Thermal Bridging Solution

2015 IEC Code Compliance

DOES Continuous Z-Furring meet Thermal Bridging Requirements?

Does Continuous Z-Furring comply with the IEC Code For Continuous Insulation?

CONTINUOUS Z-FURRING NO LONGER allowed

To be used to attach rainscreen veneers to buildings.

Buildings designed and constructed under the 2015 International Energy Code (IEC) can no longer use Continuous Z-Furring to attach rainscreen veneers to buildings.

The reason for this change is to **eliminate the amount of thermal bridging** that occurs through the continuous insulation installed over the back-up wall. Previous versions of the IEC tried to accomplish this change by specifying continuous insulation as a means to meet the U-Factor requirements for exterior wall assemblies.

This led to a debate over the **definition of continuous insulation** despite the fact that the intent of the past and present codes were to require walls with a minimum U-Factor based on climate region.

CALCULATING THE U-FACTOR

With Thermal Bridging

> ***"CONTINUOUS INSULATION (ci).*** **Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope."**

Factoring in the thermal bridging effect of Continuous Z-Furring in exterior wall assemblies shows that they do not comply with the intent of the code. Defining Continuous Insulation was a step in the right direction for compliance with the intent of the code.

Figure 1 below shows the effect of thermal bridging of Continuous Z-Furring on the thermal performance of an exterior wall assembly. The figure was taken from a thermal analysis using the THERM 6.3 software developed by Lawrence Berkley Laboratories.

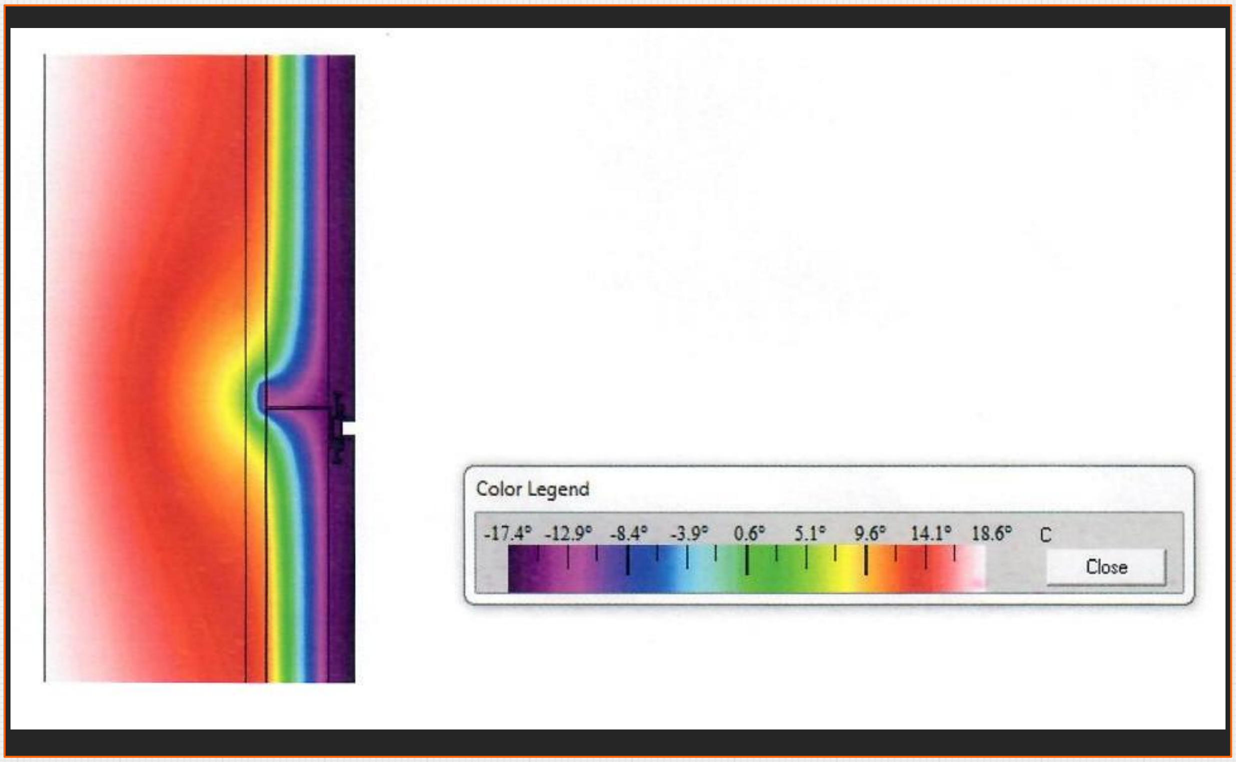

Figure 1 – The Effect of Thermal Bridging Using Continuous Z-Furring

This assembly consists of

- 6” LGMF, 5/8” gypsum sheathing,
- 2 ¼” extruded polystyrene insulation with Continuous Z-Furring and
- an ACM panel veneer.

Lawrence Berkeley Laboratories

Calculating the U-Factor

Without Factoring Thermal Bridging of Continuous Z-Furring

Calculating the U-Factor of this assembly, using THERM 6.3, without factoring in the thermal bridging of the Continuous Z-Furring, the assembly U-Factor is 0.063.

The equivalent R-Value is 1 divided by the U-Factor or R-15.87. Factoring in the thermal bridge created by the Continuous Z-Furring, using THERM 6.3, the U-Factor for the assembly increases to 0.117. The equivalent R-Factor is R-8.85 resulting in a reduction in the overall R-Factor of the assembly of R-7.2 or 44%.

According to Table C402.1.4 of the 2015 IEC, this assembly will not meet the U-Factor requirement for any metal framed exterior wall assembly in any climate zone.

TABLE C402.1.4
OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, above grade																
Mass	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.061	U-0.061	U-0.061
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.057	U-0.064	U-0.052	U-0.045	U-0.045
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036
Walls, below grade																
Below-grade wall[c]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092	C-0.092	C-0.092
Floors																
Mass[d]	U-0.322[e]	U-0.322[e]	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.057	U-0.055	U-0.051	U-0.055	U-0.051
Joist/framing	U-0.066[e]	U-0.066[e]	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-grade floors																
Unheated slabs	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40	F-0.40	F-0.40
Heated slabs[f]	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.65	F-0.65	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55
Opaque doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37

For SI: 1 pound per square foot = 4.88 kg/m^2, 1 pound per cubic foot = 16 kg/m^3.

ci = Continuous insulation, NR = No requirement, LS = Liner system.

a. Use of Opaque assembly *U*-factors, *C*-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction, excluding the cladding system on walls, complies with the appropriate construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A.

b. Opaque assembly *U*-factors based on designs tested in accordance with ASTM C1363 shall be permitted. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design.

Calculating the U-Factor

Without Thermal Bridging of Continuous Z-Furring

Table C402.1.4: Based on this change, a number of companies have offered attachment systems for rainscreen veneers to buildings. Not all of these deal with other code requirements and exterior wall assembly performance issues.

On the code requirements, the 2015 International Building Code has requirements for load-bearing elements in exterior walls such as these attachment systems.

"704.10 Exterior structural members. Load bearing structural members located within *exterior walls* or on the outside of a building or structure shall be provided with the highest *fire resistance rating* as determined in accordance with the following:

- As required by Table 601 for the type of building element based on construction of the building.
- As required by Table 601 for exterior bearing walls based on the type of construction; and
- As required by Table 602 for *exterior walls* based on the *fire separation distance.* "

In reviewing Tables 601 and 602, there are many construction types and fire separation distances that require the load bearing elements of the exterior wall to have a fire rating. Some of the attachments systems offered are made of or contain plastic or fiberglass materials or rely on plastic insulation boards to bear the loads transmitted from the veneer to the attachment system to the sheathing, to the LGMF and ultimately to the structural frame of the building. These types of products burn and therefore cannot be used in exterior wall assemblies require fire rated load bearing elements.

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (HOURS)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A	B	A	B	HT	A	B
Primary structural frame[f] (see Section 202)	3[a]	2[a]	1	0	1	0	HT	1	0
Bearing walls Exterior[e, f] Interior	 3 3[a]	 2 2[a]	 1 1	 0 0	 2 1	 2 0	 2 1/HT	 1 1	 0 0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[d]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction and associated secondary members (see Section 202)	2	2	1	0	1	0	HT	1	0
Roof construction and associated secondary members (see Section 202)	$1^1/_2$[b]	1[b,c]	1[b,c]	0[c]	1[b,c]	0	HT	1[b,c]	0

For SI: 1 foot = 304.8 mm.

a. Roof supports: Fire-resistance ratings of primary structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.

b. Except in Group F-1, H, M and S-1 occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.

c. In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.

d. Not less than the fire-resistance rating required by other sections of this code.

e. Not less than the fire-resistance rating based on fire separation distance (see Table 602).

f. Not less than the fire-resistance rating as referenced in Section 704.10.

Table 601

Fire-Resistance Rating Requirements for Building Elements (hours)

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, d, g]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[e]	OCCUPANCY GROUP F-1, M, S-1[f]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2, U
$X < 5$[b]	All	3	2	1
$5 \leq X < 10$	IA Others	3 2	2 1	1 1
$10 \leq X < 30$	IA, IB IIB, VB Others	2 1 1	1 0 1	1[c] 0 1[c]
$X \geq 30$	All	0	0	0

For SI: 1 foot = 304.8 mm.
a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. See Section 706.1.1 for party walls.
c. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
d. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
e. For special requirements for Group H occupancies, see Section 415.6.
f. For special requirements for Group S aircraft hangars, see Section 412.4.1.
g. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.

*

Table 602
Fire-Resistance Rating Requirements for Exterior Walls Based on Fire Separation Distance

Calculating the U-Factor

Without Thermal Bridging using Continuous Z-Furring

Other considerations for the rainscreen veneer attachment systems available on the market are accommodating the installation of the continuous insulation and the fastening requirements for the insulation. Cutting and trimming the insulation to fit within or around the attachment system requires additional labor. Installing fasteners through the insulation results in holes in the air and water (and vapor barrier) membranes installed on the exterior sheathing.

While manufacturers of the membranes have claimed them to be self-sealing or self-healing, their claims are based on testing done under ASTM D1970. This standard contains a nail seal ability test whereby the membrane is applied to a piece of plywood, a nail is driven through the membrane and plywood, pulled halfway back out and then the water tightness of the penetration or the nail through the membrane is tested by creating a horizontal reservoir of water around the penetration for a period of time.

This, in no way simulates the penetration through the membrane of a screw type fastener which then penetrates the gypsum sheathing, stalls in inward progress while self-tapping a hole through the LGMF member and kicks out the gypsum core of the gypsum sheathing due to the action of the threads of the screw type fastener.

The industry is aware of this issue and ASTM is currently working on a standard test method for determining fastener seal ability through these types of membranes.

Required Properties for Rainscreen Veneer Attachment System

For all construction types

What are the properties needed and wanted for a rainscreen veneer attachment system that can be used for all construction types?

1. Does not burn
2. Does not rely on plastic insulation to bear any imposed loads
3. Installs easily with few parts to assemble
4. Provides required adjust-ability without having to shim
5. Reasonable cost
6. Does not require cutting and fitting of insulation
7. Provides for the mechanical fastening of the continuous insulation.
8. Results in minimal thermal bridging through the continuous insulation.

*

We searched for such a system.
We did not find it.

So……. *We invented it.*

Using Our Stand-Off MPV Bracket

An adjustable bracket for fastening metal panel veneers to a building. It eliminates thermal bridging and provides mechanical fastening of the cavity insulation.

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Continuous Z-Furring VS Stand-Off MPV Bracket

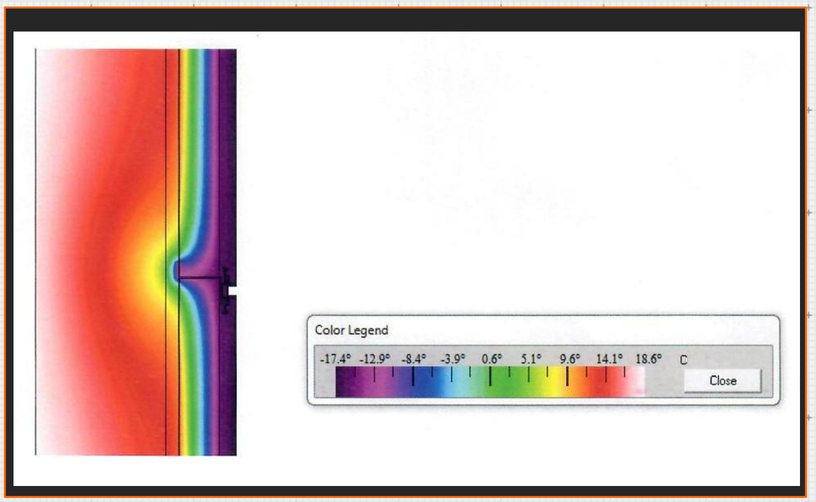

Figure 1 – The Effect of Thermal Bridging Using Continuous Z-Furring

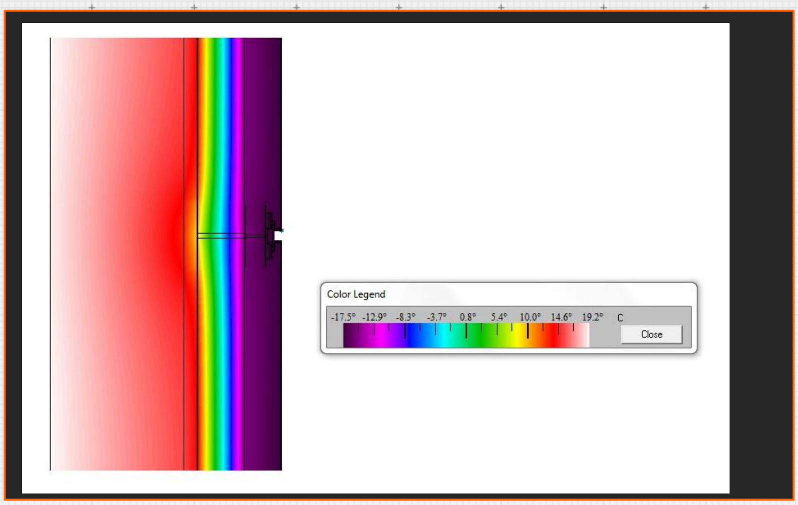

Figure 2 – The Effect of Thermal Bridging using Stand-Off MPV Bracket

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