*	Metal Framed**
Miami, FL	1	NR	R13
Tampa, FL	2	R5.7 ci	R13 + R3.8 ci
Charleston, SC	3	R7.6 ci	R13 + R5 ci
New York, NY	4 (except marine)	R9.5 ci	R13 + R7.5 ci
Spokane, WA	5 (and marine)	R11.4 ci	R13 + R10 ci
Milwaukee, WI	6	R13.3 ci	R13 + R12.5 ci
Anchorage, AK	7	R15.2 ci	R13 + R12.5 ci
Nome, AK	8	R19 ci	R13 + R18.8 ci

* Wall without Steel Studs eg. Concrete
** Steel Stud and Cavity Wall

Canadian Equivalents to US Climate Zones

City	Province	Climate Zone
Vancouver	British Columbia	5
Calgary	Alberta	7
Regina	Saskatchewan	7
Winnipeg	Manitoba	7
Toronto	Ontario	6
Montreal	Quebec	6
Halifax	Nova Scotia	6

ASHRAE Correction Factors for Metal Wall Framing

Metal Stud Size	Stud Spacing O.C.	Cavity Insulation*	Correction Factor	Effective R-value
2x4	16″	R11	0.50	5.50
		R13	0.46	6.00
		R15	0.43	6.40
	24″	R11	0.60	6.60
		R13	0.55	7.20
		R15	0.52	7.80
2x6	16″	R19	0.37	7.10
		R21	0.35	7.40
	24″	R19	0.45	8.60
		R21	0.43	9.00
2x8	16″	R25	0.31	7.80
	24″	R25	0.38	9.60

*Cavity Insulation = Steel Stud Wall Insulation

Build Your BEDR™ Wall Rainscreen System

COMFORTBATT®

CAVITYROCK®

Continuous Insulation (c.i.)

No Insulation in Steel Stud

Steel Stud – On Center

No Insulation in the Exterior Cavity

R-value and Thickness	Canada Only		US Only		North America					
	R14 (3.5″)		R15 (3.5″)		R22.5 (6″)		R24 (6″)			
	16″	24″	16″	24″	16″	24″	16″	24″		
R4.20 (1″)	19.95	19.95	20.95	20.95	28.45	28.45	29.95	29.95		Stated R-value
	12.15	13.45	12.35	13.75	13.85	15.55	14.45	16.25	7.36	Effective R-value
R6.30 (1.5″)	22.05	22.05	23.05	23.05	30.55	30.55	32.05	32.05		Stated R-value
	14.25	15.55	14.45	15.85	15.65	17.25	15.75	17.55	8.96	Effective R-value
R8.40 (2″)	24.15	24.15	25.15	25.15	32.65	32.65	34.15	34.15		Stated R-value
	16.35	17.65	16.55	17.95	18.05	19.75	18.65	20.45	11.56	Effective R-value
R10.75 (2.5″)	26.50	26.50	27.50	27.50	35.00	35.00	36.50	36.50		Stated R-value
	18.70	20.00	18.90	20.30	20.40	22.10	21.00	22.80	13.91	Effective R-value
R12.90 (3″)	28.65	28.65	29.65	29.65	37.15	37.15	38.65	38.65		Stated R-value
	20.85	22.15	21.05	22.45	22.55	24.25	23.15	24.95	16.06	Effective R-value
R15.05 (3.5″)	30.80	30.80	31.80	31.80	39.30	39.30	40.80	40.80		Stated R-value
	23.00	24.30	23.20	24.60	24.70	26.40	25.30	27.10	18.21	Effective R-value
R17.20 (4″)	32.95	32.95	33.95	33.95	41.45	41.45	42.95	42.95		Stated R-value
	25.15	26.45	25.35	26.75	26.85	28.55	27.45	29.25	20.36	Effective R-value
R21.50 (5″)	37.25	37.25	38.25	38.25	45.75	45.75	47.25	47.25		Stated R-value
	29.45	30.75	29.65	30.05	31.15	32.85	31.75	33.55	24.66	Effective R-value
	15.75	15.75	16.76	16.75	24.25	24.25	25.75	25.75		Stated R-value
	7.95	9.25	8.15	9.55	9.65	11.35	10.25	12.05		Effective R-value

- Units in h.ft² °F/BTU
- Effective Insulation/Framing Layer R-values between steel framing factors were obtained from ASHRAE 90.1-2013 Table A9.2-2
- Effective R-values are shown for thermal design only. Assumes CAVITYROCK® is installed as continuous insulation (c.i.).
- Moisture and condensation potential should be calculated for each assembly designed.
- COMFORTBATT® is also available in 2.5″ for steel stud applications.

For more detailed calculations, contact the ROCKWOOL Building Science team to discuss your specific wall design and your required performance level at 1-800-265-6878.

Effective R-values - Example Calculation

Components	R-values
Exterior Cladding	0
Air Film Ext.	0.17
1.5″ Air Space	0
Insulation in the Cavity	6.3
Exterior Gypsum Sheathing	0.45
Stud Cavity Insulation	0.91
Gypsum	0.45
Air Film Int.	0.68
Total	8.96

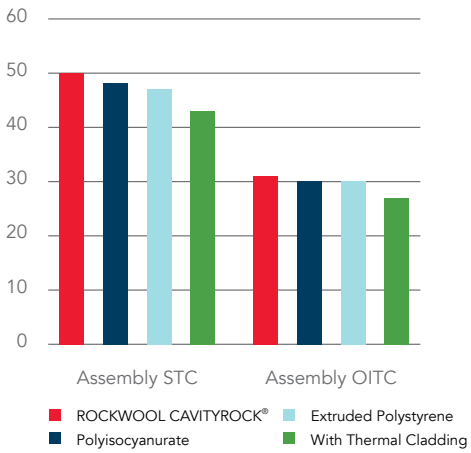
Superior Sound Absorption

Architects are increasingly choosing cladding façades on buildings, which, when compared to brick, tends to reduce the acoustical performance value of the wall system. With recent trends towards the use of new lightweight construction techniques and cladding materials, ROCKWOOL stone wool cavity wall insulation provides added acoustical value by outperforming traditional foam plastic insulation.

In a BEDR™ wall system, stone wool provides improved low frequency sound absorption to both normal and random incidents of noise. Reduced noise in the workplace can result in a more efficient and pleasant work environment for building occupants.

The stone wool fiber orientation and increased density of both CAVITYROCK® and COMFORTBATT®, compared to other types of insulation, effectively reduce sound transmission across the wall system. Greater noise or sound control is further achieved when thicker CAVITYROCK®, COMFORTBATT®, and gypsum board are used together.

ASTM E90 Sound Transmission Loss Test (Metal stud wall with exterior cladding system)



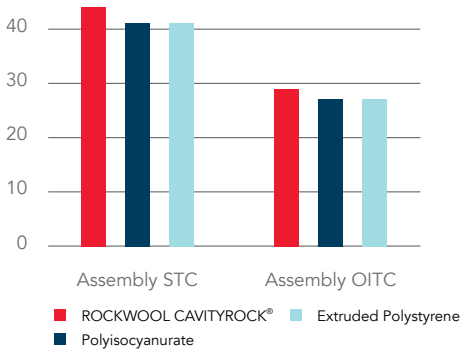
Test Wall: (Inside to Outside) 1/2" Gypsum, 6" Steel stud, ROCKWOOL COMFORTBATT® insulation, 5/8" Gypsum board, Air/Vapor retarder, ROCKWOOL CAVITYROCK® insulation, 3/8" Cement board cladding.

CAVITYROCK® – Accoustical Performance

ASTM C423 - Co-Efficients at Frequencies

Thickness	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
1.5"	0.19	0.55	1.03	1.06	1.02	1.01	0.90
2.0"	0.26	0.71	1.14	1.09	1.04	1.03	1.00
3.0"	0.72	0.93	0.88	0.84	0.90	0.97	0.90

ASTM E90 Sound Transmission Loss Test (Metal stud wall without exterior cladding system)



Test Wall: (Inside to Outside) ½" Gypsum, 6" Steel stud, Gypsum board, Air/Vapor retarder, ROCKWOOL CAVITYROCK® insulation, Airspace, 3/8" Cement board cladding.

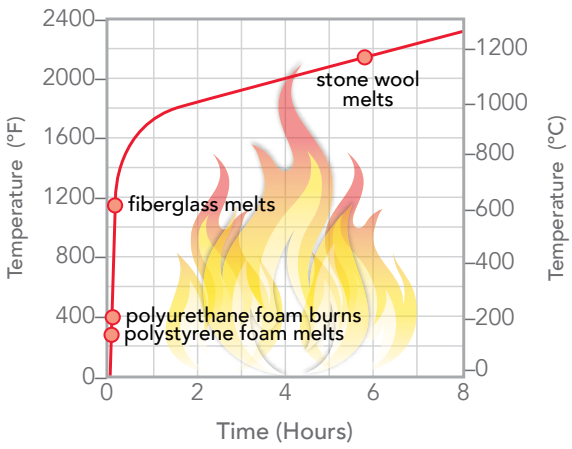
ROCKWOOL Stone Wool: Fire Resistant, Non-Combustible Insulation

A key feature of ROCKWOOL products is their fire resistance. CAVITYROCK® is classified as "non-combustible" as determined by ASTM E136 and CAN4-S114. It will not develop toxic smoke or promote flame spread, even when directly exposed to fire, as some other insulation materials do. When tested in accordance with ASTM E84, results typically show a flame spread of 0 and a smoke development of 0. By comparison, spray polyurethane foam (SPUF) results, when tested to ASTM E84, typically achieve a flame of 25 and smoke developed in the 350 to 500 range. ROCKWOOL CAVITYROCK® and COMFORTBATT® stone wool insulation have a melting point of approximately 2150°F (1177°C).

Fire Safety: Stone Wool Versus Foam

More recently, as a result of the Shanghai fire in 2010, new concerns have been raised about fire safety during construction. In the case of the Shanghai fire, foam insulation was ignited accidentally during construction and quickly spread through the building exterior. Because of these safety concerns, ROCKWOOL firmly believes in the added value that passive fire resistance provides for buildings.

Temperature Development in a Standard Fire (ASTM E119)



The severity of the Shanghai fire was partially a result of the use of urethane foam insulation, which aided in the spread of flame and smoke.

Fire Performance

Product	Specification	Test	Result
CAVITYROCK®	ASTM E136	Behavior of Materials at 1382°F (750°C)	Non-Combustible
CAVITYROCK®, COMFORTBATT®	CAN4 S114	Non-Combustibility in Building Materials	Non-Combustible
CAVITYROCK®	ASTM E84 (UL 723)	Surface Burning Characteristics	Flame Spread = 0 Smoke Developed = 0
CAVITYROCK®, COMFORTBATT®	CAN/ULC S102	Surface Burning Characteristics	Flame Spread = 0 Smoke Developed = 0

Moisture Management

Moisture Retention Comparison

To obtain a better understanding of the characteristics of in situ thermal insulation within cavity walls, a Certified Building Science Expert at ROCKWOOL reviewed two applicable scenarios in Seattle, Washington. The scenarios were modeled for a three-year period and the theoretical wall was located at mid-level of a high-rise on the western elevation. The charts below represent the first modeled scenario. Note that, in this scenario, CAVITYROCK® had much less moisture content over the same period than XPS foam insulation under the same conditions.

Wall with ROCKWOOL CAVITYROCK® [(Water Content (kg/m³)]

Layer/Material	Start of Calc.	End of Calc.	Min.	Max.
Brick (Old)	3.34	2.91	1.19	195.38
Air Layer 25 mm	1.88	2.07	0.46	23.48
ROCKWOOL CAVITYROCK®	0.02	0.02	0.00	0.07
Vapor Retarder (1 perm)	0.00	0.00	0.00	0.00
Concrete Blocks, Pumice Aggregate	28.00	11.13	8.33	28.00
Total Water Content (kg/m²)	6.0	2.58	2.16	24.79

Results: Mineral wool insulation in a typical cavity wall will at maximum increase water content from 0.02 kg/m³ to 0.07 kg/m³. XPS had an increase in water content from 0.31 kg/m³ to 0.68 kg/m³.

Ten air changes/hour were included in this calculation.

WUFI* – Seattle, Washington Climate Zone 4 Wall with XPS [(Water Content (kg/m³)]

Layer/Material	Start of Calc.	End of Calc.	Min.	Max.
Brick (Old)	3.34	3.01	1.19	195.38
Air Layer 25 mm	1.88	2.44	.044	24.27
Extruded Polystyrene	0.31	.033	0.12	0.68
Vapor Retarder (1 perm)	0.00	0.00	0.00	0.00
Concrete Blocks, Pumice Aggregate	28.00	10.85	8.17	28.00
Total Water Content (kg/m²)	6.03	2.58	2.13	24.89

*WUFI is the acronym for "Wärme – und Feuchtetransport instationär" ("Transient Heat and Moisture Transport"). WUFI is designed to calculate the simultaneous heat and moisture transport in multi-layered building components.

Double Vapor Barriers can Lead to Moisture Problems

Building enclosures see vapor transport and air movement through the assembly. Although both should be mitigated when designing, air transport will carry higher moisture levels, which could lead to significant moisture problems.

Vapor barriers (retarders) are typically required on the warm side of the assembly (i.e. the interior side for colder climates). As such, the permeability of the insulating materials and the exterior weather resistive barrier/air barrier is critical to avoid the use of double vapor barriers and ensure the wall assembly is able to dry out appropriately.

Vapor Permeability

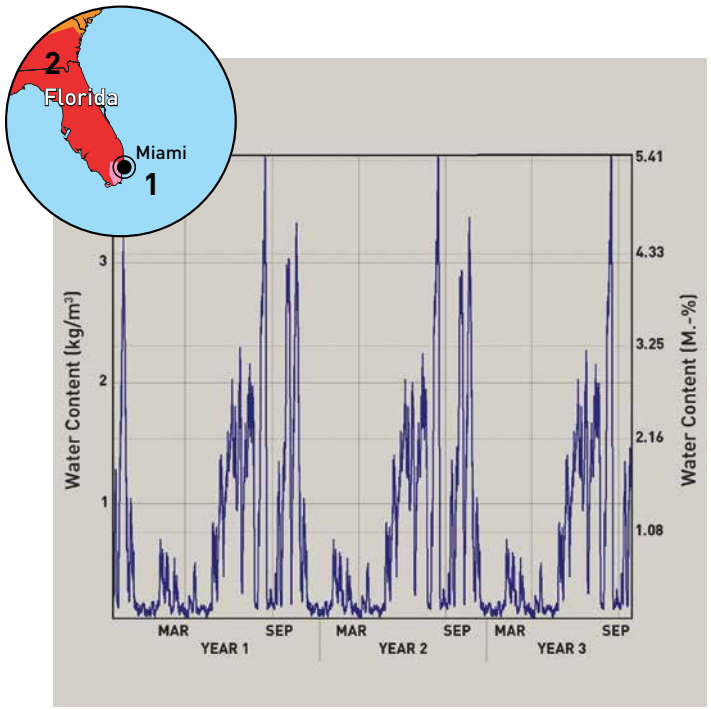
CAVITYROCK® and COMFORTBATT® are water repellent, yet vapor permeable insulation (30-40 perms) and will allow transient vapors to pass through without restriction. This vapor permeable quality of ROCKWOOL's cavity wall insulation allows for an increased potential for drying without trapping water in the wall assembly.

Lower-permeability insulations such as spray foam or XPS can function as vapor retarders and may affect drying potential of typical building assemblies if not designed appropriately.

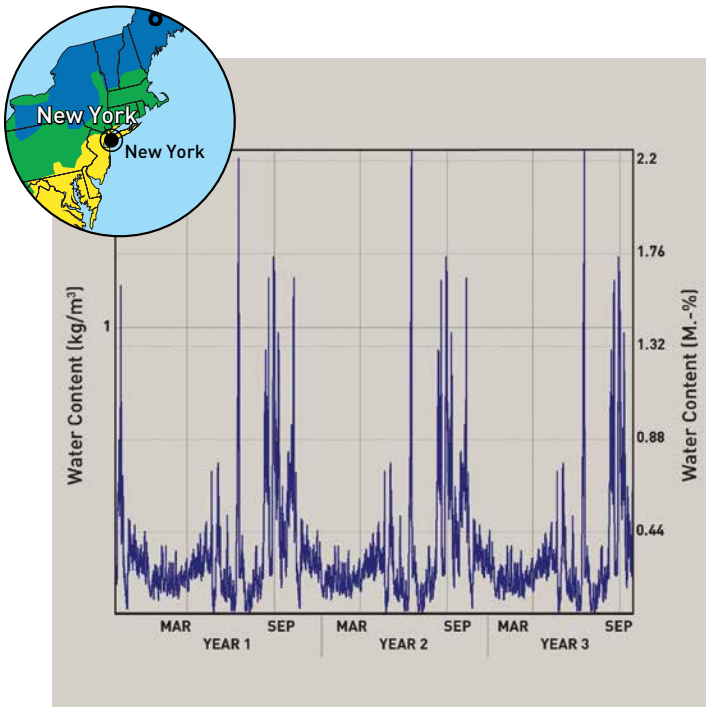
The stone wool insulation in a cavity wall assembly does not wick water, which means that any bulk water that contacts the outer surface will drain and not be absorbed into the body of the insulation.

Long-Term Performance

WUFI* – Moisture Content within BEDR Wall over 3 Years in Climate Zone 1



WUFI* – Moisture Content within BEDR Wall over 3 Years in Climate Zone 4



- Graphs indicate the moisture performance of CAVITYROCK® over a 3-year timeframe.
- CAVITYROCK® dries out year over year to the same levels, indicating that moisture does not build up in the insulation over time.

BEDR Wall Layer/Material CLIMATE ZONE 1	Start of Calc.	End of Calc.	Min.	Max.
Cement Board	43.71	197.46	16.46	349.35
Air Layer (25 mm)	1.88	13.97	0.45	26.14
ROCKWOOL CAVITYROCK®	0.20	2.19	0.05	3.89
Vapor Retarder (10 perm)	0.00	0.00	0.00	0.00
Gypsum Board (USA)	6.19	4.32	2.74	6.19
ROCKWOOL COMFORTBATT®	0.07	0.04	0.02	0.07
Interior Gypsum Board	8.65	5.24	3.45	8.65
Total Water Content*	0.79	3.05	0.3	5.19

*Water content (kg/m³)

BEDR Wall Layer/Material CLIMATE ZONE 4	Start of Calc.	End of Calc.	Min.	Max.
Cement Board	43.71	144.77	13.08	348.58
Air Layer (25 mm)	1.88	9.46	0.34	17.99
ROCKWOOL CAVITYROCK®	0.20	0.46	0.04	1.60
Vapor Retarder (10 perm)	0.00	0.00	0.00	0.01
Gypsum Board (USA)	6.19	6.18	2.44	11.79
ROCKWOOL COMFORTBATT®	0.07	0.06	0.01	1.41
Vapor Retarder (0.1 perm)	0.00	0.00	0.00	0.00
Interior Gypsum Board	8.65	4.99	3.56	8.65
Total Water Content*	0.79	2.21	0.28	4.86

*Water content (kg/m³)

ROCKWOOL CAVITYROCK® thermal insulation has a very low moisture vapor sorption and does not permit the horizontal transmission of bulk moisture through the material or the assembly.

At the ROCKWOOL Group, we are committed to enriching the lives of everyone who comes into contact with our solutions. Our expertise is perfectly suited to tackle many of today's biggest sustainability and development challenges, from energy consumption and noise pollution to fire resilience, water scarcity and flooding. Our range of products reflects the diversity of the world's needs, while supporting our stakeholders in reducing their own carbon footprint.

Stone wool is a versatile material and forms the basis of all our businesses. With approx. 10,500 passionate colleagues in 38 countries, we are the world leader in stone wool solutions, from building insulation to acoustic ceilings, external cladding systems to horticultural solutions, engineered fibres for industrial use to insulation for the process industry and marine & offshore.

ROCKWOOL
8024 Esquesing Line
Milton, ON L9T 6W3
Tel: 1 800 265 6878
rockwool.com