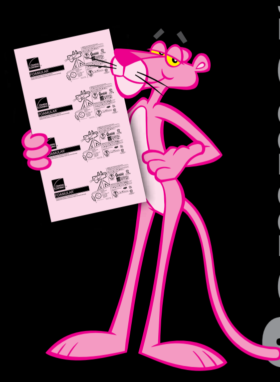
OWENS CORNING®

INNOVATIONS FOR LIVING®

CommercialComplete™ Wall Systems

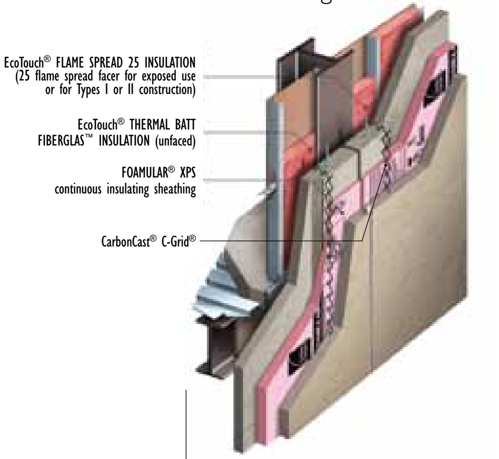
FOR STEEL STUD/MASONRY VENEER



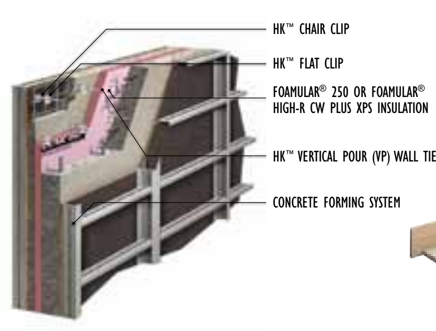
INTRODUCTION

This book is a CommercialComplete™ Wall Systems guide for steel stud/masonry veneer. The CommercialComplete™ Wall Systems portfolio also includes:

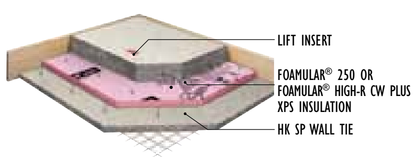
- Steel Stud and Masonry Veneer with FOAMULAR® Extruded Polystyrene (XPS), EcoTouch® FIBERGLAS™ and JointSealR™ Foam Joint Tape
- Wood Stud with FOAMULAR® XPS, EcoTouch® FIBERGLAS™ and JointSealR™ Foam Joint Tape
- Masonry Cavity Wall with FOAMULAR® XPS
- Interior Furring with FOAMULAR® XPS
- Insulated Concrete Sandwich Panel, including tilt-up, precast and cast-in-place, with structural non-composite or composite action wall tie options with FOAMULAR® XPS and EcoTouch® FIBERGLAS™
- Exterior Insulation Finish System (EIFS) with FOAMULAR® XPS
- Curtainwall with CW 225 FIBERGLAS™ Insulation
- Metal Building with EcoTouch® Metal Building FIBERGLAS™ Insulation



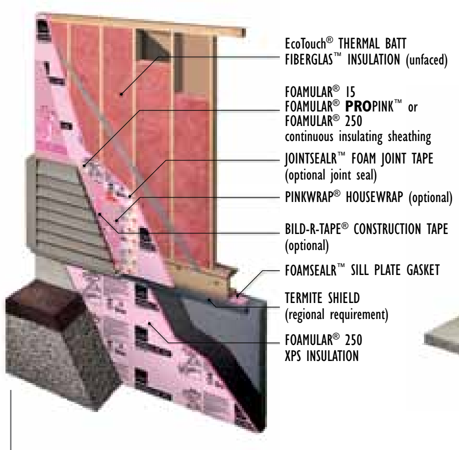
Insulated Concrete Sandwich Panel, Precast



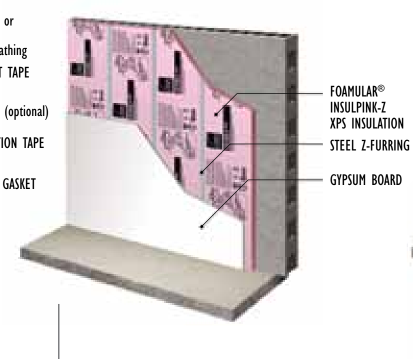
Insulated Concrete Sandwich Panel, Cast-in-Place



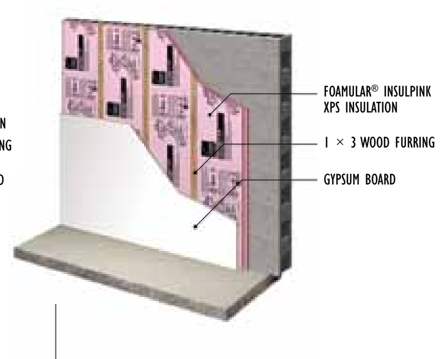
Insulated Concrete Sandwich Panel, Tilt-Up



Wood Stud Framing



Masonry Wall with Z-Furring



Masonry Wall with Wood Furring

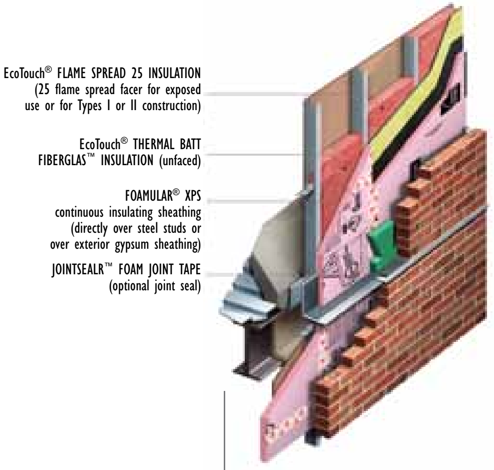
CommercialComplete™ Wall Systems

Owens Corning's™ CommercialComplete™ Wall Systems are a variety of exterior wall system solutions that provide superior energy efficiency coupled with complete air and water barrier performance, as well as fire, structural and acoustical performance qualities. They provide complete flexibility to integrate with multiple water/air barrier products and systems to effectively manage both external bulk water, and, internal and external water vapor permeation depending on regional demands. It is the complete commercial wall.

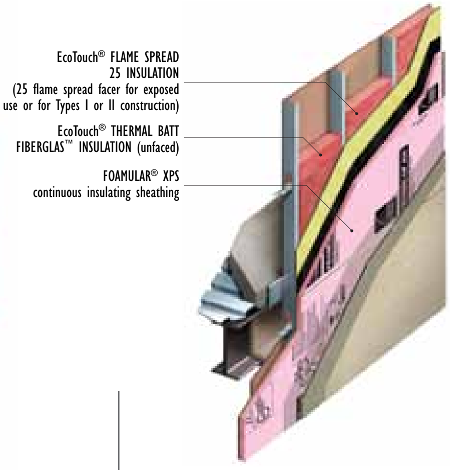
Owens Corning's™ CommercialComplete™ Wall Systems Insulation product solutions range from FOAMULAR® XPS Insulation and EcoTouch® FIBERGLAS™ Insulation for many types of commercial construction, to EcoTouch® FIBERGLAS™ Insulation for metal buildings. CommercialComplete™ Wall Systems can be designed to meet or exceed the ASHRAE 90.1[1] energy efficiency and air infiltration requirements for walls, as well as comply with the International Building Code[2] requirements for fire, structural and water resistance.

Owens Corning's™ CommercialComplete™ Wall Systems Insulation product solutions used in standard wall construction provide critical wall system performance qualities such as:

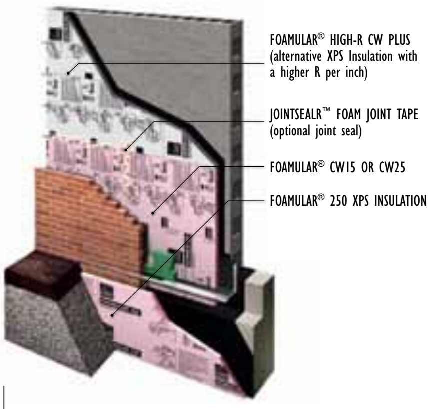
- **Continuous Insulation:** Whether in wood or steel stud framing, masonry cavity walls, interior furring, or as the core of concrete sandwich panels, FOAMULAR® XPS provides a layer of continuous insulation (ci) to thermally seal the exterior wall and minimize "thermal bridging".
- **Thermal Efficiency:** EcoTouch® FIBERGLAS™ Batt Insulation provides high R-value inside stud framing cavities utilizing that valuable space to better insulate the building envelope.
- **Air and Water Intrusion:** JointSealR™ Foam Joint Tape over FOAMULAR® XPS joints seals the wall system, creating a water and air resistive barrier layer, minimizing air infiltration/exfiltration and water intrusion.
- **Vapor Intrusion:** EcoTouch® FIBERGLAS™ Batt Insulation is available with a variety of facer materials to suit all types of construction and to manage potential moisture vapor permeation through interior surfaces. It is also available unfaced.
- **Water Drainage:** FOAMULAR® XPS is highly water resistant, maintaining its R-value while shedding cavity water in rain screen systems like brick or CMU veneer that have a drainage cavity.
- **Fire Resistance Ratings:** CommercialComplete™ Wall Systems have ASTM E119/UL 263 hourly fire resistance ratings, and NFPA 285 limited spread of flame ratings suitable use in for Types I, II, III, or IV construction. (Type V is combustible construction, not subject to NFPA 285 testing.)



Brick, CMU, Stone, or Terra-Cotta Veneer over Steel Stud Framing



PM EIFS over Steel Stud Framing or CMU (EIFS system by others)



Brick, CMU, Stone, or Terra-Cotta Veneer over CMU

1. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc, 1791 Tullie Circle NE, Atlanta, GA 30329
2. International Building Code; International Code Council, Inc., 500 New Jersey Ave. NW, 6th Floor, Washington D.C. 20001

OWENS CORNING®
INNOVATIONS FOR LIVING®

CommercialComplete™ Wall Systems

For Steel Stud/Masonry Veneer

FOAMULAR® Extruded Polystyrene (XPS) Insulation

JointSealR™ Foam Joint Tape

EcoTouch® Flame Spread 25 & Thermal Batt FIBERGLAS™ Insulation

About the Author

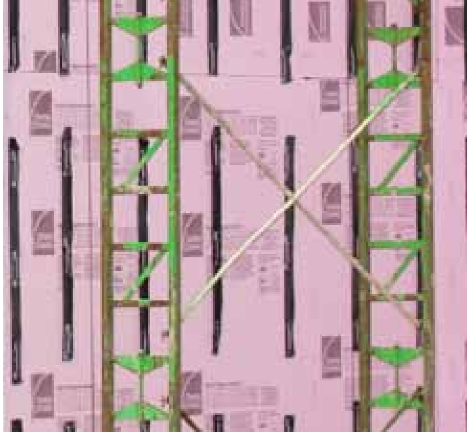
Herbert Slone is a registered architect and Technical Manager of Commercial Building for Owens Corning. With over 26 years in the insulation industry he is responsible for the development of architectural system specifications, fire, structural and wind testing, building code approvals, codes and standards development and energy analysis.

For his work on the "direct-to-deck" fire rated roof insulation system he won the Owens Corning Slayter Award for technical achievement yielding high business impact. He has authored numerous professional articles and AIA/CES educational programs on building construction, fire rated systems and energy code compliance.

Prior to joining Owens Corning, Mr. Slone worked as an architect, building code official, and taught codes and standards in the Kent State University College of Architecture and Environmental Design. He is a former member of the Ohio Board of Building Standards, appointed by the Governor of Ohio, and has chaired many industry committees including the Commercial Building Council of the Extruded Polystyrene Foam Association and a term as President of the Ohio Building Officials Association.

Mr. Slone graduated from Bowling Green State University with a Bachelor of Science in Construction Technology, and from Kent State University with a Master of Architecture. ***Herbert.Slone@owenscorning.com***

ENERGY EFFICIENCY



Energy Efficiency

Steel stud/masonry veneer construction is widely used as an economical wall system that combines the durability and aesthetics of masonry with the structural reliability and construction economies of steel. This method of construction is an effective alternative to durable concrete block backup systems that are heavier and often more costly to construct. Steel stud/masonry veneer construction yields good performance when important details are addressed including:

- **Thermal Transmission:** Steel studs must be covered with a layer of continuous insulation (ci) to minimize "thermal bridging" that robs energy.
- **Air and Water Intrusion:** The wall system must be sealed with weather resisting sheathing and sealed joints to minimize exterior air and water intrusion.
- **Vapor Intrusion:** A vapor retarder may be needed to manage seasonal moisture vapor permeation through interior surfaces.
- **Water Drainage:** In rain screen systems with a drainage cavity, like brick or CMU veneer, weepholes must be properly placed and protected against clogging.
- **Bracing:** For some veneers like brick and CMU, steel studs must be appropriately braced or stiffened to prevent flexural cracking.
- **Masonry Wall Ties:** Masonry ties that transfer wind and seismic loads directly to the steel stud framing must be used.
- **Fire Resistance Ratings:** System ratings and floor-to-floor fire stopping must be established as needed depending on project conditions.

The Answer?

Owens Corning's™ CommercialComplete™ Wall Systems: An Insulation, Air and Water Resistant Barrier System

CommercialComplete™ Wall Systems for steel stud/masonry veneer construction consists of FOAMULAR® (unfaced) XPS Insulation, with joints sealed as needed with JointSealR™ Foam Joint Tape, combined with EcoTouch® FIBERGLAS™ Batt Insulation in the stud cavities to provide a complete thermal, moisture and air barrier wall system solution. See Table 1 for a CommercialComplete™ Wall Systems product summary.

FOAMULAR® XPS sheathing provides a ci layer over the steel studs, complying with energy code recommendations and reducing the effect of thermal bridging. FOAMULAR® XPS sheathing is available in a variety of sizes, thicknesses and edge configurations to suit any jobsite need.

JointSealR™ Foam Joint Tape applied to the FOAMULAR® XPS joints effectively seals the sheathing envelope to protect against air and water infiltration.

EcoTouch® FIBERGLAS™ insulation in the stud cavity, available faced or unfaced, raises the overall thermal performance of the entire wall system by utilizing the valuable space inside the stud cavity, with the option of facers to limit vapor permeation.

FOAMULAR® XPS, JointSealR™ Foam Joint Tape and EcoTouch® FIBERGLAS™ Insulation working together (see Figure 1) provide an excellent thermal envelope and water resistive barrier with moisture resistance and thermal properties that enhance the performance of the entire wall assembly.

ENERGY EFFICIENCY

Table 1

Owens Corning™ CommercialComplete™ Wall Systems Product Selection Guide

FOAMULAR® Extruded Polystyrene Continuous Insulation

Product Name Application	Thickness (inches)	R-Value[1] (180 Day)		R-Value[1] (LTTR)	Size[2] (inches)	Compressive Strength (psi)	ASTM C578 Type	Edge Type
		@75°F mean temp.	@40°F mean temp.	@75°F mean temp.				
FOAMULAR® CC Steel Stud Framing	2 2½ 3	10.0 12.5 15.0	10.8 13.5 16.2	10.6 13.4 16.2	2 x 48 x 96 2½ x 48 x 96 3 x 48 x 96	16	X	Ship-lap long edge
FOAMULAR® 250 Steel Stud Framing	¾ 1 1½ 2 2½ 3 4	4.0 5.0 7.5 10.0 12.5 15.0 20.0	4.3 5.4 8.1 10.8 13.5 16.2 21.6	 5.0 10.6 13.4 16.2 22.0	¾ x 48 x 96 1 x 48 x 96 1½ x 48 x 96 2 x 48 x 96 2½ x 48 x 96 3 x 48 x 96 4 x 48 x 96 (FOAMULAR® XPS 250 also in 24" wide)	25	IV	Square (or T&G up to 2" thick only)
FOAMULAR® CC High R Steel Stud Framing	1¾ 2⅛ 3	10.0 12.0 17.0	10.8 13 18.4	10.3 12.5	1¾ x 48 x 96 21/8 x 48 x 96 3 x 48 x 96	25	IV	Ship-lap long edge
FOAMULAR® CW15 Concrete Masonry	1 1½ 2 2½ 3	5.0 7.5 10.0 12.5 15.0	5.4 8.1 10.8 13.5 16.2	5.0 10.6 13.4 16.2	1 x 16 x 96 1½ x 16 x 96 2 x 16 x 96 2½ x 16 x 96 3 x 16 x 96	15	X	Square
FOAMULAR® CW25 Concrete Masonry	1 1½ 2 2½ 3	5.0 7.5 10.0 12.5 15.0	5.4 8.1 10.8 13.5 16.2	5.0 10.6 13.4 16.2	1 x 16 x 96 1½ x 16 x 96 2 x 16 x 96 2½ x 16 x 96 3 x 16 x 96	25	IV	Square
FOAMULAR® High R CW Plus Concrete Masonry	1¾ 2⅛ 3	10.0 12.0 17.0	10.8 13.0 18.4	10.3 12.5	1¾ x 16 x 96 2⅛ x 16 x 96 3 x 16 x 96	25	IV	Square

1. *R-values vary depending on many factors including the mean temperature at which the test is conducted, and the age of the sample at the time of testing. Because rigid foam plastic insulation products are not all aged in accordance with the same standards, it is useful to publish comparison R-value data. The R-value for FOAMULAR® XPS is provided from testing at two mean temperatures, 40°F and 75°F, and from two aging (conditioning) techniques, 180 day real-time aging (as mandated by ASTM C 578), and, a method of artificially accelerating aging sometimes called "Long Term Thermal Resistance" (LTTR, CAN/ULC S770). The R-value at 180 day real-time aged, and 75°F mean temperature, is commonly used to compare products. It is recommended that the specifier verify testing and conditioning methods with the manufacturer before comparing the R-value of rigid foam plastic insulation products.*
2. *Availability may vary depending on sizes, edge configuration, and/or region. Some items are made to order. Check with your local FOAMULAR® representative for specific information.*

EcoTouch® FIBERGLAS™ Insulation

Product Name Application	Thickness (inches)	R-Value @75° F mean temp.	Perms maximum	Width (inches)	Length (inches)	ASTM C665 Type	
EcoTouch® Thermal Batt Unfaced	3½ 3½ 6¼	11.0 13.0 19.0	NA NA NA	16 or 24 (Specify full width for steel stud)	48 or 96 48 or 96 48 or 96	Type I Type I Type I	
EcoTouch® Flame Spread 25 Faced	3½ 3½ 6¼ 9½	11.0 13.0 19.0 30.0	Depends on Facer Type	16 or 24 (Specify full width for steel stud)	96 96 96 48	Depends on Facer Type	
Facer Types: FSK (foil) faced PSK (white) faced			 0.02 0.02			 Type III, Class A Type II, Class A	

JointSealR™ Foam Joint Tape for CommercialComplete™ Wall Systems

Function	Roll Widths (inches)	Roll Length (feet)	Backer				
Foam board joint sealing	3.5	90	Acrylic				

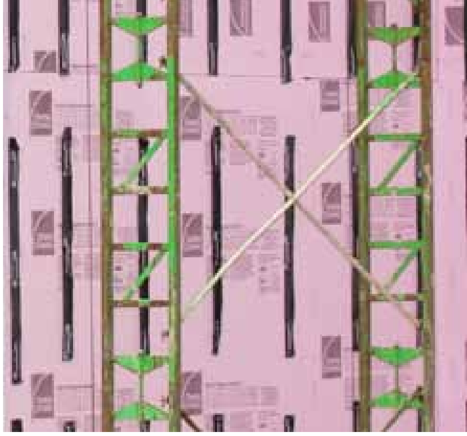
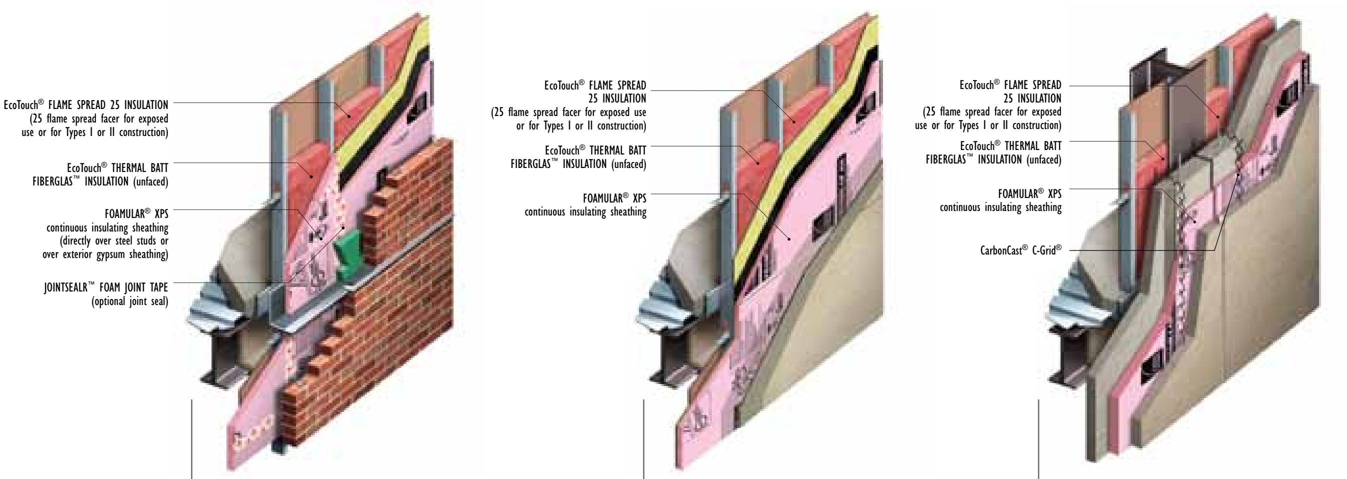


Figure 1

CommercialComplete™ Wall Systems



Brick, CMU, Stone, or Terra-Cotta Veneer over Steel Stud Framing

PM EIFS over Steel Stud Framing or CMU (EIFS system by others)

Insulated Concrete Sandwich Panel, Precast

Achieving Energy Efficient and Sustainable Wall Systems

CommercialComplete™ Wall Systems provide the solution to minimize energy use, and maximize resistance to water and air penetration, all with sustainable product attributes. Owens Corning is committed to driving sustainability through greening our operation, greening our products and accelerating energy efficiency in the built environment. Owens Corning's™ EcoTouch® FIBERGLAS™ produced with PureFiber® Technology, and FOAMULAR® XPS products, are GREENGUARD Indoor Air Quality Certified® and GREENGUARD Children and Schools Certified.℠ EcoTouch® FIBERGLAS™ insulation products are made with 99 percent natural[1] ingredients and are verified to be formaldehyde free. They are also third party certified to have a minimum of 50 percent recycled glass content. FOAMULAR® insulation is also third party certified to contain a minimum 20 percent recycled polystyrene content and is produced with a zero ozone depletion blowing agent formulation. All FIBERGLAS™ and FOAMULAR® insulation products contribute to multiple LEED® categories including energy efficiency and recycled material content. Every pound of glass fiber thermal insulation annually saves 12 times more energy than was originally used to produce it.

CommercialComplete™ Wall Systems are all about using sustainable, energy saving products continuously over framing, and in the stud cavity, to maximize energy efficiency. Read on to see how the system works.

Continuous Insulation Reduces the Effect of Thermal Bridging

In steel stud wall systems the stud is structurally necessary, but, it is the weak link in terms of thermal performance. Steel studs, highly conductive and spaced 16" on center, create thermal bridges through the wall. Thermal bridging occurs due to the high thermal conductivity of the steel studs that rapidly transfer heat through an insulated stud cavity, reducing the overall thermal performance of the stud cavity insulation by approximately 50 percent.[2] That is not to say that the stud cavity insulation is not valuable. It is valuable, for many reasons, and is discussed in the next section. As for the negative effects of thermal bridging, it is greatly diminished by installing FOAMULAR® XPS sheathing insulation over the exterior flange of the steel stud as ci.

ENERGY EFFICIENCY

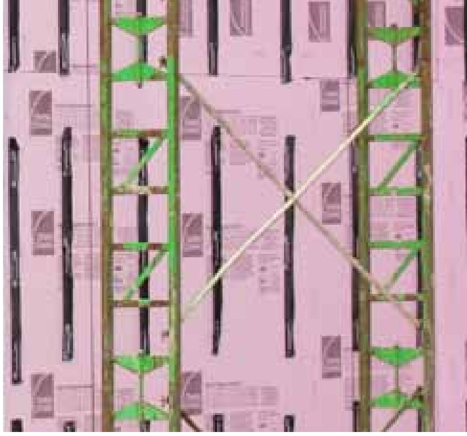
The Benefits of FOAMULAR® XPS Continuous Insulation Sheathing

Owens Corning™ FOAMULAR® XPS ci is key to the thermal performance of steel stud framed walls because it:

- **Reduces** the negative effect of thermal bridging.
- **Reduces** air infiltration with sealed joints.
- **Resists** cavity penetrating, wind driven rainwater when joints are sealed.
- **Reduces** seasonal "reverse vapor drive" that occurs with sheathings that absorb and hold moisture like polyisocyanurate or spray foam, thus reducing moisture levels and the potential for mold growth on the backside of interior gypsum.
- **Reduces** the potential for corrosion of steel framing and connections by raising winter stud cavity temperatures and discouraging moisture vapor condensation.
- **Replaces** exterior gypsum sheathing or works installed over it.
- **Achieves** necessary fire ratings applied directly over steel stud framing or over exterior gypsum sheathing.
- **Reduces** building life-cycle energy cost.
- **Maintains** a stable long-term insulating value even in the presence of moisture.
- **Decreases** HVAC heating and cooling loads.

ASHRAE 90.1 Prescribes the Use of Continuous Insulation

ASHRAE 90.1[2] is the energy performance standard used for commercial buildings throughout most of the United States. The standard prescribes ci for most of the continental USA. See Table 2 and Figure 2 for a summary of prescribed ci values by location. FOAMULAR® XPS meets the ASHRAE 90.1 definition of a "continuous insulation layer," that is, "insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings." [3]



Continuous Insulation Increases Total Wall "R"

Adding FOAMULAR® XPS ci to a traditional, gypsum-sheathed steel stud wall system increases the R-value of the complete wall by an amount equal to the R-value of the FOAMULAR® XPS, and, it reduces the thermal bridging effect of the steel studs through the batt insulation, further improving the overall thermal performance of the wall system. By reducing the negative thermal bridging effect of the steel studs, FOAMULAR® XPS increases the overall energy performance of the steel stud wall by more than its simple R-5 per inch. Replacing or covering commonly used gypsum sheathing with 1.5" of FOAMULAR® XPS can more than double the effective R-value of a steel stud wall assembly. See Table 3.

Table 2

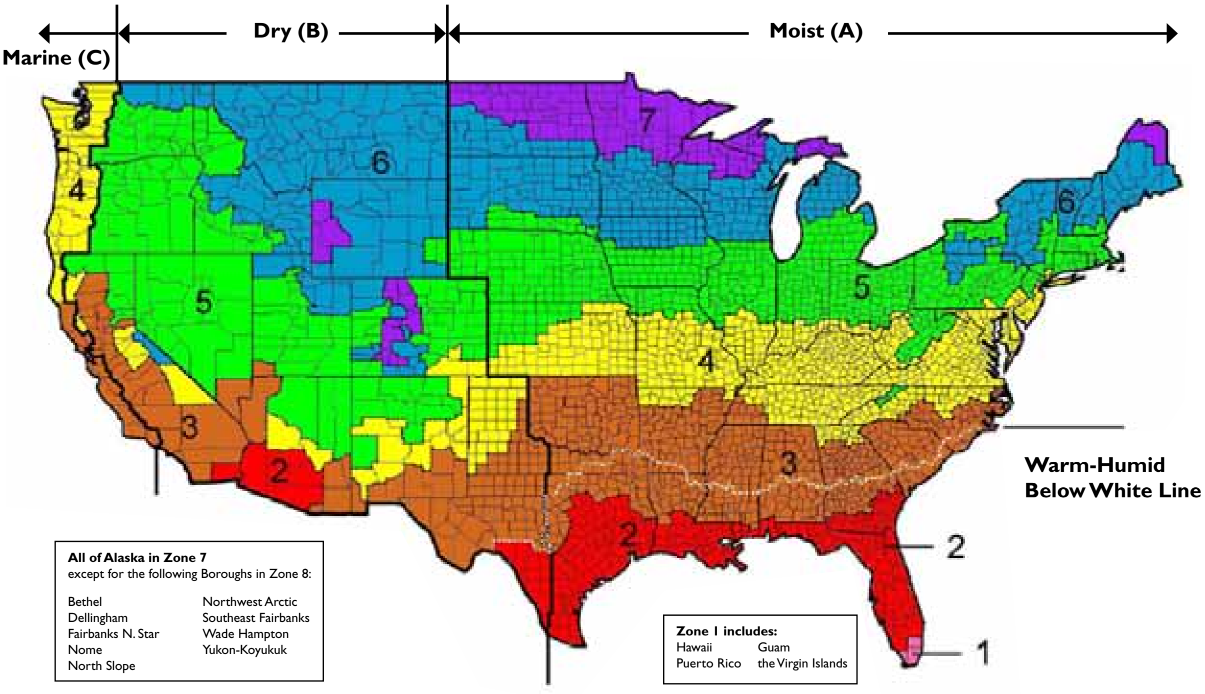
Insulation for Steel Framed, Above Grade Walls
ASHRAE 90.1-2010

Climate Zones	Prescribed Minimum R-Values	
	Nonresidential	**Residential**
1 (A, B)	R-13 + 0 ci	R-13 + 0 ci
2 (A, B)	R-13 + 0 ci	R-13 + 7.5 ci
3 (A, B, C)	R-13 + 3.8 ci	R-13 + 7.5 ci
4 (A, B, C)	R-13 + 7.5 ci	R-13 + 7.5 ci
5 (A, B, C)	R-13 + 7.5 ci	R-13 + 7.5 ci
6 (A, B)	R-13 + 7.5 ci	R-13 + 7.5 ci
7	R-13 + 7.5 ci	R-13 + 15.6 ci
8	R-13 + 7.5 ci	R-13 + 18.8 ci

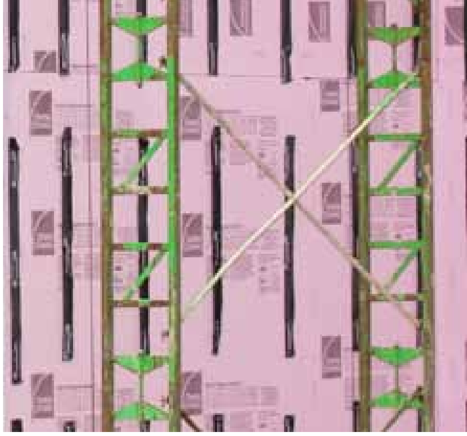
Source: ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings; Tables 5.5-1 through 5.5-8

Figure 2

Climate Zones for United States Locations



Source: ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise
Residential Buildings; Figure B-1

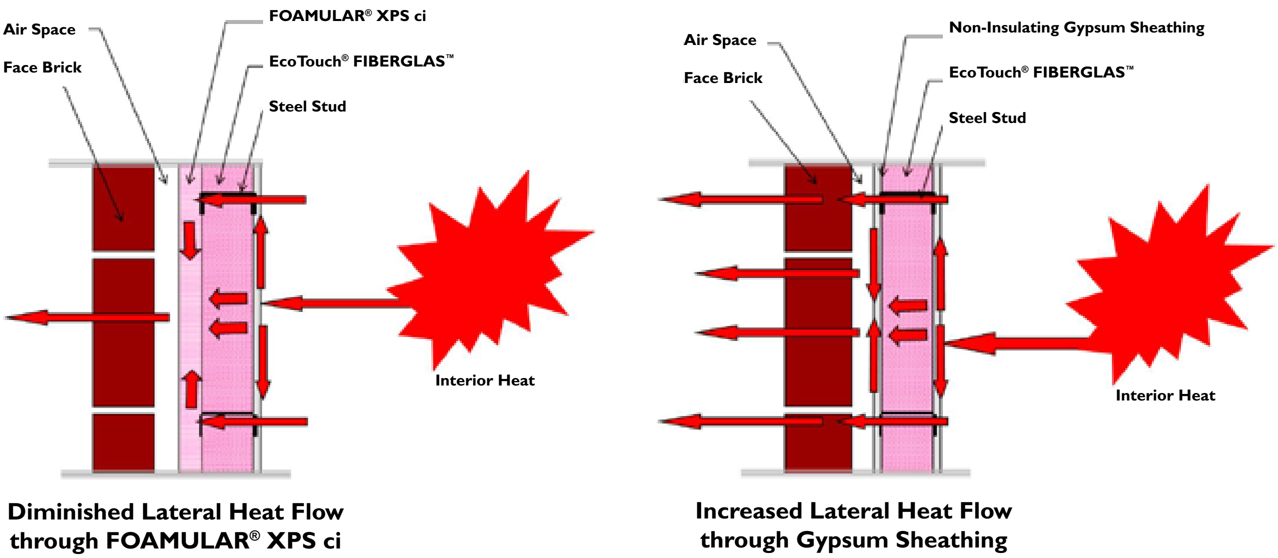


Continuous Insulation Minimizes Lateral Heat Flow Through Sheathing Surface Area

FOAMULAR® XPS ci sheathing improves thermal performance of the wall because, unlike non-insulating gypsum sheathing, it diminishes lateral heat flow through the sheathing itself. The large surface area of sheathing conducts energy along its length, to the steel stud, where the energy then bridges into, or out of, the building. See Figure 3.

Figure 3

Lateral Heat Transfer: Non-insulating sheathing does little to minimize heat loss because it conducts and radiates heat energy through and along the wall. An insulating sheathing reduces heat loss by minimizing lateral heat energy transfer along the large sheathing surfaces of the wall.



Depending on the season, ci diminishes lateral heat flow into, or away from, the steel stud. In other words, during the cooling season, when heat flow is from the outside in, insulating sheathing reduces lateral heat flow through its large surface area to the exterior flange of the steel stud so there is less heat transferred through the steel stud thermal bridge into the building. During the heating season, when heat flows from inside out, FOAMULAR® XPS sheathing insulation reduces heat transfer laterally, through the sheathing, away from the steel stud flange. Whether reducing lateral heat flow into or away from the steel stud flange, FOAMULAR® XPS ci reduces thermal bridging, which increases the overall thermal performance of the entire wall. The thermal benefit of reducing lateral transfer through sheathing is illustrated in Table 3.

Alternative Wall Insulation Solutions: Omitting the Cavity Fiber Glass

An alternative method for insulating steel stud wall systems is to omit the fiber glass batt in the stud cavity and achieve all of the required R-value using only the ci sheathing layer outboard of the stud. The reason often cited for omitting the cavity batt is to better control condensation potential by eliminating the temperature difference in the insulated stud cavity, usually meaning warm on the inside and cold on the outside. This method of insulating a wall assembly places all of the insulation layer outside the steel stud thus placing the stud cavity, and the full depth of the stud, in a space that is essentially conditioned as interior space. Since the stud is in conditioned space, the dew point, the temperature point at which moisture vapor is likely to condense, is not likely to occur in the stud cavity. Instead, it will occur in the ci sheathing layer where the temperature difference between inside and out will be relocated. Moving the dew point into the ci layer lessens the likelihood of condensation, and therefore lessens the likelihood of corrosion of the steel stud and the wall system fasteners that penetrate the stud.

However, omitting the cavity batt insulation, and achieving the complete wall system R-value with only ci presents other challenges due to the increase in ci thickness required to achieve optimum insulation levels and meet ASHRAE 90.1. And, does it really completely solve the potential condensation problem?

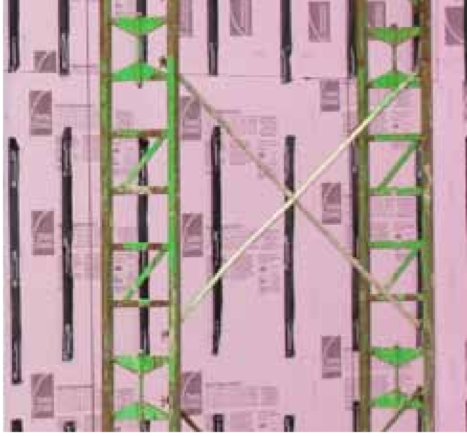


Table 3

Effective Steel Frame Wall R-Values

				Effective Wall R-Value (2) (5)		
Steel Studs (3)		**Cavity Batt Insulation**		**With ½" Gypsum Sheathing**	**With 1½" FOAMULAR® XPS ci Sheathing**	
Size of Members	**Spacing of Framing (inch)**	**Installed R-Value**	**Effective R-Value(4)** (Diminished due to thermal shorting by steel studs)	**R-0.45**	**R-8.1 (winter)** Thermal resistance (R) – (hr x ft² × °F / Btu) – of a 1" thickness, 5.4 at 40 °F mean temperature	**R-7.5 (summer)** Thermal resistance (R) – (hr x ft² × °F / Btu) – of a 1" thickness, 5.0 at 75 °F mean temperature
2×4	16	11	5.5	6.9	15.2	14.6
		13	6.0	7.5	16.2	15.5
		15	6.4	7.9	17.1	16.4
	24	11	6.6	8.0	16.4	15.8
		13	7.2	8.8	17.6	17.0
		15	7.8	9.5	18.8	18.1
2×6	16	19	7.1	9.4	17.8	17.1
		21	7.4	9.8	18.6	17.8
	24	19	8.6	11.4	20.1	19.5
		21	9.0	12.0	21.2	20.5

Notes:

1. *Unfaced insulation made with a minimum of 99% by weight natural materials consisting of mineral, and plant-based compounds.*
2. *The effective wall R-values shown in this table include R-values for insulation in the steel stud cavity, foam or gypsum sheathing, steel stud, and interior gypsum board. They do not include R-values for 4" brick veneer, 2" air space, and exterior and interior air films.*
3. *Calculations applicable for 18 or 16 gauge studs.*
4. *Corrected for thermal shorting created by steel stud. Data from ASHRAE Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential," Table A9.2B.*
5. *"Effective Wall R-value" shown is based on the calculation technique described in the 2009 ASHRAE Handbook of Fundamentals, Chapter 27, page 27.6, "Modified Zone Method for Metal Stud Walls with Insulated Cavities." System "Effective R" calculations were completed using the "Modified Zone Method Calculator," developed by Oak Ridge National Laboratories (ORNL), on-line access at www.ornl.gov/sci/roofs+walls/calculators/modzone/index.html. The calculation includes the effective cavity insulation value, plus the enhanced benefit of insulating sheathing.*

Why Omit the Stud Cavity Batt? To Control Moisture Intrusion?

Omitting the cavity batt leaves valuable space unused inside the cavity that could help insulate the wall, subtracting from the overall system R-value. So, why do it? Often the reason for omitting fiber glass batts from the stud cavity is to shift the dew point into the ci sheathing layer and presumably avoid condensation in the vicinity of the stud and stud cavity. This reasoning assumes that the internal vapor retarder is not properly designed or installed, and that the flaws will compromise the ability of the retarder to control vapor diffusion into the insulated stud cavity. Therefore, the reasoning goes, remove the stud cavity insulation, which has the effect of making the stud cavity warm with no dew point. It relocates the dew point from the stud cavity into the ci layer outside the volume of the stud cavity, and thereby eliminates the concern for condensation inside the stud cavity.

Actually, only a small percentage of vapor entry into wall assemblies is due to diffusion. So, does omitting the fiber glass batt insulation really solve the problem? Vapor diffusion is the moisture transport mechanism that vapor retarders are intended to thwart, and is the basis for static dew point calculations and location identification. However, many sources agree that the much larger percentage of vapor infiltration is due to air leakage. Air infiltration/exfiltration is controlled by air barrier systems. Even if a wall does not include the use of cavity batt insulation, it is still prone to condensation if colder air from the outside can infiltrate the stud cavity and mix with warmer air. In other words, regardless if there is stud cavity fiber glass insulation or not, condensation can still occur if the wall is not properly protected by a well installed air barrier. It is difficult to predict precisely where condensation due to air infiltration will occur due to the random nature of air flow paths. In general, condensation will occur on surfaces chilled by moving air, such as the face of a steel stud where sheathing joints are located.

It is for this reason the practice of omitting stud cavity batt insulation may not avoid cavity condensation. With the potential condensation concern not really solved, the real downside is that omitting the cavity batt leaves the valuable space unused inside the cavity that could help insulate the wall and improve the overall thermal performance of the building. Taking out the cavity insulation as a technique of managing moisture is effectively "giving up" on achieving good wall construction. It is, as the old saying goes, "throwing the baby out with the bathwater." On the other hand, a well installed air barrier layer, coupled with a properly designed and properly installed vapor retarding layer when needed, are essential safeguards against cavity condensation, and, they enable the use of cavity batt insulation, adding significant wall system R-value.

Without Cavity Batts, Thermal Performance Requires More Continuous Insulation

When cavity batts are omitted, energy code compliance using the "prescribed" amounts of insulation shown in Table 2 is not possible. In that case, the "Assembly Maximum" U-values as specified in ASHRAE 90.1 must be used for design. Table 4 shows the thickness of FOAMULAR® XPS ci that must be used if the "prescribed" cavity batt insulation is omitted. The end result is, if fiber glass batts are omitted from the wall stud cavity, the FOAMULAR® XPS ci layer must be thicker to make-up for the lost cavity insulation.

Detailing the Wall to Accommodate Thicker Continuous Insulation

If thick ci is used to achieve energy code compliance, the details of the wall assembly must be changed to accommodate the increased thickness. For example, the continuous steel shelf angles that support the brick veneer at each floor line must be widened to create a wider cavity for ci sheathing. See Figure 4. Similarly through-wall flashing, parapet caps, window flashing, window pan assemblies, brick tie base units and fasteners all must be lengthened to accommodate a thicker ci layer.

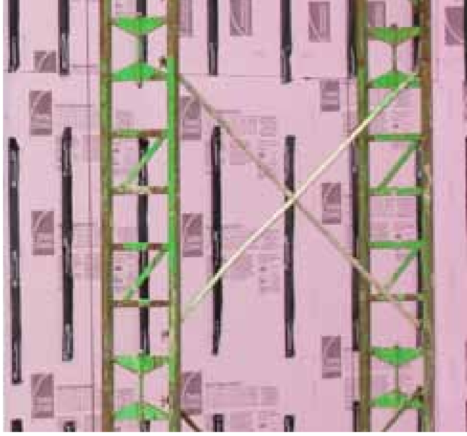


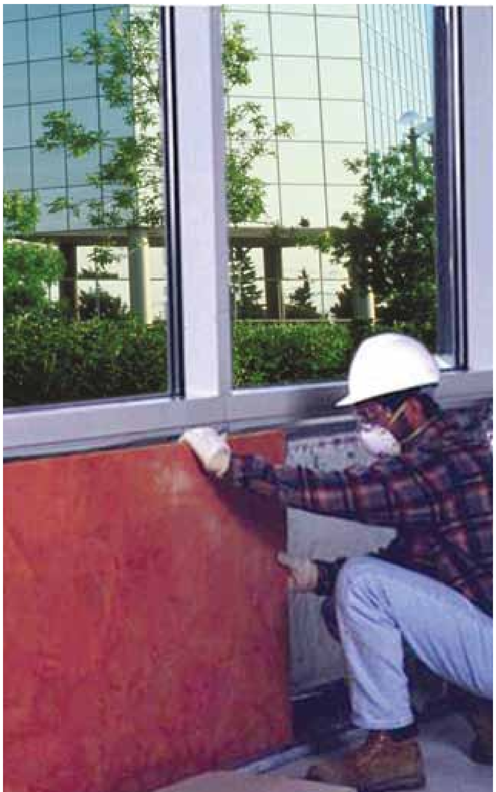
Table 4

Insulation Requirements for Steel Frame, Above Grade Walls [1]
ASHRAE 90.1-2010

Prescribed Batt + ci	ASHRAE 90.1 Maximum "U" [2] (Minimum R = 1/ max U)		Required FOAMULAR® XPS ci Thickness (R-5 per inch) If the cavity batt is used	If the cavity batt is not used [3]
R-13 + 0 ci	0.124	(8.1)	0.00" ci	1.5"
R-13 + 3.8 ci	0.084	(11.9)	0.75" ci	2.0"
R-13 + 7.5 ci	0.064	(15.6)	1.50" ci	3.0"
R-13 + 15.6 ci	0.042	(23.8)	3.50" ci	4.5"
R-13 + 18.8 ci	0.037	(27.0)	4.00" ci	5.0"

Notes:

1. *Source: ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings; Tables 5.5-1 through 5.5-8.*
2. *"Minimum R-value," calculated as the reciprocal of the "Maximum U," is less in thermal insulation value than the simple sum of the "Batt + ci" prescription because "Batt + ci" assumes an effective R less than that prescribed after thermal shorting of the cavity batt by the steel studs has been taken into account.*
3. *Required FOAMULAR® XPS ci thickness (in inches) is calculated by subtracting R-2.2 from the Minimum Assembly R-value, and dividing the remainder by R-5 per inch of FOAMULAR® XPS ci thickness. R-2.2 is subtracted to account for the sum of the R-value of the other components of the steel stud wall assembly including interior air film, R-0.68; exterior air film, R-0.17; ½" interior gypsum board, R-0.45; and, R-0.90 for the empty stud cavity air space.*



ENERGY EFFICIENCY

System Ratings, Acoustic and Fire Resistance

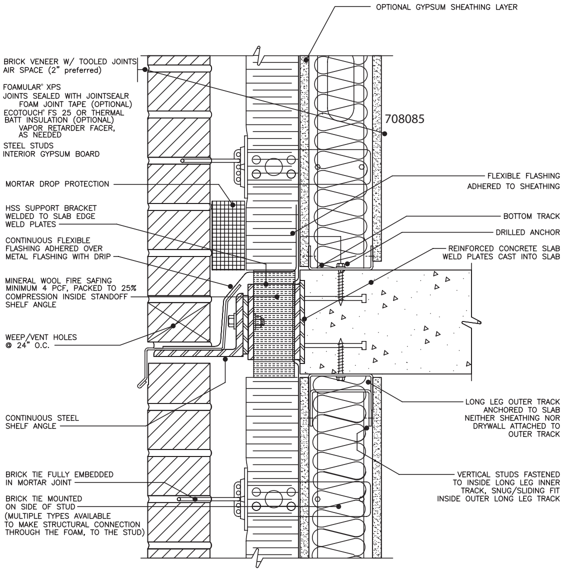
Another important consideration when omitting cavity batt insulation are wall system ratings that may be affected.

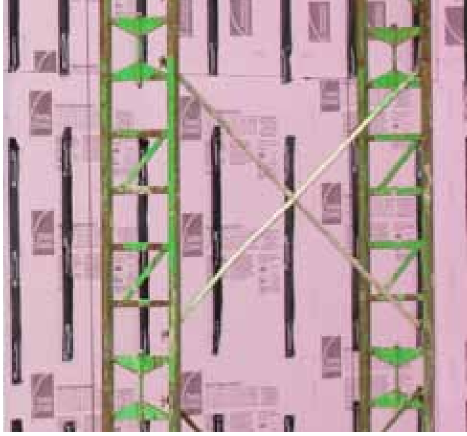
For example, a 3⅝" steel stud wall assembly, studs 16" o.c., with a single layer of ⅝" gypsum board on the inside, fiber glass batt in the stud cavity, FOAMULAR® XPS ci sheathing, air space and brick veneer, has a sound transmission classification (STC) of 67. If the fiber glass is omitted, and the ci thickness increased, the assembly STC rating is diminished to 61.

If the wall requires a fire resistance rating (ASTM E119/UL 263), Underwriters Laboratories (UL) assemblies V414 and V434 require the use of stud cavity batt insulation to achieve the ratings specified in the listing. For full details concerning the fire resistance rated wall assemblies, see the section of this brochure regarding fire performance.

Figure 4

Steel shelf angles around the building perimeter to support masonry must be longer if ci is thicker.





Air Barrier Performance

FOAMULAR® XPS ci not only enhances the thermal performance of steel stud wall assemblies, but, when joints are sealed with JointSealR™ Foam Joint Tape, it qualifies as continuous air barrier material as required in ASHRAE 90.1-2010, Section 5.4.3.1.3 (a). FOAMULAR® XPS and JointSealR™ Foam Joint Tape have been tested as air barrier materials in accordance with ASTM E2178[4], and a water resistive barrier in accordance with AC71.[5] Resistance to air intrusion enhances the thermal and moisture resistance of buildings by minimizing intrusion of unconditioned, moisture laden air into the wall assembly. The water resistive barrier provides a secondary layer of external moisture resistance behind the cladding to protect the building.

FOAMULAR® XPS ci sheathing, with square edge, ship lap or tongue and groove joints sealed with JointSealR™ Foam Joint Tape has achieved an air leakage rate of 0.0000335 cfm/ft^2 when tested in accordance with ASTM E2178.[6] This level of performance is more than 100 times less than 0.004 cfm/ft^2, tested under a pressure differential of 1.57 psf, which is the ASHRAE 90.1 maximum requirement for air barrier material performance.[7]

Air intrusion is one of the most significant sources of moisture that may cause condensation inside the wall. The accumulation of hidden moisture may lead to corrosion of wall framing materials as well as to the growth of mold and mildew.

A high quality air barrier system is always part of a high performance steel stud masonry veneer wall system. Air barriers can also be established using a variety of commercially available products either in sheet form or spray on that can be applied over the foam, or over the gypsum board sheathing under the foam. When using any type of air barrier material, peel and stick, or asphalt or latex based membranes, always verify necessary NFPA 285 system fire performance. Also, use caution if black or non-white coatings of any type are installed directly over FOAMULAR® XPS. Black and non-white surfaces collect solar energy and may, at times, become hot enough to damage thermoplastic XPS.

ENERGY EFFICIENCY

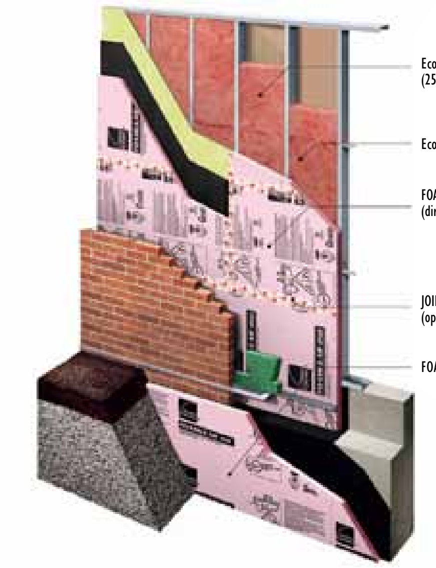
References:

1. *ANSI/ASHRAE/IESNA Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential Buildings"; Table A9.2B*
2. *ANSI/ASHRAE/IESNA Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential Buildings"*
3. *ANSI/ASHRAE/IESNA Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential Buildings"; Section 3.2, Definitions*
4. *ASTM E2178 – 03, "Standard Test Method for Air Permeance of Building Materials*
5. *AC 71, "Acceptance Criteria for Foam Plastic Sheathing Panels Used as Water Resistive Barriers", International Code Council Evaluation Service (ICC-ES)*
6. *Air Permeance Test on Owens Corning™ JointSealR Foam Joint Tape over FOAMULAR® XPS Joints, tested in accordance with ASTM E2178; QAI Laboratories, Test Report No. RJ1390P-1, September 12, 2011*
7. *ANSI/ASHRAE/IESNA Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential Buildings"; Section 5.4.3.1.3 a*

AIR & MOISTURE MANAGEMENT

Managing Moisture: Air Leakage, Vapor Diffusion and Condensation

Owens Corning's™ CommercialComplete™ Wall Systems provide excellent energy efficiency coupled with complete air and water barrier performance, complete flexibility to integrate with other water/air products and systems as needed, and a complete array of products to effectively manage both internal and external vapor permeation depending on regional demands. It is the complete commercial wall.



Water enters walls in three different ways. CommercialComplete™ Wall Systems provide solutions to manage each.

Mode of Entry	CommercialComplete™ Wall Systems Solutions
1) Liquid water driven in by external weather.	**Water Resistant Barrier** FOAMULAR® XPS ci & JointSealR™ Foam Joint Tape.
2) Water vapor carried in via air leakage.	**Air Barrier** FOAMULAR® XPS ci & JointSealR™ Foam Joint Tape.
3) Water vapor driven in by a vapor pressure difference across the wall system.	**Vapor Retarder** EcoTouch® Flame Spread 25 and Thermal Batt FIBERGLAS™ Insulation, faced or unfaced.

Each of these modes of moisture transfer must be managed by a combination of thoughtful architectural analysis and design details, with careful attention to installation during construction and using high quality materials that work together like the CommercialComplete™ Wall Systems.

AIR & MOISTURE MANAGEMENT

Water Resistant Barrier Performance

CommercialComplete™ Wall Systems with FOAMULAR® Extruded Polystyrene (XPS) continuous insulation (ci), joints sealed with JointSealR™ Foam Joint Tape, is an effective water resistant barrier,[1,2] repelling water that penetrates the system. Steel stud/masonry veneer walls are an "open rain screen" design. They "catch" rainwater, effectively depressurize it, and drain it away from the wall. Some water drains away on the outside face of the brick veneer, while some passes through the veneer into a drainage cavity behind the veneer. Water can enter in any number of ways such as through open joint designs in the rain screen cladding through surface absorption by brick or CMU veneer, or through controlled flexural cracking or construction defects. Water that penetrates the exterior veneer is drained down the air space behind the masonry and out through weep holes at the bottom of the cavity. Since it is by design that water penetrates rain screen systems, the Brick Industry Association (BIA) and the American Iron and Steel Institute (AISI) recommend that sheathing be "exterior grade" or "resistant to moisture attack." [3,4] The CommercialComplete™ Wall Systems with highly water resistant, closed cell, FOAMULAR® XPS is the perfect water resistant ci solution.

Gypsum sheathing is sometimes used behind ci to provide additional fire resistance to the wall, and/or, to provide a solid surface for a spray or sheet applied air/moisture barrier layer. It is important that gypsum sheathing be covered with a water resistant barrier because even the improved water resistant core/glass fiber faced sheathings still absorb water. Gypsum is a "reservoir" material. Water that finds its way to gypsum sheathing is slowly absorbed and retained. Wet sheathing speeds the corrosion of steel framing and fasteners.

FOAMULAR® XPS ci and JointSealR™ Foam Joint Tape can be used to prevent gypsum sheathing from being wetted by moisture intrusion. BIA recommends that all "water resistant barrier" types of sheathing have joints taped or sealed.[3] Sealants and tapes can lose their bond to materials like gypsum sheathing that absorb water and become wet. The bond between FOAMULAR® XPS ci and JointSealR™ Foam Joint Tape is durable because FOAMULAR® ci is hydrophobic. It does not become wet, absorbing very little water.

CommercialComplete™ Wall Systems provide a long term air and water resistant barrier as well as an energy saving ci layer.

Air Barrier Performance

FOAMULAR® XPS ci not only enhances the thermal performance of steel stud wall assemblies, but, when joints are sealed with JointSealR™ Foam Joint Tape, it qualifies as continuous air barrier material as required in ASHRAE 90.1-2010, Section 5.4.3.1.3 (a). FOAMULAR® XPS and JointSealR™ Foam Joint Tape have been tested as air barrier materials in accordance with ASTM E2178[4], and a water resistive barrier in accordance with AC71.[5] Resistance to air intrusion enhances the thermal and moisture resistance of buildings by minimizing intrusion of unconditioned, moisture laden air into the wall assembly. The water resistive barrier provides a secondary layer of external moisture resistance behind the cladding to protect the building.

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Air intrusion is one of the most significant sources of moisture that may cause condensation inside the wall. The accumulation of hidden moisture may lead to corrosion of wall framing materials as well as to the growth of mold and mildew.

A high quality air barrier system is always part of a high performance steel stud masonry veneer wall system. Air barriers can also be established using a variety of commercially available products either in sheet form or spray on that can be applied over the foam, or over the gypsum board sheathing under the foam. When using any type of air barrier material, peel and stick, or asphalt or latex based membranes, always verify necessary NFPA 285 system fire performance. Also, use caution if black or non-white coatings of any type are installed directly over FOAMULAR® XPS. Black and non-white surfaces collect solar energy and may, at times, become hot enough to damage thermoplastic XPS.

AIR & MOISTURE MANAGEMENT

Vapor Retarder Performance

Indoor air, warm, and seemingly dry, if sealed in a jar, taken outside and cooled, will condense liquid water or "excess moisture" on the inside walls of the jar. If the same warm air leaks through a hole into a wall, migrating until it reaches a surface colder than its dew point temperature, the same condensation will occur. If that condensation happens it will be in a location inside the wall that can't be seen and where it eventually may cause damage. An air barrier can limit the flow of warm moist air into a wall. However, even if the wall is sealed with an air barrier, unless the wall is properly vapor protected, water vapor may still diffuse into the wall on the molecular level, where it may also encounter dew point temperature and condense with the same damaging result.

Vapor permeation is controlled by the careful analysis of location, selection and installation of vapor retarding material in the wall system. In heating driven regions the vapor retarding layer is typically near the interior surface with minimal perm resistance in the layers in the wall nearer the exterior. In cooling driven regions the vapor retarder is typically near the exterior, with minimal resistance in the layers nearer the interior. In moderate climates the specifier may decide that it is best to omit a vapor retarder. Whatever is decided, EcoTouch® Flame Spread 25 and Thermal Batt FIBERGLAS™ Insulation, faced or unfaced, provide multiple options for the designer to manage vapor diffusion in the CommercialComplete™ Wall Systems. Any of the facers available on EcoTouch® Insulation products form an effective vapor retarding layer if properly installed with flanges and penetrations sealed. EcoTouch® steel stud cavity batt insulation is available with no facer when conditions do not warrant an internal vapor retarding layer, or when an internal vapor retarder is required. There are also multiple facer options with a variety of perm ratings including kraft faced (1.0 perm), foil faced (0.50 perm), FSK-foil faced (0.02 perm), and PSK-white faced (0.02 perm). The lower the perm rating of a material, the lower the amount of water vapor that will permeate through the material per unit of area, per unit of time and per unit of vapor pressure difference from one side of the material to the other.

Note that only the FSK and PSK type facers have a flame spread rating of 25 or less as required for use in construction Types I and II as defined by the International Building Code.

Building Science: Moisture Management

Vapor retarders limit the amount of moisture that can enter a wall system through diffusion at the molecular level. Air barriers limit the amount of moisture that enters a wall system because of moist air infiltration. As a source of moisture in buildings, rainwater and mass transport of moisture through air movement are likely to be many times greater than diffusion.[8] When air moves rapidly through a wall it can get all the way outside before it loses enough heat for condensation to occur. However, in a wall deliberately constructed to be tighter, slow flow will probably insure that cooling and condensation occur before the leaking air gets outside. Steel studs, masonry wall ties, gypsum board, and the screws that hold it all together, are all materials that may be damaged by long-term condensation. Regardless of how moisture vapor gets into the wall, once it gets in, condensation is the concern. The key is to limit condensation.

Condensation

Condensation occurs when water vapor changes to liquid water. Water vapor changes to liquid when relative humidity (RH) reaches 100 percent. Relative humidity is an expression of how much water vapor an air mass is holding at a given temperature, relative to the maximum it could hold. Warm air holds more moisture than cold air at the same RH. For example, 30 percent RH in cold air is not as much moisture in an absolute sense as 30 percent RH in warm air. Differences in water vapor content (RH) on one side of a wall versus the other side creates a vapor pressure differential across the wall. Vapor pressure difference across a wall drives moisture vapor into the wall as the vapor pressure attempts to equalize.

If there is a vapor pressure difference across a wall, there is often a temperature difference from one side to the other as well. If one side is warmer, and the other side is colder, there are gradations of temperature at each layer through the wall. Lowering the temperature of the air while holding the amount of moisture constant effectively raises the RH and brings the air/vapor combination closer to the dew point. Water vapor that is migrating through a wall either on an air current, or via vapor diffusion, coupled with temperature differences throughout the wall, creates the potential for air and water vapor to encounter surfaces at the dew point temperature that will possibly result in condensation.

Dew point is the temperature at which water vapor condenses to form liquid water. Air that has absorbed all of the water vapor it can possibly hold at a given temperature is saturated. At saturation, the air mass can hold no more water vapor. The temperature at which an air mass reaches full saturation is called "dew point" temperature. In that condition, the amount of water vapor is called 100 percent RH. As water vapor in air is cooled, the RH level changes.

For example, warm air at 70˚F and 30 percent RH still has the capacity to absorb more water vapor. It is only 30 percent full. In that condition condensation won't occur. However, if conditions change in either one of two ways, condensation will occur: 1) if moisture is added to the warm air to raise the RH to 100 percent, or 2) if the temperature of the air is lowered to 37˚F. That is the temperature at which the same amount of water vapor that was 30 percent RH at 70˚F will equal 100 percent at 37˚F since colder air cannot hold as much water. If either of these conditions are present, condensation will occur.

Those changing conditions are essentially what moist air or water vapor encounters as it migrates through walls. On its path through the wall, driven by differences in vapor pressure one side to the other, the fixed amount of water vapor encounters increasingly lower temperature which raises the RH. The challenge for the designer is to utilize design strategies that select and arrange layers of materials in the wall so that dew point conditions never or rarely occur. This is accomplished by: 1) effectively managing the temperature of the stud cavity with insulation selection and placement; 2) by managing the amount of water vapor migrating into the wall with a properly designed and placed vapor retarder; and 3) by a properly designed and placed air barrier layer.

Design Strategies to Prevent Condensation

In steel stud framed wall systems where materials are susceptible to damage from water vapor condensation, there are several design strategies often used in combination to minimize or prevent condensation:

- **Install** ci sheathing such as FOAMULAR® XPS to keep the materials in the wall above the dew point temperature.
- **Install** a properly placed vapor retarding layer to limit water vapor diffusion into the wall such as EcoTouch® FIBERGLAS™ Insulation with a variety of available facers and permeance ratings.
- **Install** air barriers such as FOAMULAR® XPS with JointSealR™ Foam Joint Tape sealed joints to limit the amount of moisture laden air leakage into the wall.
- **Omit** stud cavity batt insulation, thus placing the most vulnerable steel framing components at room temperature.
- **Limit** the accumulated condensation to an amount that can be safely absorbed, stored in reservoir materials, and reliably evaporated under summer conditions. *(An interior vapor retarder may inhibit the effectiveness of this design strategy by limiting drying capability.)*

Continuous Insulation Sheathing Manages Stud Cavity Temperature

As discussed previously, warm air can hold more water vapor than cold air without condensing. Therefore, if the wall and the surfaces in it are warmer, there is more tolerance for the presence of water vapor because the dew point temperature is higher. In regions with prolonged heating seasons, where dew point and condensation control are critical, using FOAMULAR® XPS ci to insulate the steel stud cavity, raises the temperature of the cavity. Since warm air can hold more moisture than cold air, a warmer stud cavity is capable of holding more moisture vapor. In other words, FOAMULAR® XPS ci makes a warmer cavity that is more tolerant of higher RH levels.

Vapor Retarding Facers Manage Water Vapor Diffusion

When the air mass is warm and "relatively" humid on one side of the wall, and the air mass on the other side of the wall is colder and less humid, a vapor pressure differential exists through the wall. The higher vapor pressure on one side is driven to equalize with the lower vapor pressure on the other side. By placing a vapor retarding layer in the wall close to the warm/humid side, the flow of water vapor can be limited. By regulating or "slowing the flow" of water vapor, the relative humidity inside the wall can be lowered. Lowering the RH lowers the dew point temperature.

Vapor Retarder Placement:

It is important to emphasize that high vapor pressure (warm/humid/moist air) is driven by nature to equalize with low vapor pressure (cooler/less humid/drier air). If a vapor retarder is to be placed in a wall, it always goes on the side that has the dominantly higher vapor pressure for most of the annual cycle. Properly placed on the "high pressure" side, the vapor retarding layer limits the inflow of water vapor at a place in the wall where actual temperature is higher than dew point temperature. In that condition, no condensation will occur. Improperly placed on the "low pressure" side, the vapor retarding layer limits the outflow of water vapor at a place in the wall where actual temperature is potentially lower than dew point temperature. That condition will cause damaging condensation to occur. In heating dominated climates the vapor retarding layer is placed on the inside, warm side. In cooling dominated climates, the vapor retarding layer is placed on the outside, warm side. In moderate climates, the reservoir principle is often utilized, and the vapor retarding layer is omitted.

EcoTouch® Flame Spread 25 and Thermal Batt FIBERGLAS™ Insulation, faced or unfaced, provides multiple options for the designer to limit vapor diffusion into the wall. The facers available on EcoTouch® Insulation products form an effective vapor retarding layer if properly installed with flanges sealed. EcoTouch® FIBERGLAS™ stud cavity batt insulation is available with no facer when conditions do not warrant an internal vapor retarding layer. When an internal vapor retarder is required, there are multiple product options with a variety of perm ratings including kraft faced (1.0 perm), foil faced (0.50 perm), FSK-foil faced (0.02 perm), and PSK-white faced (0.02 perm).

Note that only the FSK and PSK facers have a flame spread rating of 25 or less as required for use in construction Types I and II as defined by the International Building Code.

Example Wall Designs, Vapor Diffusion Estimates

A key design strategy to manage moisture in walls is to design so the actual temperature is always higher than the dew point temperature. As explained earlier, lower RH requires colder temperatures to cause condensation. Insulated walls can be designed to keep their internal temperatures higher. Walls sheathed with ci have higher internal actual temperatures in heating seasons. Higher actual temperature, coupled with lower dew point temperature, means the two critical temperatures are never equal. If actual temperature is never less than dew point temperature, condensation will not occur.

A condensation analysis should be conducted on wall designs to determine if the potential for condensation and moisture accumulation exists. There are two common methods to accomplish condensation analysis including: 1) A simple static dew point analysis[9] can be done for a wall at the environmental extremes (hot/humid, cold/dry) that it will experience. If a more detailed analysis is needed, 2) WUFI-ORNL/IBP,[10] a menu-driven PC program, can be used.

Static Dew Point Analysis

The static method enables a quick calculation of the possibility of condensation in a wall design at winter and summer maximum conditions. Viewing susceptibility to condensation at the static maximum conditions enables a judgment to be made about performance at conditions in between the extremes. Using the static extremes, or "bracketing" conditions, provides directional insight into potential concerns. The design can be altered accordingly, or the analysis may indicate that condensation is likely to occur at the extremes, prompting a more detailed analysis.

Although widely used, the "Dew Point Method" is limited in that it focuses on the prevention of interstitial condensation. Many building failures such as mold and mildew, buckling of siding, and paint failure are not necessarily related to surface condensation. Conversely, limited condensation can often be tolerated, depending on the materials involved, the temperature conditions, and the speed at which the material dries out. Wetting and drying cycles cannot be accurately analyzed with the steady-state dew-point calculation because it does not account for moisture storage capacity in building materials. Also, this method does not account for any method of moisture vapor transport other than diffusion. Results obtained with this method should therefore be considered as approximations and should be used with care and professional judgment.

WUFI-ORNL/IBP

Static dew point analysis is not capable of considering dynamic variables that can affect performance such as hourly simulation of environmental conditions over multiple seasons. If simple static analysis is insufficient, WUFI-ORNL/IBP can be used.

WUFI-ORNL/IBP is a menu-driven PC program that enables realistic calculation of the transient coupled one-dimensional heat and moisture transport in multi-layer building components exposed to natural weather. It is based on the newest findings regarding vapor diffusion and liquid transport in building materials and has been validated by detailed comparison with measurements obtained in the laboratory and on outdoor testing fields.[10] It is considered a definitive source for wall hygrothermal performance and design guidance.

Design Options to Manage Vapor Intrusion

Design options available to manage the diffusion of moisture vapor into a wall assembly include installing a low permeance vapor retarder at an appropriate layer location inside the wall, or not installing a vapor retarder enhancing the ability of the wall to seasonally dry. If a vapor retarder is used, it is generally installed on the side of the wall exposed to the highest vapor pressure for most of the year. In a cold (heating dominated) climate, the high vapor pressure side is typically the warm inside. In warm (cooling dominated) climates, the high vapor pressure side is often outside. In moderate climates, the best design strategy may be to omit a vapor retarder to facilitate seasonal drying. Other elements in the wall such as air and water barriers, batt insulation, and XPS ci sheathing also affect overall moisture flow and retention in a wall system.

AIR & MOISTURE MANAGEMENT

Static Dew Point Analysis

Owens Corning's™ CommercialComplete™ Wall Systems for steel stud and brick veneer is shown in Figure 1. Figures 2 through 5 show the material layers of the wall on a graph that has plotted "dew point" and "actual" temperature profiles calculated in accordance with the Dew Point Method. The temperature profiles are calculated under a set of static conditions. The plot of actual temperature is a function of the inside and outside temperature, and the R-value of each layer in the wall assembly. The dew point temperature plot shows the temperature necessary to cause water vapor to condense based on the amount of vapor predicted to arrive by diffusion at a given point in the wall. Water diffusion through the wall is a function of the permeance of each layer of material in the wall. Condensation potential exists at points where the actual temperature either equals or falls below the dew point temperature.

The examples provided do not account for moisture that arrives in the wall via air leakage. It is assumed that air leakage is minimized by the proper specification and installation of the FOAMULAR® XPS ci and joints sealed with JointSealR™ Foam Joint Tape, or an alternate air barrier system.

Wall Design and Design Conditions:

4" steel stud with ⅝" gypsum board inside, vapor retarder as noted, R-13 EcoTouch® FIBERGLAS™ Batt Insulation, faced or unfaced as noted, FOAMULAR® XPS ci sheathing as noted, and/or gypsum sheathing, 1" air space, and 4" face brick. (See Figure 1)

- **Exterior** Conditions: 0°F, 50 percent relative humidity.
- **Interior** Conditions: 70°F, 30 percent relative humidity.

Figure 1

CommercialComplete™ Wall Systems for steel stud framing and masonry veneer showing FOAMULAR® XPS ci applied directly over steel stud framing or, an optional layer of exterior gypsum board and air barrier.

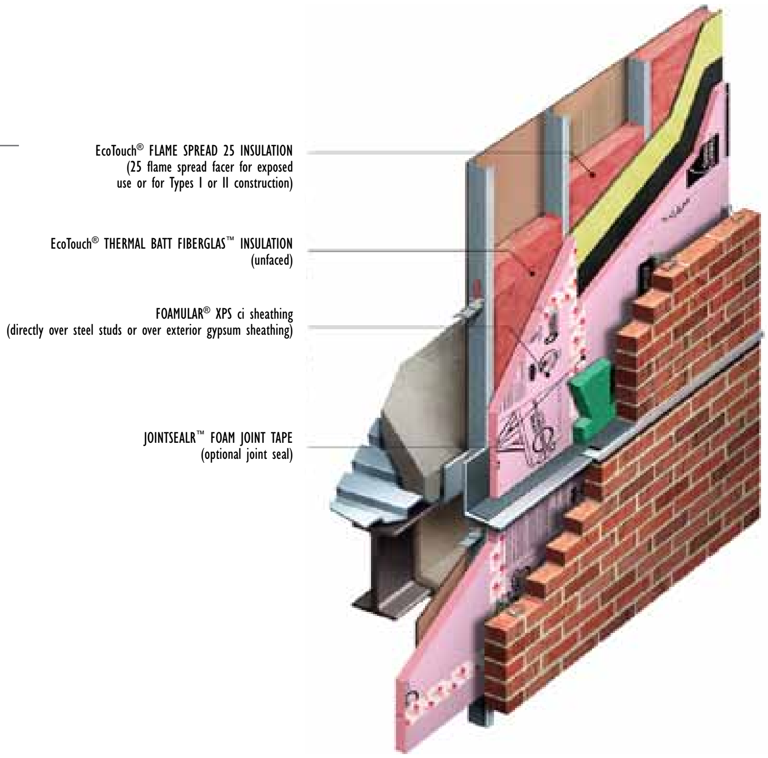
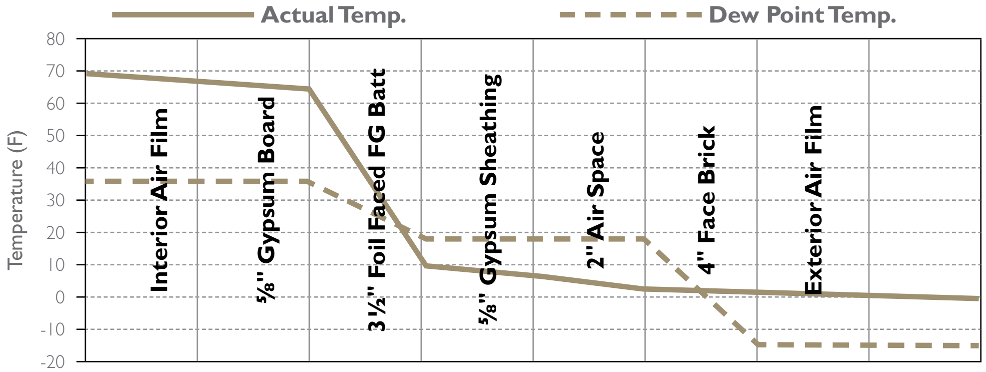


Figure 2

Winter Conditions with Only Gypsum Sheathing, No Insulating Sheathing

This wall design shows the solid actual temperature line dropping below the dotted dew point temperature line. When the actual temperature drops below the dew point temperature it is an undesirable condition. This example suggests condensation potential in the fiber glass insulated stud cavity, primarily due to the lack of insulating sheathing. During extreme low temperatures in winter, condensation is likely to occur on the backside of the gypsum sheathing, which is an undesirable location. Using the CommercialComplete™ Wall Systems design strategies, this condensation problem can be remedied.

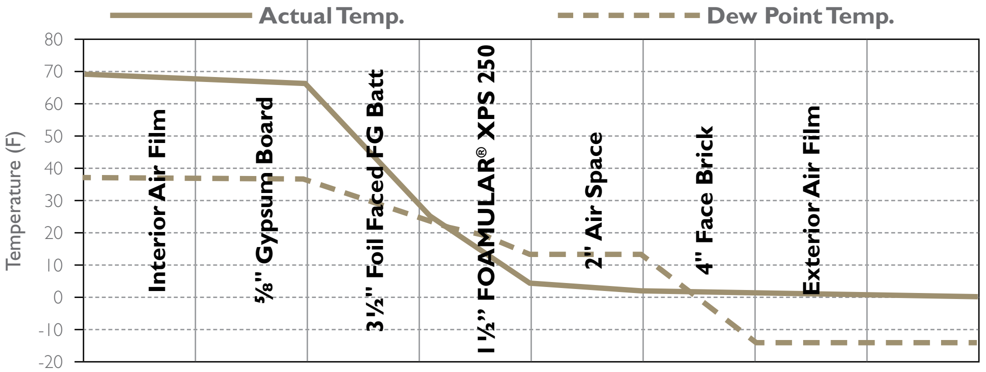


5/8" gypsum exterior sheathing (33 perm), with Owens Corning's™ EcoTouch® Thermal Batt Insulation (foil faced, 0.50 perm) in stud cavity. Note: Foil faced is used for its permeance rating to illustrate this example, however, due to its ASTM E84 flame spread index of 75, it may not be approved for use in steel stud construction. Check local building codes for applicable requirements.

Figure 3

Winter Conditions with FOAMULAR® XPS Continuous Insulation

This wall design is similar to Figure 2 except non-insulating gypsum sheathing has been replaced with FOAMULAR® XPS ci sheathing resulting in a steel stud cavity that is about 20˚F warmer. That raises the actual temperature above the dew point temperature resulting in a more desirable performance. The shift in predicted temperature moves the dew point out of the fiber glass batt in the stud cavity and into the FOAMULAR® XPS ci layer where condensation will not occur. Also, the wall has much better thermal performance with insulating sheathing than without. Condensation in this model is predicted to occur in the air space behind the brick veneer, a space that is designed to accommodate moisture and drain it away.

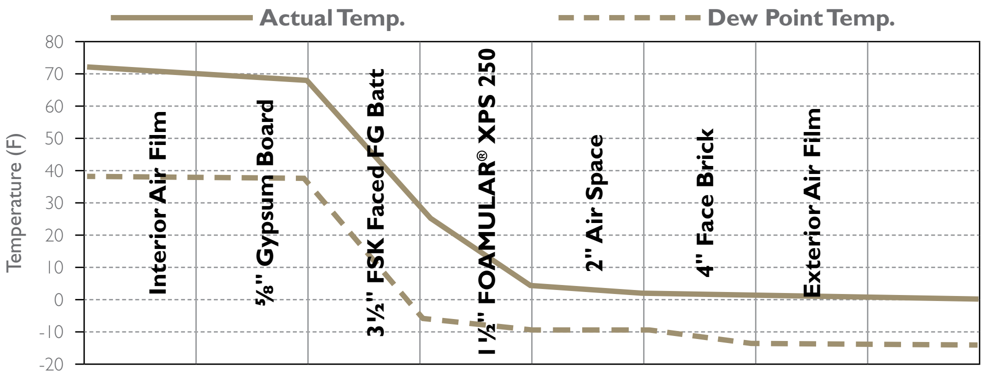


1.5" FOAMULAR® XPS ci exterior sheathing (0.80 perm), with Owens Corning's™ EcoTouch® Thermal Batt Insulation (R-13, foil faced, 0.50 perm) in the stud cavity. Note: Foil faced is used for its permeance rating to illustrate this example, however, due to its ASTM E84 flame spread index of 75, it may not be approved for use in steel stud construction. Check local building codes for applicable requirements.

Figure 4

Winter Conditions with FOAMULAR® XPS Continuous Insulation and a Lower Perm Facer on the EcoTouch® FIBERGLAS™ Batt

This design incorporates a low perm/low flame spread facer on the EcoTouch® Flame Spread 25 FIBERGLAS™ Batt Insulation. Its 0.02 perm rating holds out enough water vapor to create a separation between estimated actual temperature and dew point temperature. A low perm faced insulation, or an unfaced insulation covered with a four to six mil poly sheet, with taped joints on the warm-in-winter side of the wall, minimizes the amount of water vapor that will flow into the wall by diffusion. Therefore, minimizing the potential for condensation in the wall.



1.5" FOAMULAR® XPS ci exterior sheathing (0.80 perm), with Owens Corning's™ EcoTouch® Flame Spread 25 Batt Insulation (FSK faced, 0.02 perm) in the stud cavity. Note: Owens Corning's™ EcoTouch® Flame Spread 25 Batt Insulation, in addition to having a low perm rating, also has a low ASTM E84 flame spread index of 25 or less. It is generally the faced product approved for use in steel stud construction. Check local building codes for applicable requirements.

In Figure 4 it is also important to consider that an interior vapor retarder inhibits drying at times, primarily during summer seasons. In cooling dominated climates this may result in more moisture accumulation than if an interior vapor retarder was not used.

Managing Outside-In Vapor Drive

Figures 2 through 4 illustrate water vapor drive from inside to outside. Water vapor can also be driven from the outside of the building to the inside when: 1) the building is in a cooling dominated climate, and the outside vapor pressure is routinely higher than the inside vapor pressure, or 2) potentially in any climate, when moisture absorbing "reservoir" type claddings (masonry or even gypsum) are wetted and retain water. The reservoir of moisture in the cladding may be driven inward, into the building, primarily during the summer season in the northern USA, or at nearly any time of year in the south. "Outside-In" or "reverse vapor drive" is caused by a combination of factors including retained moisture in the exterior wall surfaces, and/or high exterior temperature and humidity (high exterior vapor pressure). This can be coupled with lower interior temperature and humidity (lower interior vapor pressure), and, at times, additionally driven by exposure of the exterior surface to solar energy.

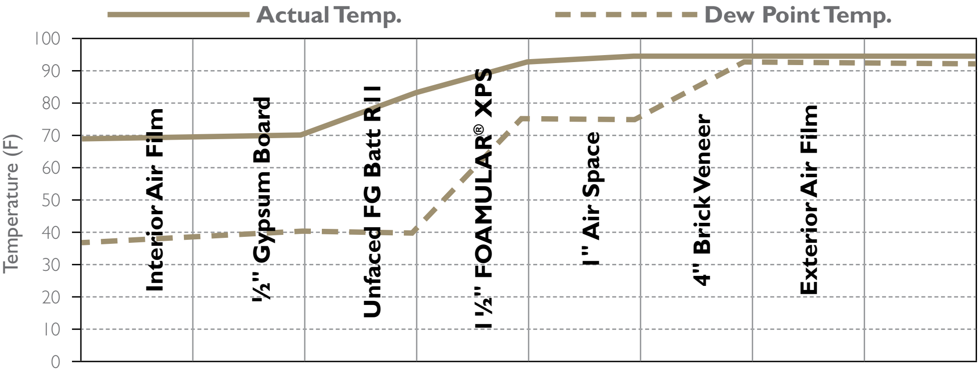
CommercialComplete™ Wall Systems resist reverse vapor drive due to the presence of FOAMULAR® XPS ci. Its relatively low permeance value (1.1 perm for 1" thick, even lower as it gets thicker) limits diffusion of exterior moisture vapor into the building during reverse vapor drive conditions. By limiting diffusion of moisture vapor into the wall, condensation is discouraged, thereby limiting steel stud deterioration and mold growth.

FOAMULAR® XPS ci has vapor resisting properties perfectly suited for the CommercialComplete™ Wall Systems. Its permeance is not so low that it creates a relevant barrier against winter time vapor flow to the outside, nor is it so high that it allows excessive summer time vapor flow to the inside. Figure 5 provides an example of a summer or warm climate reverse vapor flow condition.

Figure 5

Warm Climate or Summer Conditions with FOAMULAR® XPS Continuous Insulation and No Facer on the EcoTouch® FIBERGLAS™ Batt

This design incorporates FOAMULAR® XPS ci with unfaced EcoTouch® Thermal Batt FiberGlas™ Insulation. Because the high vapor pressure side is on the outside in this example, unlike the previous examples, the vapor drive is from the outside toward the inside. In this condition, the FOAMULAR® XPS has a moderate perm rating, suitable to moderate the diffusion of exterior water vapor. Once the vapor passes through the FOAMULAR® XPS layer, it moves relatively unimpeded through the remaining layers of the wall without encountering dew point temperature and without condensing.



1.5" FOAMULAR® XPS ci insulation exterior sheathing (0.80 perm), with Owens Corning's™ EcoTouch® Thermal Batt Insulation unfaced in the stud cavity. Exterior Conditions: 95°F, 95 percent relative humidity. Interior Conditions: 70°F, 30 percent relative humidity.

AIR & MOISTURE MANAGEMENT

Air Barriers Manage Air Infiltration

Designing to manage temperature and RH level in wall systems can be of little consequence if air infiltration is not controlled. The significant majority of condensation related water problems in wall assemblies are attributable to air infiltration rather than water vapor diffusion.[8] Vapor retarders control the diffusion challenge, while air barriers control the infiltration challenge. Effective design addresses both. (Bulk water leakage from rain or melting snow is a different challenge related to flashing, sealing and drainage.)

CommercialComplete™ Wall Systems have the design flexibility to accommodate a variety of air barrier design solutions. See Figure 1 (left side) that shows FOAMULAR® XPS ci with joints sealed with JointSealR™ Foam Joint Tape. That combination of materials is an effective air barrier layer that achieves an air leakage rate of 0.0000335 cfm/ft^2 at 1.57 psf pressure differential when tested in accordance with ASTM E2178.[6] That level of performance is more than 100 times less than the 0.004 cfm/ft^2, that is the ASHRAE 90.1 maximum requirement for air barrier performance.[7] FOAMULAR® XPS with joints sealed with JointSealR™ Foam Joint Tape is an effective air barrier layer if other penetrations are effectively sealed.

Figure 1 also shows (right side) another typical wall system configuration. This wall system uses exterior grade gypsum board sheathing over the steel studs, covered with a spray or sheet applied air barrier and covered with a layer of FOAMULAR® XPS ci. Either option is a very effective solution to manage thermal performance and air infiltration.

Why Omit the Stud Cavity Fiber Glass Batt? To Control Condensation?

An alternative method for insulating steel stud wall systems is to omit the fiber glass batt insulation in the stud cavity and accomplish all of the required R-value using only the ci sheathing layer outboard of the stud. This method of insulation places all of the insulation layer outside the steel stud thus placing the stud cavity, and the full depth of the stud, in a space that is essentially conditioned as interior space. Since the stud is in conditioned space, the dew point, the temperature point at which water vapor condenses, is not likely to occur in the vicinity of the stud. Instead, it will occur in the ci sheathing layer. Moving the dew point into the ci layer lessens the likelihood of condensation and therefore lowers the potential for corrosion of the steel stud and the wall system fasteners that penetrate the stud. However, omitting the cavity batt insulation, and achieving the complete wall system R-value with only ci presents other challenges due to the increase in the ci thickness required to meet ASHRAE 90.1. Does it really completely solve the potential water vapor condensation problem?

Often the reason for omitting fiber glass batts from the stud cavity is to shift the dew point into the ci sheathing layer and presumably avoid condensation in the vicinity of the stud and stud cavity. See Figure 6. This reasoning assumes that the internal vapor retarder is not properly installed, that it is not possible to get it properly installed, and that the flaws will compromise the ability of the retarder to control water vapor diffusion into the insulated stud cavity. Therefore, the reasoning goes, remove the stud cavity insulation. Doing so relocates the dew point from the stud cavity into the ci layer outside the volume of the stud cavity, and thereby eliminates the concern for condensation inside the stud cavity. Actually, only a small percentage of vapor entry into wall assemblies is due to diffusion[8]. Therefore, does omitting the fiber glass stud cavity insulation really solve the moisture control problem?

Vapor diffusion is the moisture transport mechanism that vapor retarders are intended to thwart, and is the basis for dew point calculation and location. However, many sources agree that a much larger percentage of vapor infiltration is due to air leakage.[8] Air infiltration/exfiltration is controlled by air barrier systems. Even if a wall does not include the use of cavity batt insulation, it is still prone to condensation if cold air can infiltrate the stud cavity and mix with warm humid air. In other words, regardless if there is stud cavity fiber glass or not, condensation can still occur in the stud cavity if the wall is not properly protected by a well installed air barrier.

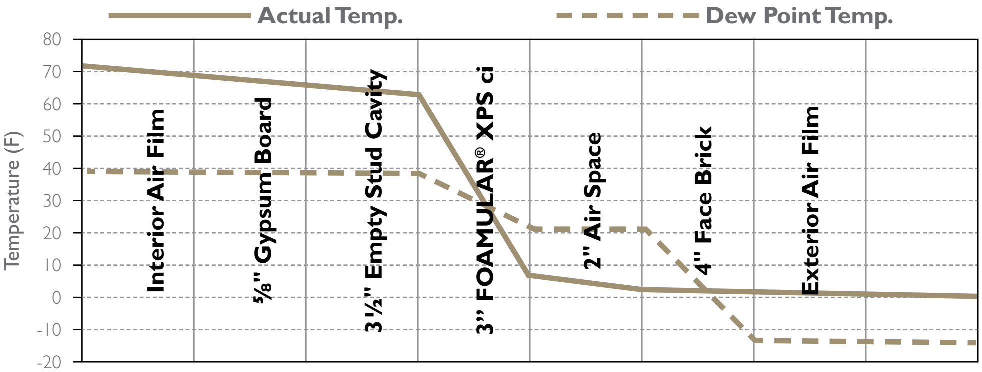
It is difficult to predict where condensation due to air infiltration will occur due to the random nature of air flow paths. Condensation may occur on surfaces chilled by moving air, such as the face of a steel stud where sheathing joints are located. It is for this reason the practice of omitting stud cavity batt insulation may not completely avoid condensation in the stud cavity. Also, consider that omitting the cavity batt leaves the valuable space unused inside the cavity that could help insulate the wall. Omitting the cavity fiber glass batt insulation subtracts from the overall wall system R-value. The wall system is less energy efficient without the fiber glass batt insulation.

A well installed air barrier layer goes a long way toward protecting the wall against condensation from water vapor laden air. With an air barrier in place, coupled with a properly designed and installed vapor retarding layer, essential safeguards against cavity condensation are provided enabling the use of cavity batt insulation that adds significant system R-value.

Figure 6

Winter Conditions with Only FOAMULAR® XPS Continuous Insulation and No Fiber Glass Batt in the Stud Cavity

This design shows the predicted vapor performance of a wall with no cavity insulation, and no vapor retarder, relying fully on the sheathing for insulation. This wall design is similar to Figure 3 except the fiber glass batt insulation is removed. As in Figure 3, the "dew-point" is shifted out of the stud cavity and into the FOAMULAR® XPS Insulation layer where condensation will not occur. Any condensation in this model is predicted to occur in the air space, behind the brick veneer, a space that is designed to accommodate moisture and drainage.



Owens Corning's™ 3" FOAMULAR® XPS ci sheathing insulation (0.60 perm), no stud cavity insulation and no interior vapor retarder.

AIR & MOISTURE MANAGEMENT

Additional Design Considerations

Maintaining the Air Space

Rain screen claddings rely on an air space behind the cladding to collect and drain away water that penetrates the cladding. After the exterior cladding, the air space is the second layer of defense in the CommercialComplete™ Wall Systems, followed by water resistant FOAMULAR® XPS ci with JointSealR™ Foam Joint Tape to seal the joints. Behind that may be another layer of air barrier over gypsum board. It is usually not necessary to use taped FOAMULAR® Insulation joints and an air/moisture barrier over gypsum. One or the other is commonly used.

The drainage cavity or air space width, between the face of the sheathing and the back of the brick, should be at least 2" wide according to the Brick Industry Association (BIA).[11] The "Steel Stud Brick Veneer Design Guide" recommends a minimum 1" air space, with 2" preferred. Water intrusion must also be managed by adhering to BIA recommendations concerning the installation of flashing and the placement of weep holes. Mortar dropping control devices should be specified to maintain drain paths by preventing mortar clogging of weep slots. See Figure 7.

Figure 7

Mortar drop control mesh in the air space between the brick veneer and FOAMULAR® XPS ci, protecting the weep hole insert from mortar clogging.

Flashing

Install through wall head/sill and floor line flashings to shed water, either shingle style under foam sheathing, adhered to the surface of the foam sheathing, or between sheathing layers if multiple layers are used. Multi-layer sheathing installation may consist of FOAMULAR® XPS ci over exterior gypsum sheathing. Sealing flashing to foam is optional if the leading edge of flashing is "shingled" under another layer of sheathing. Flashing should be sealed to the foam if it is not installed shingle style.

Flashing should be installed at each floor line, at shelf angles, lintels, window sills, and other penetrations in the veneer. Flashing should have slope and lead to large weep slots (holes) to promote drainage. See Figure 7.

Corrosion Protection

FOAMULAR® XPS ci provides important protection against corrosion. Canada Mortgage and Housing Corporation (CMHC) research concludes that insulating sheathing significantly reduces the potential for condensation in an insulated stud space.[12] This is accomplished by moderating the temperature of the stud cavity, thereby minimizing the potential for condensation, the potential corrosion of steel studs, and by resisting the intrusion of bulk moisture from the exterior. Reduced condensation potential means less moisture, therefore, less corrosion of steel components. Still, it is important to specify proper corrosion resistant coatings for steel framing, brick ties, and fasteners as recommended by the steel component manufacturer.

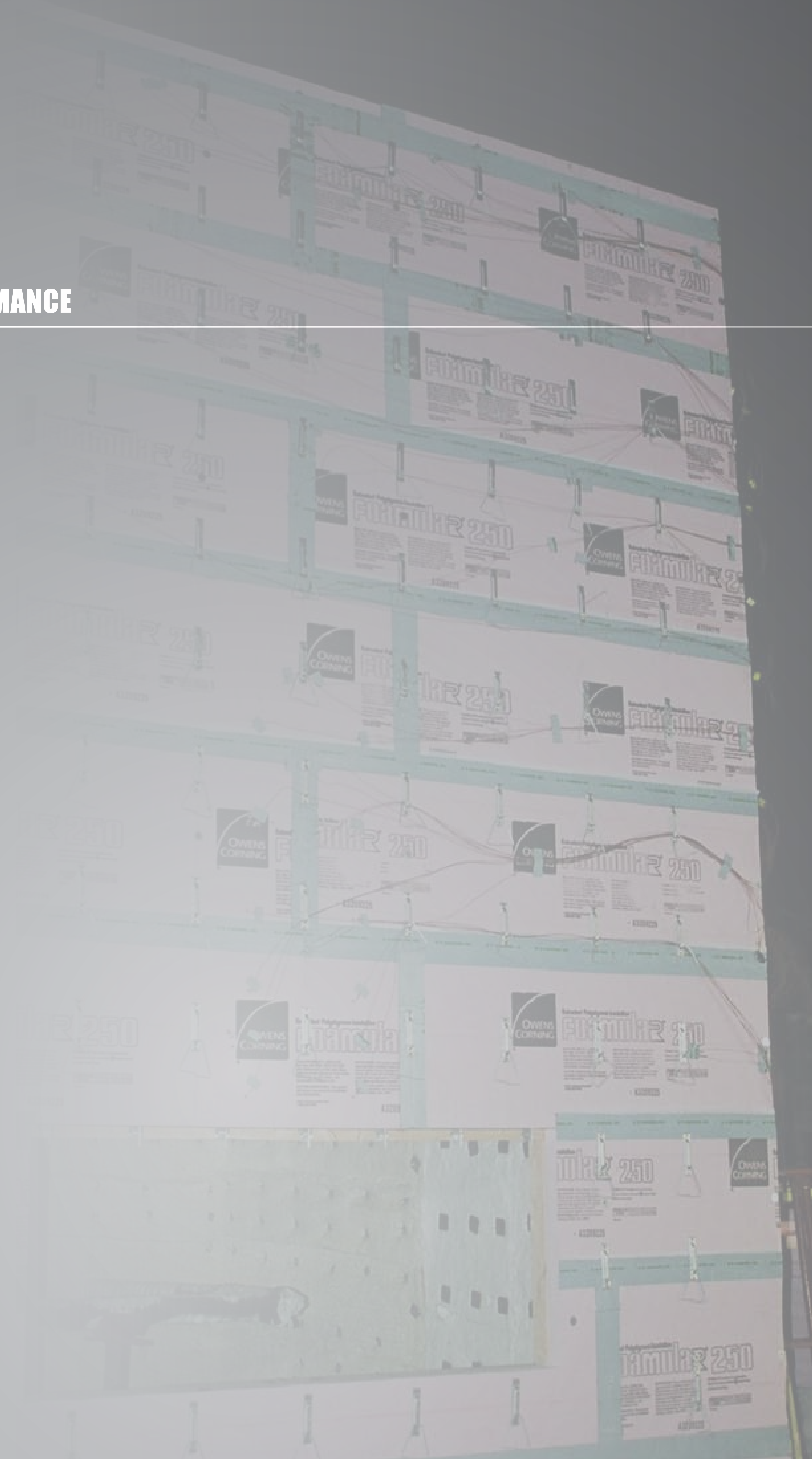
AIR & MOISTURE MANAGEMENT

References:

1. AC 71, "Acceptance Criteria for Foam Plastic Sheathing Panels Used as Water Resistive Barriers," International Code Council Evaluation Service (ICC-ES)
2. Air Permeance Test on Owens Corning™ JointSealR Foam Joint Tape over FOAMULAR® XPS Joints, tested in accordance with ASTM E2178; QAI Laboratories, Test Report No. RJ1390P-1, September 12, 2011
3. Brick Industry Association (BIA); "Technical Notes on Brick Construction," 28B, Brick Veneer/Steel Stud Walls, December 2005; page 1 and 6
4. Steel Stud Brick Veneer Design Guide, Design Guide CF03-1, November 2003, Committee on Specifications for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; page 20
5. ASTM E2178 – 03, "Standard Test Method for Air Permeance of Building Materials"
6. Air Permeance Test on Owens Corning™ JointSealR Foam Joint Tape over FOAMULAR® XPS Joints, tested in accordance with ASTM E2178; QAI Laboratories, Test Report No. RJ1390P-1, September 12, 2011
7. ANSI/ASHRAE/IESNA Standard 90.1-2010, "Energy Standard for Buildings Except Low-Rise Residential Buildings;" Section 5.4.3.1.3 a
8. Whole Building Design Guide, Moisture Concepts, Dynamics and Definitions, Moisture Movement; National Institute of Building Sciences; http://www.wbdg.org/resources/moisturedynamics.php
9. ASHRAE Handbook, Fundamentals, 2009; Moisture Transport, Dew Point Method, page 27.8; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
10. WUFI-ORNL/IBP Moisture Design Tool for Architects and Engineers; Oak Ridge National Laboratories, Buildings Technology Center; http://www.ornl.gov/sci/btc/apps/moisture/index.html
11. Brick Industry Association (BIA); "Technical Notes on Brick Construction," 28B, Brick Veneer/Steel Stud Walls, December 2005; page 1 and 7
12. Brick Veneer Steel Stud Best Practice Guide Building Technology, 1996; pages 3-7; Canada Mortgage and Housing Corporation


OWENS CORNING
FOAMULAR 250

FIRE PERFORMANCE



Fire Performance

Foam plastic insulation has been used very effectively and safely in building construction for several decades. Section 2603 of the International Building Code[1] (IBC) defines fire performance requirements that govern the use of foam plastics in building construction. The major elements of fire performance for foam plastic insulation are discussed in this section of the CommercialComplete™ Wall Systems guide.

Flammability Requirements for Foam Plastic as a Component

The basic IBC criteria governing foam plastic insulation, before it is placed into an assembly, are:

- **Labeling and Identification:** All foam plastics or foam plastic components delivered to the job site must bear the label of an approved third party inspection agency. (IBC Section 2603.2 and 2603.5.6)
- **Surface-Burning Characteristics:** With a few exceptions, foam plastics are required to have a maximum flame spread index of 75, and a maximum smoke developed index of 450 when tested in accordance with ASTM E84. (IBC Section 2603.3) One exception applies to foam plastic used in the exterior walls of Types I, II, III or IV construction where the flame spread for the foam plastic component is 25 maximum. (IBC Section 2603.5.4) With a flame spread rating of 5, FOAMULAR® Extruded Polystyrene (XPS) is suitable for use in all applications.
- **Thermal Barrier Protection:** Also with a few exceptions, foam plastics are required to be separated from the interior of a building by a 15 minute thermal barrier, performance criteria for which is defined in the IBC, or prescribed to be minimum ½" thick regular gypsum wallboard. (IBC Section 2603.4 and 2603.5.2)

FOAMULAR® XPS Insulation is listed and labeled as required by the IBC, for a variety of building construction applications, with independent third party agencies including Underwriters Laboratories (UL) and Factory Mutual (FM) Approvals. The basic listing for FOAMULAR® XPS Insulation surface burning characteristics can be confirmed using the UL On-Line Certifications Directory, or by downloading a copy of UL Certificate U-197.

UL Certificate U-197

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CERTIFICATE U-197

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33P1

FOR ROOFING SYSTEMS
AS TO EXTERNAL FIRE EXPOSURE ONLY
SEE UL BUILDING MATERIALS DIRECTORY

AS ROOF DECK CONSTRUCTION MATERIAL
AS TO WIND UPLIFT RESISTANCE ONLY
CLASS 60 AS SHOWN BY CONSTRUCTION NO. 58
CLASS 30 AS SHOWN BY CONSTRUCTION NO. 87
SEE UL BUILDING MATERIALS DIRECTORY

FIRE RESISTANCE CLASSIFICATION

SEE UL FIRE RESISTANCE DIRECTORY

The manufacturer makes the following statement regarding Surface Burning Characteristics: "THESE NUMERICAL FLAME SPREAD AND SMOKE RATINGS ARE NOT INTENDED TO REFLECT HAZARDS PRESENTED BY THIS MATERIAL UNDER ACTUAL FIRE CONDITIONS."

Pictured at left

NFPA 285 test wall assembly under construction, ready for the installation of the exterior cladding material.

Wall System Fire Performance

To meet energy efficiency standards, commercial buildings often incorporate foam plastic insulation in the building envelope. All foam plastic insulation is combustible including XPS, expanded polystyrene (EPS), polyisocyanurate (iso), and spray polyurethane (SPF). Commercial buildings, because of their area, height, proximity to property lines or the nature of their use, are often required to be constructed in whole or in part of non-combustible materials. Non-combustible construction "Types" are defined in Section 602 of the IBC. Types I and II are defined as essentially all building elements consisting of non-combustible materials. Types III and IV are defined as the exterior walls being constructed of non-combustible materials. Type V is wholly combustible construction.

Limiting Fire Spread, NFPA 285

The IBC requires the exterior walls of most commercial buildings to be constructed of non-combustible materials, as is the case in Types I, II, III and IV construction. The ASHRAE 90.1 energy standard for commercial buildings prescribes the use of continuous insulation (ci) over steel framing to minimize energy inefficient thermal bridging. As explained earlier, ci is typically combustible foam plastic insulation. To address the dual requirements of non-combustible walls containing combustible foam plastics, the IBC requires all wall assemblies of any height, that are required to be Type I, II, III or IV construction, be tested and comply with the acceptance criteria of NFPA 285.[2] See IBC Section 2603.5.5.

To pass the NFPA 285 test, a wall assembly must demonstrate limited fire spread vertically and horizontally away from the area of fire exposure. The IBC imposes two additional criteria for NFPA 285 tested wall assemblies:

- **Potential Heat:** The potential heat of foam plastic in walls, expressed in Btu per square foot, is limited to the amount that has been successfully tested in the required NFPA 285 full scale wall test. (IBC Section 2603.5.3)
- **Ignition:** Exterior walls shall not exhibit sustained flaming when tested in accordance with NFPA 268.[3] Walls that are protected on the outside with a minimum of 1" thick masonry, concrete, or a minimum of ⅞" thick stucco, are not required to be tested for ignition. (IBC Section 2603.5.7)

NFPA 285 Tested CommercialComplete™ Wall Systems

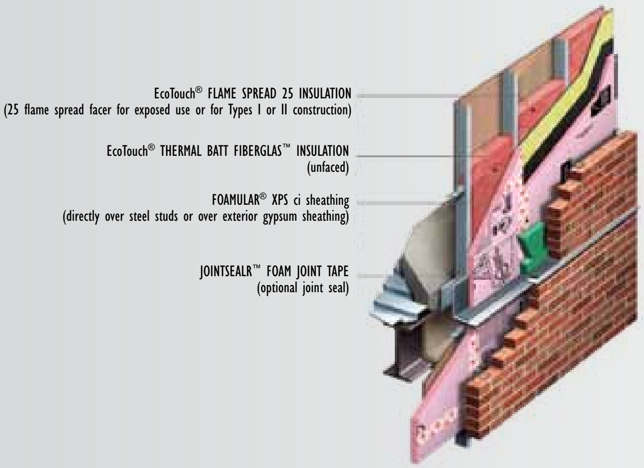
Owens Corning's™ CommercialComplete™ Wall Systems with FOAMULAR® XPS ci sheathing, and, with or without EcoTouch® FIBERGLAS™ Insulation, using steel stud frame or masonry back-up walls, with a variety of masonry veneer exterior finishes, have successfully passed NFPA 285. For complete wall system specification details see the Owens Corning publication entitled "NFPA 285 Tested Wall Assemblies."

NFPA 285 test wall under construction.

Fire emitting from the NFPA 285 test window.

FOAMULAR® XPS with brick veneer stripped away above the test window showing limited damage and minimal fire spread after the NFPA 285 fire test.

CommercialComplete™ Wall Systems for Steel Stud and Masonry Veneer



FIRE PERFORMANCE

Fire Resistance Ratings, ASTM E119

The IBC sometimes requires the exterior walls of commercial buildings to be fire resistance rated. Fire resistance ratings are prescribed by the code depending on the type of construction required, and based on fire separation distances between buildings and/or property lines. (IBC Section 602.1) The IBC requires that fire resistance ratings for wall assemblies be determined by testing in accordance with ASTM E119.[4] (IBC Section 703.2, and Section 2603.5.1 which is specific to walls containing foam plastic insulation.) The test evaluates a wall assembly's ability to maintain its structural integrity and survive hose stream exposure, with limited passage of heat, flaming, and smoke, while exposed to the test fire for a specific period of time.

Owens Corning's™ CommercialComplete™ Wall Systems have hourly fire resistance ratings with FOAMULAR® XPS ci sheathing, with EcoTouch® FIBERGLAS™ Insulation, using steel stud frame or masonry back-up walls with a brick veneer exterior finish. Possibilities include exterior wall assemblies that are load bearing with a 1 hour interior exposure rating, and non-load bearing with a 3 hour interior exposure rating. See Table 1 for CommercialComplete™ Wall Systems fire resistance rated steel stud wall assembly summary details. For complete wall system specification details see the UL On-Line Certifications Directory and other wall systems including V414, V434, U460, U902, and U912.

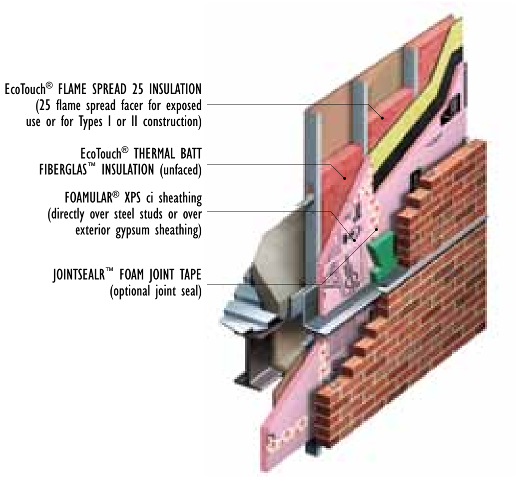
Table 1

CommercialComplete™ Wall Systems, Steel Stud, Fire Resistance Rated System Summary

Assembly #	V414	V434
Exterior Fire Rating	1 hour	1 hour
Interior Fire Rating	3 hour	1 hour
Structural	Nonbearing	Bearing
Steel Stud Spacing	16" max. oc.	24" max. oc.
Steel Stud Depth	3⅝"	3⅝"
Interior Finish	⅝", type "C" gypsum board	⅝", type X gypsum board
Vapor Retarder	4 mil polyethylene	4 mil polyethylene
Batt Insulation	EcoTouch® FIBERGLAS,™ faced or unfaced	EcoTouch® FIBERGLAS,™ faced or unfaced
Sheathing Insulation	2" max., FOAMULAR® XPS, faced or unfaced	2" max., FOAMULAR® XPS, faced or unfaced
Joint Treatment	JointSealR™ Foam Joint Tape (optional)	JointSealR™ Foam Joint Tape (optional)
Air Space	Varies 1" to 2"	Varies 1" to 2"
Mortar Drop Protection	At the bottom of the air space (optional)	At the bottom of the air space (optional)
Exterior Finish	4" face brick	4" face brick
Wall Tie Type	Any mfgr., bracket legs	Any mfgr., bracket legs
Wall Tie Spacing	16" max.	24" max.(1)

(1) Building code requirements for brick support may differ.

CommercialComplete™ Wall Systems for Steel Stud and Masonry Veneer



Exterior Curtain Wall and Floor Intersection, ASTM E2307

Where ASTM E119 fire resistance rated floor assemblies are required by the IBC, the void created at the intersection of the exterior curtain wall and the floor assembly must be sealed with an approved joint system to prevent the interior spread of fire between the floor and wall. The joint systems must be tested in accordance with ASTM E2307[5] to prevent the passage of flame for the time period at least equal to the fire-resistance rating of the floor and prevent the passage of heat and hot gases sufficient to ignite cotton waste. (IBC Section 714.4) For complete joint system specification details see the UL On-Line Certifications Directory, Perimeter Fire Containment Systems.

The void at the intersection between exterior curtain walls and non-fire resistance rated floor assemblies also must be sealed with an approved material or system to retard the interior spread of fire and hot gases between stories. (IBC Section 714.4.1) Figure 1 is an example of a non-rated seal using a "cold angle" detail that has mineral wool fire safing insulation packed around the angle to complete the fire stop while at the same time improving thermal efficiency at the joint. Shelf angles may also be installed with the vertical leg in direct contact with the slab edge, thus completely sealing the cavity with the horizontal leg of the angle.

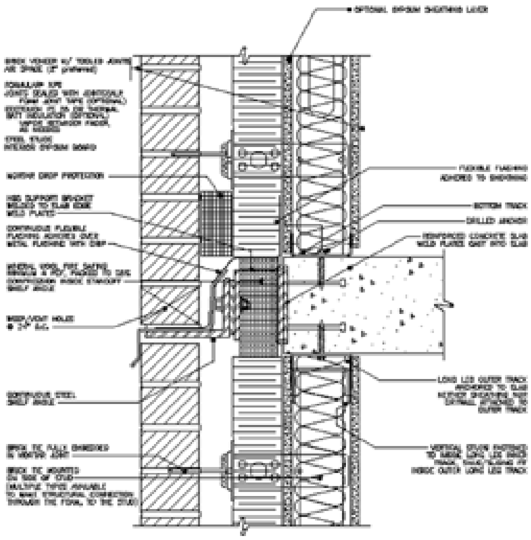


Figure 1

Non-Fire Resistance Rated Floor/Wall Joint Detail

Spaces Above Suspended Ceilings

Where FOAMULAR® XPS ci extends above a suspended ceiling, generally either the interior gypsum board finish must also extend above the ceiling, or there must be a layer of exterior gypsum sheathing underlying the foam, separating it from the interior of the building. This detail is to insure that building code requirements are met with regard to separation of the foam plastic insulation from the interior of the building by a 15 minute thermal barrier. Where the foam is in a dead air space above a suspended ceiling, meaning the space above the ceiling is not a return air plenum, and the ceiling bears a minimum 15 minute finish rating, it is possible that the interior gypsum board finish may be permitted to stop just above the ceiling line. Verify local code requirements before specifying.

FIRE PERFORMANCE

References:

1. *International Building Code, 2009; International Code Council, Inc.; 500 New Jersey Ave, NW, 6th Floor, Washington D.C. 20001*
2. *NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components; National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169*
3. *NFPA 268, Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02169*
4. *ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials; American Society for Testing and Materials, International, 100 Barr Harbor Drive, West Conshohocken, PA, 19428*
5. *ASTM E2307, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story, Test Apparatus; American Society for Testing and Materials, International, 100 Barr Harbor Drive, West Conshohocken, PA, 19428*

Caution: *Combustible. Although it does contain a flame-retardant additive to inhibit ignition from small fire sources, if exposed to fire of sufficient heat and intensity, FOAMULAR® XPS ci insulation will ignite. Do not expose the product to open flame during shipping, storage, installation or use. In most applications, a code compliant thermal barrier must be used to separate FOAMULAR® XPS ci insulation from the building interior. See ICC-ES Evaluation Report 1061 for building code related details.*

STRUCTURAL PERFORMANCE

Structural Performance

Owens Corning's™ CommercialComplete™ Wall Systems for steel stud/masonry veneer will be subjected to wind and seismic forces throughout its service life. Steel stud framing must be designed to support the masonry veneer, with the studs resisting rotation and limiting deflection to control masonry cracking. Also, the masonry wall ties that structurally connect the masonry veneer to the steel studs must be designed to positively engage the steel stud, through the Extruded Polystyrene (XPS) Insulation layer, transferring horizontal loads directly to the steel stud.

Industry Research on Steel Stud Bracing

In theory, steel stud framing, sheathing and masonry veneer act as a composite assembly. Each resist out-of-plane loads by taking a portion of the load relative to its flexural stiffness, span length, and the ability of the masonry ties to transfer load between the masonry wythe and the stud framing/sheathing system. However, over time, as the masonry/steel stud system repeatedly experiences cyclic deflection, the masonry eventually cracks and no longer functions to fully transfer flexural stresses to the studs. Under such cyclical deflection loading, seemingly rigid sheathing materials, like gypsum board, will deteriorate around fastener heads resulting in a reduced ability to accept flexural stress.

Therefore, according to some design standards, no sheathing should be considered to be a bracing element against deflection:

- **The American Iron and Steel Institute** (AISI) disregards the contribution of sheathing as bracing when analyzing the stiffness of steel studs as a back-up for brick veneer.[1]
- **The Canada Mortgage and Housing Corporation** (CMHC) states, "…unless the integrity of the sheathing can be guaranteed over the life of the structure, some other form of bracing must be provided…"[2]
- **Further, CMHC** states, "…the initial composite action between the gypsum board sheathing and the steel stud increased the backup wall stiffness by a small percentage. Under cyclic loading most of this small increase in stiffness diminished until the interaction between the two was insignificant…"[3]
- **The Brick Industry Association** (BIA) makes the following recommendation, "…Even though rigid sheathing braces the studs against a compression flange failure, no consideration may be given to composite action between the stud and sheathing in design (against deflection criteria)…"[4]

Steel Stud Bracing Techniques

All foam plastic insulating sheathing is non-structural and incapable of providing bracing to steel stud framing. Gypsum board, due to its friability, is also considered unsuitable for bracing steel stud framing. Therefore, steel stud backup framing must be independently braced against rotation and deflection and must not rely on sheathing for bracing.

Several techniques are used to brace steel stud framing. The most common bracing technique is the insertion of horizontal continuous cold rolled channel or angle through knockouts in the steel stud web section and fastened to the web of each stud. See Figures 1 and 2. Bracing must be installed in accordance with the recommendations of the AISI, Standard S2115 as referenced in the International Building Code (IBC), however, it is commonly installed at four feet on center.

STRUCTURAL PERFORMANCE

Steel Stud Bracing Techniques

Figure 1
Channel bracing through knockout in steel stud web.

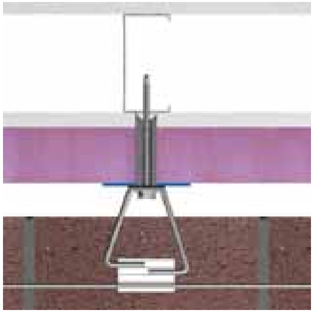
Figure 2

Figure 3
Combination of horizontal bracing through the steel stud knockout and a steel strap on the outer flange of the stud.

An alternative to bracing through the knockouts is to install horizontal steel strapping on both the inner and outer stud flange faces. Figure 3 shows a combination of bracing through the knockouts and a horizontal steel strap on the outer flange of the steel stud.

Masonry Veneer Ties

The masonry veneer ties that structurally connect the masonry veneer to the steel studs must be designed to positively engage the steel stud, through the XPS insulation layer, transferring horizontal loads directly to the steel stud.



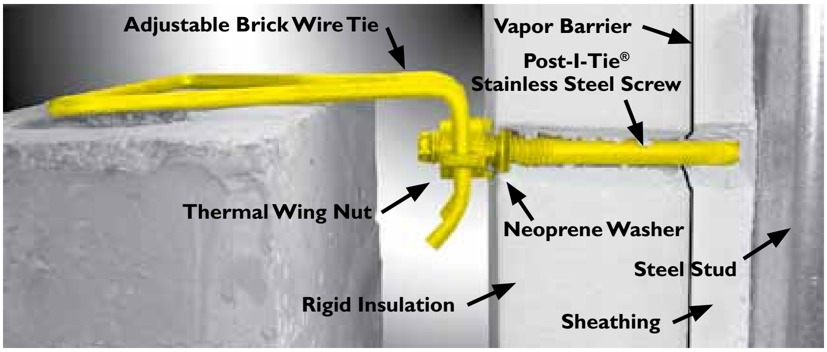
Exterior sheathings such as gypsum board and rigid foam insulation do not have adequately durable surfaces to accomplish long-term transfer of cyclical wind loads. Therefore, anchors and ties must connect directly to the steel stud framing, through the ci, without relying on the compressive strength of the FOAMULAR® XPS to transfer positive wind pressures to the steel studs. Ties should be designed to anchor masonry veneer to the steel stud backup in a manner that will permit the masonry to move freely, in-plane, relative to the steel studs. Anchors and ties must provide out-of-plane support, resisting tension and compression, but should not resist shear. This permits in-plane differential movements between the structural frame and the veneer without causing cracking.

The design of masonry veneer ties varies depending on the type of tie and the manufacturer. Some tie designs minimize steel tie to steel stud contact intending to minimize the energy inefficiencies of thermal bridging. Although consideration of thermal performance is important, providing for adequate load transfer from tie to steel stud framing is critical.

Three examples of commonly available masonry veneer tie products that are suitable for use with FOAMULAR® XPS continuous insulation (ci) are shown in this section. Contact the tie system manufacturer for current product data and for complete specification and installation details. The tie manufacturer must verify compliance with the IBC and verify the suitability of the masonry tie type and placement requirements for all projects.

Heckmann Building Products, Thermal Pos-I-Tie®:

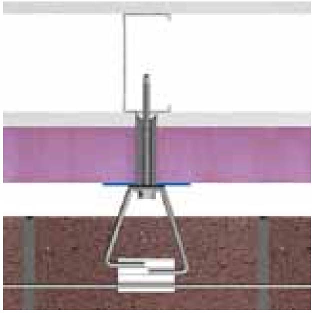
The Thermal Pos-I-Tie® is a factory assembled four-piece system that features a plastic wing nut, stainless steel barrel, neoprene washer and screw inserts for steel stud, concrete, CMU, brick and wood backup walls. For backups with insulation or gypsum board, the post anchor screw penetrates the insulation and screws directly into the backup while sealing the penetration hole. The wing nut is made from a high quality proprietary plastic material which acts

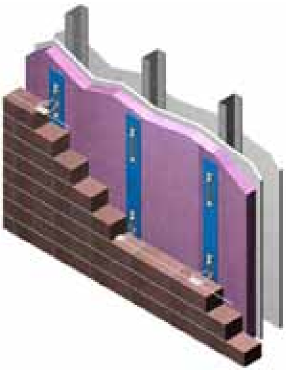


STRUCTURAL PERFORMANCE

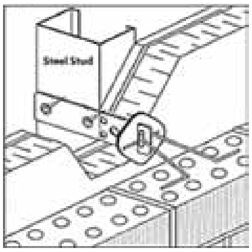
as a thermal break, decreasing thermal transfer through the ci layer.

Hohmann & Barnard, X-Seal™ Veneer Anchor:
The X-Seal™ Veneer Anchor has pronged legs that bridge the sheathing and ci layers and engage the steel stud, affording independent, positive anchorage. Compression of the sheathing by positive loads is prevented. The X-Seal™ Anchor has horizontal pronged legs offset in from each end, enabling the backplate portion of the anchor to effectively seal the wallboard/insulation. This helps to maintain the integrity of the weather resistive barrier and prevents the ingress of air and moisture through the sheathing.





Ferro Engineering, Slotted Side Mounting Rap Tie:
The system consists of a Flat Plate, a V-Tie,™ and an Insulation Support (optional). Lateral loads applied to the brick veneer are transferred through the V-Tie™ to the Flat-Plate, which is attached to the backup wall studs. The fasteners transfer the load from the tie to the stud in shear. The holes in the exterior end of the Flat-Plate, through which the V-Tie™ is placed, provide a positive connection while allowing for up to 36 mm (1.4") of vertical adjustability of the V-Tie™ placement during construction. The incorporation of the voids in the Flat-Plate minimizes thermal conductivity through the tie system. The Insulation Support is optionally used to securely fix the insulation in place.



Slotted Side Mounting Rap-Tie Application

Structural Design Summary

Owens Corning's™ CommercialComplete™ Wall Systems for steel stud/masonry veneer provide the benefits of durable, water resistant FOAMULAR® XPS ci applied directly to steel stud framing, or over a layer of exterior grade gypsum board. CommercialComplete™ Wall Systems provide excellent thermal performance, with air and weather resistive barrier coverage for the entire wall assembly, yet requires only the same bracing that must be specified with any other type of sheathing.

Steel stud framing, bracing and masonry wall tie systems should be specified and verified by a design professional, architect or engineer to verify code compliance and adequate consideration of loading, bracing, deflection and stresses in the exterior wall system.

FOAMULAR® XPS sheathing materials shall not be considered as lateral bracing for the stud to resist compression in bending, nor shall sheathing and stud be considered as acting as a structural composite. Adequate bracing must be provided by installing steel straps or channels, attached to/through the studs horizontally and diagonally as needed.

The allowable out-of-plane deflection of the studs due to service level loads should be restricted to L/600,[6] or restricted to the limit established by other applicable standards. Design the system to accommodate construction tolerances, deflection of building structural members and clearances of intended openings. Provide for movement of components without damage, failure of joint seals, undue stress on fasteners or ties, or other detrimental effects when subject to cyclic seasonal or diurnal temperature variation.

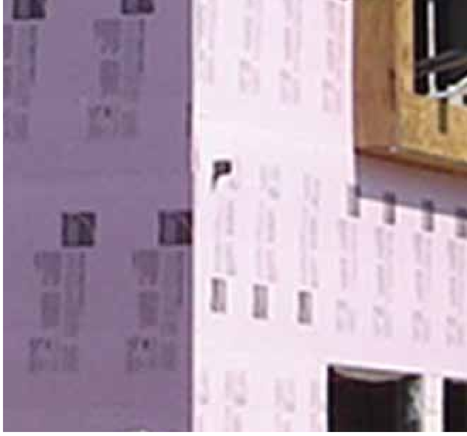
Masonry wall ties must be designed to transfer all loads directly in the steel stud wall framing through the FOAMULAR® XPS ci and other sheathing layers as required.

STRUCTURAL PERFORMANCE

References:

1. *Steel Stud Brick Veneer Design Guide, Design Guide CF03-1, November 2003, Committee on Specifications for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; pages 3-7*
2. *Canada Mortgage and Housing Corporation, "Strength and Stiffness Characteristics of Steel Stud Backup Walls Designed to Support Brick Veneer," Technical Series 98-111, 1991; Project Manager, Jacques Rousseau*
3. *Canada Mortgage and Housing Corporation, "A Report on Strength and Stiffness Characteristics of Steel Stud Backup Walls Designed to Support Brick Veneer," December 1991, section 5.3.4; By Robert G. Drysdale, P.E. McMaster University*
4. *Brick Industry Association (BIA); Engineering and Research Digest, "Lateral Bracing of Steel Stud Backing for Brick Veneer," one page, undated*
5. *American Iron and Steel Institute (AISI); S211, North American Standard for Cold-Formed Steel Framing – Wall Stud Design*
6. *Brick Industry Association (BIA); "Technical Notes on Brick Construction," 28B, Brick Veneer/Steel Stud Walls, December 2005; page 1 and 4*

GUIDE SPECIFICATION



PROJECT ARCHITECT RESPONSIBILITY:

This is a general guide specification, intended to be used by experienced construction professionals, in conjunction with good construction practice and professional judgment. This guide is to aid in the creation of a complete building specification that is to be fully reviewed and edited by the architect of record (specifier). Sections of this guide should be included, edited or omitted based on the requirements of a specific project. It is the responsibility of both the specifier and the purchaser to determine if a product or system is suitable for its intended use. Neither Owens Corning, nor any of its subsidiary or affiliated companies, assume any responsibility for the content of this specification guide relative to actual projects and specifically disclaim any and all liability for any errors or omissions in design, detail, structural capability, attachment details, shop drawings or other construction related details, whether based upon the information provided by Owens Corning or otherwise.

[Bracketed boldface] information highlights text that must be edited to suit the criteria of a particular project.

07 21 13 FOAM BOARD INSULATION
07 21 16 BATT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Thermal, air and water resistive barrier wall system for cold-formed metal exterior wall assemblies:
1. Exterior wall steel stud cavity batt insulation
2. Exterior wall insulating sheathing
3. Taped joint seal on insulating sheathing [optional]

B. Related Sections:
1. Section 05 41 00 Structural Metal Stud Framing
2. Section 09 21 16 Gypsum Board Assemblies
3. Section 07 26 13 Above Grade Vapor Retarders
4. Section 07 27 23 Board Product Air Barriers

1.2 REFERENCES

A. Reference standards:
1. ASTM International (ASTM):
   a. ASTM C578: Standard Specification for Rigid Cellular Polystyrene Thermal Insulation
   b. ASTM C272: Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
   c. ASTM C518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
   d. ASTM C665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
   e. ASTM D1621: Standard Test Method for Compressive Properties of Rigid Cellular Plastics
   f. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
   g. ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials
   h. ASTM E119: Standard Test Methods for Fire Tests of Building Constructions and Materials
   i. ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
   j. ASTM E2178: Standard Test Method for Air Permeance of Building Materials

2. National Fire Protection Association (NFPA):
    a. NFPA 285: Standard Fire Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
3. International Code Council Evaluation Service (ICC-ES)
    a. AC 71: Acceptance Criteria for Foam Plastic Sheathing Panels Used as Water Resistive Barriers
    b. AC 148: Acceptance Criteria for Flexible Flashing Materials
4. American Architectural Manufacturers Association (AAMA)
    a. AAMA 711: Voluntary Specification for Self Adhering Flashing Used for Installation of Exterior Wall Fenestration Products

1.3 SYSTEM DESCRIPTION

A. Provide and install cold formed steel stud exterior wall framing **[load-bearing, non-load bearing]**, **[fire resistance rated, non-fated]** system, **[with or without exterior gypsum sheathing] [with or without sheet or spray applied air and water resistive barrier layer over the exterior gypsum]**, with ci sheathing **[foam board joints sealed or unsealed]**, **[with or without fiber glass batt insulation]** in the stud cavity **[with or without a vapor retarding facer on the fiber glass]**, that effectively controls thermal, air and water performance and provides ci and continuity of the building envelope. The system shall include the following:
1. Steel stud framing independently braced to resist vertical and transverse structural loading
2. Insulating foam plastic sheathing secured to the exterior of the steel stud wall framing
3. **[Fiber glass batt insulation in the steel stud framing cavity]**
4. **[Joint sealing tape over the insulating sheathing joints and penetrations]**

B. All joints, penetrations and gaps of the insulating **[and air barrier]** wall system shall be made water **[and air]** tight

C. Code Compliance: Exterior wall system and component materials shall comply with the following requirements:
1. The complete exterior wall assembly shall comply with the passing criteria defined in NFPA 285 for exterior wall limited fire spread performance
2. Wall and floor joints shall be fire stopped as required in International Building Code Section 714
3. Insulating sheathing and foam joint sealing tape shall comply with ASTM E2178, AC71 and AC148 for exterior wall products sealed against air and water penetration

1.4 SUBMITTALS

A. Product Data: Submit data on product characteristics and performance criteria, including installation and application instructions

B. International Code Council Evaluation Service (ICC-ES) product evaluation report(s)

C. Submit Material Safety Data Sheets (MSDS) for thermal and air barrier wall system components

1.5 QUALITY ASSURANCE

A. Provide third party verification claims including physical properties, R-value, code required listing and labeling, indoor air quality, environmental (recycle content, regional sourcing), and product warranties

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's unopened and undamaged packaging and bundles, fully identified with manufacturer name, product name, and compliance with the applicable material standard. Exercise care to avoid damage during unloading, storing and installation. Damaged or deteriorated material shall be removed from the job site.

B. Store, and protect materials in accordance with the manufacturer's instructions to prevent damage, contamination, exposure and deterioration.

C. Store with packaging and labels intact and legible. For batt and fiberous materials that are subject to wetting and water absorption, store in a sheltered and ventilated location to protect the materials from moisture and soiling.

PART 2- PRODUCTS

2.1 EXTRUDED POLYSTYRENE INSULATION

A. Insulating Sheathing: Extruded polystyrene foam plastic insulation, unfaced, complying with ASTM C578 and meeting the following criteria:
1. ASTM C578 type **[X, IV]**, certified by independent third party such as RADCO
2. Blowing Agent Formulation: Shall be zero ozone depleting.
3. Compressive Strength (ASTM D1621): **[15, 25]** psi, minimum.
4. Edge condition: **[square, tongue & groove, shiplap]**
5. Thermal Resistance (180 day real-time aging as mandated by ASTM C578, measured per ASTM C518 at mean temperature of 75F): **[R-5.0, 5.6]** per inch of thickness, with 90 percent lifetime limited warranty on thermal resistance
6. Water Absorption (ASTM C272): Maximum 0.10 percent by volume.
7. Surface Burning Characteristics (ASTM E84): Flame spread less than 25, smoke developed less than 450, certified by independent third party such as Underwriters Laboratories
8. Indoor Air Quality: Compliance certified by independent third party such as GreenGuard Indoor Air Quality Certified® and/or GreenGuard Children and Schools Certified℠
9. Recycle Content: Minimum 20 percent, certified by independent third party such as Scientific Certification Systems
10. Warranty: Limited lifetime warranty covering all ASTM C578 physical properties

B. Manufacturers: Subject to compliance with product criteria, the manufacturers whose products may be incorporated into the work include but are not limited to:

1. DiversiFoam Products
2. Dow Chemical Company
3. Owens Corning
4. Pactiv Corporation

C. Acceptable Products: Subject to compliance with product criteria, the products that may be incorporated into the work include but are not limited to:

1. **[FOAMULAR® CC; ASTM C578 Type X; R-5 per inch of thickness; [2", 2½", 3"]; 48"x96"; shiplap long edge]**
2. **[FOAMULAR® XPS 250; ASTM C578 Type IV; R-5 per inch of thickness; [¾", 1", 1½", 2", 2½", 3", 4"]; [48"x96" or 24"x96"]; square edge or tongue & groove up to 2" only]**
3. **[FOAMULAR® CC High R; ASTM C578 Type IV; R-5.6 per inch of thickness; [1¾" R-10, 2⅛" R-12, 3" R-17]; 48"x96"; shiplap long edge]**

D. Fasteners: Provide preassembled screw/stress plate fasteners recommended by their manufacturer for securing foam plastic insulating sheathing. Polymer or other corrosion-protected, coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness and fastener manufacturer recommendation.

2.2 FIBER GLASS BATT INSULATION

A. Stud cavity batts: Fiber glass batt insulation **[faced, unfaced]**, complying with ASTM C665 and meeting the following criteria:

1. ASTM C665 type **[I (batt without facing), or II Class A (batt with nonreflective facing, flame spread 25 or less), or III Class A (batt with reflective facing, flame spread 25 or less]**
2. Full width batt for use with steel studs spaced **[16", 24"]** on center
3. Thermal Resistance: Measured in accordance with ASTM C518, R-value **[11, 13, 15, 19, 21, 30]**
4. **[Factory applied facing, or Unfaced]** : (If faced, choose from the following options) :
   [FSK (foil-scrim-kraft, Type III Class A, Category 1, facer is a vapor retarder with 0.02 water vapor permeance)]
   [PSK (light-reflective white polypropylene-scrim-kraft, Type II Class A, Category 1, facer is a vapor retarder with 0.02 water vapor permeance)].
   [Surface burning characteristics, ASTM E84, flame spread 25 or less.]
5. **[Water Vapor Permeance: Permeance of vapor retarding facings measured in accordance with ASTM E96.]**
6. Indoor Air Quality: Verified to be formaldehyde free by independent third party such as GreenGuard Environmental Institute, and, Indoor Air Quality and/or GreenGuard Children and Schools Certified[SM]
7. Recycle Content: Minimum 50 percent, certified by independent third party such as Scientific Certification Systems
8. Sustainable Product Certification: Verified to comply with EcoLogo Certification Criteria Document 016 for Thermal Insulation Materials (CCD-016) for environmentally preferable products
9. Renewable Materials: Verified to contain renewable ingredients to meet or exceed the biobased content criteria for the USDA Certified Biobased Product Label

B. Manufacturers: Subject to compliance with product criteria, the manufacturers whose products may be incorporated into the work include but are not limited to:

1. CertainTeed Corporation
2. Guardian Building Products
3. Johns Manville
4. Owens Corning

C. Acceptable Products: Subject to compliance with product criteria, the products that may be incorporated into the work include but are not limited to:

1. **[EcoTouch® Thermal Batt, unfaced; ASTM C665 Type I; thickness [3½" R-11, 3½" R-13, 6¼" R-19]; full width for steel stud framing 16" or 24" on center; 48" or 96" long]**
2. **[EcoTouch® Flame Spread 25, FSK faced; ASTM C665 Type III, Class A, reflective FSK faced, flame spread 25, 0.02 perm; thickness [3½" R-11, 3½" R-13, 6¼" R-19, 9½" R-30]; full width for steel stud framing 16" or 24" on center; 48" or 96" long]**
3. **[EcoTouch® Flame Spread 25, PSK faced; ASTM C665 Type II, Class A, white PSK faced, flame spread 25, 0.02 perm; thickness [3½" R-11, 3½" R-13, 6¼" R-19, 9½" R-30]; full width for steel stud framing 16" or 24" on center; 48" or 96" long]**

2.3 **[TAPE]**

A. **[Joint Sealing Tape: Pressure sensitive, self adhering, acrylic adhesive joint sealing tape, complying with AAMA 711, and, meeting the following criteria:]**

1. **Recommended by its manufacturer for sealing the joints of extruded polystyrene insulation board in vertical cavity wall construction**
2. **Peel Adhesion Strength: Compliant with ICC-ES AC 148 and AAMA 711**
3. **Water Resistance and Joint Sealing: Compliant with ICC-ES AC 71**
4. **Air Permeance: Air permeance less than or equal to 0.004 cfm/ft², tested in accordance with ASTM E2178**
5. **Service Temperature: Service temperature range shall be at least 0˚F to 120˚F maximum**
6. **Width: Minimum 3.5"**

B. **[Manufacturers: Subject to compliance with product criteria, the manufacturers whose products may be incorporated into the work include but are not limited to:**
   1. Owens Corning]

C. **[Acceptable Products: Subject to compliance with product criteria, the products that may be incorporated into the work include but are not limited to:**
   1. JointSealR™ Foam Joint Tape; 3.5" wide, 90' long, supplied in rolls]

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that steel wall studs, opening framing, bridging and structural bracing and other framing support members and anchorage have been installed in accordance with good construction practice and are compliant with this specification.

B. Verify that adjacent materials are dry and ready to receive insulation. Verify mechanical and electrical services within walls have been tested and inspected.

C. Report unacceptable conditions in writing. Do not proceed with work until unsatisfactory conditions have been corrected.

D. Installation of products specified in this section constitutes acceptance of existing conditions and assumption of responsibility for satisfactory performance.

3.2 INSTALLATION OF EXTRUDED POLYSTYRENE INSULATING SHEATHING

A. Install extruded polystyrene (XPS) insulation boards over **[the exterior face of the steel stud framing, or exterior gypsum board sheathing, or exterior air/water resistive barrier layer]** in accordance with manufacturer's recommendations.

B. Install XPS Insulation board in maximum sizes to minimize joints. Locate joints square to framing members. Center end joints over framing. Provide additional framing as necessary.

C. Stagger end joints a minimum of one stud space from adjacent joints.

D. Insulation board edges shall be butted together tightly, and fit around openings and penetrations. **[Install square edges to fit square and tight.] [Install horizontal shiplap joints to fit square and tight, in shingle configuration, with the outer lap extending down and the inner lap extending up.] [Install horizontal tongue and groove joints to fit square and tight with the tongue pointing up.]**

E. Fasten the insulation board to the exterior face of the steel stud wall framing using preassembled screw/stress plate fasteners, type and length as recommended by their manufacturer for securing foam plastic insulating sheathing. Spacing shall be minimum 16" on center at the board perimeter and 24" on center in the field of the board. Drive fasteners so the stress plate is tight and flush with the board surface but do not countersink. Stress plates can bridge between adjoining board edges if the plate is a minimum of 1¾" diameter. Do not fasten more than two board edges with one stress plate. **[Fastening requirements can be revised to suit job site conditions if the insulation board is being installed at the same time as the base units for masonry ties that will serve to secure the insulation board to the framing. Contractor must receive written confirmation from the architect before altering fastener requirements.]**

F. **[For extruded polystyrene insulation installed over spray applied or sheet applied air/water resistive barrier, verify chemical compatibility of the polystyrene board and the barrier material.] [For spray applied air/water resistive barrier material, verify manufacturer recommended cure time before installing extruded polystyrene insulation board.]**

G. Install exterior brick veneer as soon as possible, best within 60 days, to avoid possible discoloration of the foam from UV exposure. If black tape or coatings are installed over the insulation board, cover the black surfaces as soon as possible to avoid foam damage due to potential solar heat build-up on the black surface.

H. Do not permit the extruded polystyrene insulation board to come in contact with surfaces or temperatures in excess of 165°F.

3.3 **[INSTALLATION OF JOINT SEALING TAPE JOINT TAPE]**

A. Install foam board joint sealing tape in accordance with manufacturer's recommendations.

B. Insure that the extruded polystyrene board surface is smooth, clean, dry and free of contaminates. To insure best adhesion, install insulation board joint sealing tape at the same time that the panels are installed.

C. Only install the tape when the outdoor temperatures are above 0°F, and below 120°F.

D. Remove the release liner backing material and center the adhesive side of the tape over the joint to be sealed. Continue to remove the liner and press the tape firmly in place over the joint. CAUTION: The paper release liner is slippery and should not be walked on at any time. Dispose of the liner paper safely away from scaffolding and in a receptacle.

E. Lap intersections or joined tapes a minimum of 3.5".

F. Use a J-roller or laminate roller to roll the tape firmly in place to ensure intimate contact between the tape and substrate and to eliminate trapped air between the tape and substrate.

G. Cover tape within 60 days of application to minimize degradation due to exposure to ultraviolet sun light.

3.4 INSTALLATION OF FIBER GLASS BATT STEEL STUD CAVITY INSULATION

A. Install fiber glass batt insulation in accordance with manufacturer's recommendations and not before the exterior sheathing has been installed on one side of the stud cavity and sealed to be water resistant.

B. Protect insulation from damage due to weather and physical abuse until protected by permanent construction.

C. Fit batt insulation tightly into exterior wall steel stud cavity spaces and framing voids to create a ci layer without gaps. Trim to fill spaces and voids neatly. Fluff insulation to full thickness for specified R-value before installation. Do not compress insulation.

D. Within exterior wall framing, install insulation between pipes, mechanical services, electrical boxes, and backside of sheathing. Cut or split insulation material as required to fit around wiring and plumbing.

E. **[Install factory applied facing with vapor retarder membrane facing warm side of building spaces. Facing flanges (tabs) may be left unfolded for friction fit installation, or they may be unfolded and lapped over or between framing members.]**

F. **[Maintain vapor retarder integrity by tightly abutting adjacent insulation. Repair punctures or tears in vapor retarder facing by taping with a vapor retarding tape. Follow tape manufacturer's application recommendations.]**

G. Fiber glass batt support in steel stud cavities:

1. **[Unfaced and faced batt]**: Tightly friction fit full width 16", or full width 24", batt insulation to fill the interior of the cavities between steel studs, and, to completely fill the voids inside the steel stud flanges.
2. **[Factory faced batt insulation]**: Support by taping or adhering the facing flanges to the face of the steel stud. Gypsum board wall finish is applied after the facing is secured. No additional support is required.
3. **[Unfaced batt insulation, completely filled cavity depth, both sides of the stud cavity closed]**: Friction fit is adequate if the insulation completely fills the depth of the stud cavity, and the cavity is enclosed on both sides. No additional support is required
4. **[Unfaced batt insulation, completely filled cavity depth, one side of the stud cavity open]**: Friction fit, supplement with straps or wires, described below, installed starting 4' above the floor and every 2' on center above 4'.
5. **[Unfaced batt insulation, does not completely fill depth of stud cavity]**: Friction fit, supplement with straps or wires, described below, installed starting 4' above the floor and every 2' on center above 4'.
6. **[Supplemental wire or strap supporting devices]**: Multiple types of support devices may be used. Wires can be inserted through the batts extending from stud to stud. The wires may be installed continuously through the punch outs of the steel stud framing. Or, heavy gauge wire may be cut slightly larger than each stud space and wedged into place between studs. When the insulation is less than the depth of the stud cavity, the wires should be positioned to hold the batt against the sheathing (gypsum or foam plastic) on the opposite side of the cavity. Another option is the use of punched metal straps attached to the face of the framing. The punched pronged tabs are bent 90 degrees pointing into the stud cavity and are pushed into the insulation after installation. The punched prongs impale the insulation batt and hold it in place.

END OF SECTION 07 21 13
END OF SECTION 07 21 16

FOR MORE INFORMATION ON THE OWENS CORNING FAMILY OF BUILDING PRODUCTS, CONTACT YOUR OWENS CORNING DEALER, CALL 1-800-GET-PINK® OR ACCESS OUR WEB SITES: WWW.FOAMULAR.COM OR WWW.OWENSCORNINGCOMMERCIAL.COM.

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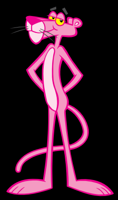

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