August 23, 2012

Len Anastasi
EXO-TEC Manufacturing, Inc.
22 Washington Street Stoughton, MA 02072

RE: Stand-off MPV Bracket Thermal Performance

Dear Mr. Len Anastasi,

A 2D thermal modeling of a wall assembly containing Stand-off MPV Bracket was performed using THERM 6.3 software to determine thermal resistance (R-Value) of the assembly at winter condition. This report documents thermal modeling work which was completed.

1.0 Modeling Approach

In order to compare thermal performance of Stand-off MPV Bracket with conventional mechanical fasteners such as Z-furring, a wall assembly was modeled in two different configurations: once using Stand-off MPV Bracket and once using Z-furring. The R-value of the two models was compared and used as thermal performance criteria in steady-state conditions. The configurations of the developed models are:

a) ½" Drywall, 2 x 6 metal studs, 5/8" gypsum sheathing, 2 ¼" of extruded polystyrene insulation (R-12), intermittent Stand-off MPV brackets at 16" o.c. horizontally and 2' o.c. vertically and composite metal panel

b) ½" Drywall, 2 x 6 metal studs, 5/8" gypsum sheathing, 2 ¼" of extruded polystyrene insulation (R – 12), continuous Z-furring at 2' o.c. vertically and composite metal panel

Sections of wall assembly configurations a) & b) are illustrated in Figures 1 & 2, respectively.

In order to model non-continuous elements in a 2D section such as Figures 1 & 2, a procedure suggested by section 8.9 of THERM5/WINDOW5 NFRC Simulation Manual was used. This procedure estimates heat flow through non-continuous thermal bridge elements by considering an effective conductivity based on the fraction of bridging and non thermal bridging elements.

2.0 Parameters

For the purpose of the modeling the following thermal conditions were assumed:

1. Interior Winter Temperature: 21.1 C
2. Exterior Winter Temperature (NFRC 100-2001 exterior boundary condition): -18 C

In addition, the thermal properties of the wall assembly components are listed in Table 1.

Table 1: Thermal Conductivity and conductance of wall assembly components

Material	**Thermal Conductivity (W/m.K)**	**Thermal Conductance ($W/m^2.K$)**
Drywall	0.16	-
Metal stud[1]	62	-
Gypsum sheathing	0.16	-
Extruded polystyrene insulation (2 ¼")	-	0.473
Cold Rolled 1008/1010 Steel (Stand-off MPV Bracket plates)	50	-
Z-furring	62	-
Metal panel veneer	237	-

3.0 Results and Discussions

The modeled R-value of the wall assembly configurations are listed in Table 2. The values are shown for three wall assembly configurations: clear wall assembly where the wall is not influenced by thermal bridging effect of bracket or z-furring; wall assembly with Stand-off MPV Bracket & finally wall assembly with Z-furring. The R-values are reported separately for the wall with and without air film resistances.

It should be noted that the air film resistance is a function of temperature and air flow characteristics and therefore dependent on interior and exterior climate in which the wall is exposed to. However, the wall assembly resistance is only a property of its composing materials and not a function of its surrounding climates.

As the modeled R-values show in the Table 2, it is evident that wall assembly with Stand-off MPV Bracket has a superior thermal performance than that of the wall assembly with Z-furring. This is due to the fact that the bracket is an intermittent thermal bridge while Z-furring is a continuous thermal bridge.

Figures 3 & 4 illustrate the temperature distribution of modeled section of the wall assembly configurations with the bracket and Z-furring, respectively.

Table 2: Modeled R-values of wall assemblies with bracket and Z-furring

	Clear Wall Assembly	Wall Assembly w/ Stand-off MPV Bracket	Wall Assembly w/ Z-furring
R-value excluding Interior & Exterior Air Film Resistances (ft^2.F.hr/Btu)	R-13.35 (Z-furring configuration) R-14.85 (Bracket configuration)	R-12.17	R-7.95

[1] The material assumed to be Steel Galvanized Sheet, 0.14% C. The dimensions of the C studs are 6" web depth, 1 5/8" flange size, ½" lip size and 18 gages (43 mil)

Sum of Interior & Exterior Air Film Resistances (ft^2.F.hr/Btu)	R-90	R-0.90	R-90
Total R-value including Interior & Exterior Air Film Resistances (ft^2.F.hr/Btu)	R-14.25 (Z-furring configuration) R-15.75 (bracket configuration)	R-13.07	R-8.85

4.0 Conclusion

A 2D steady-state thermal modeling of a wall assembly performed once with Stand-off MPV Bracket and once with Z-furring. The modeled R-value indicates wall assembly with Stand-off MPV Bracket provides total R-value approximately 1.5 times better than the same wall assembly with Z-furring.

It should be noted that the total R-value in both configurations includes air film resistances as well.

I trust that the result of the modeling and discussion provides you with the supplemental information. If I can be of further assistance to you on this, or other matters, please do not hesitate to contact me.

Yours Truly,

Ali Fallahi, Ph.D.
Aug 23, 2012

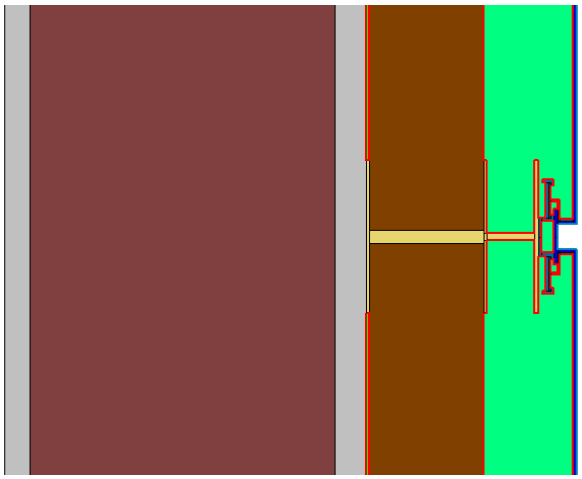

Figure 1: Section view of wall assembly “a)” with Stand-off MPV Bracket

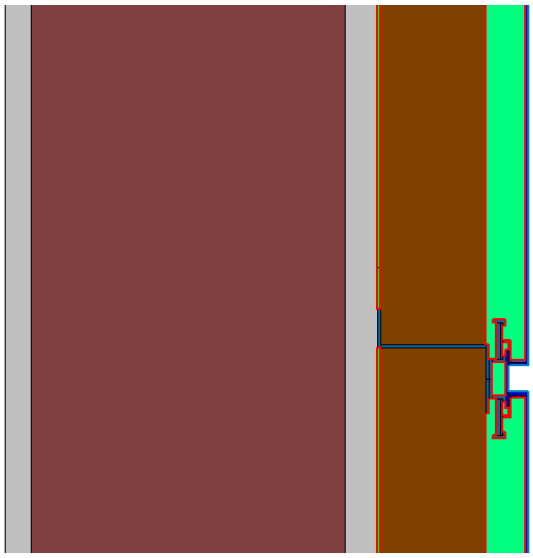

Figure 2: Section view of wall assembly “b)” with Z-furring

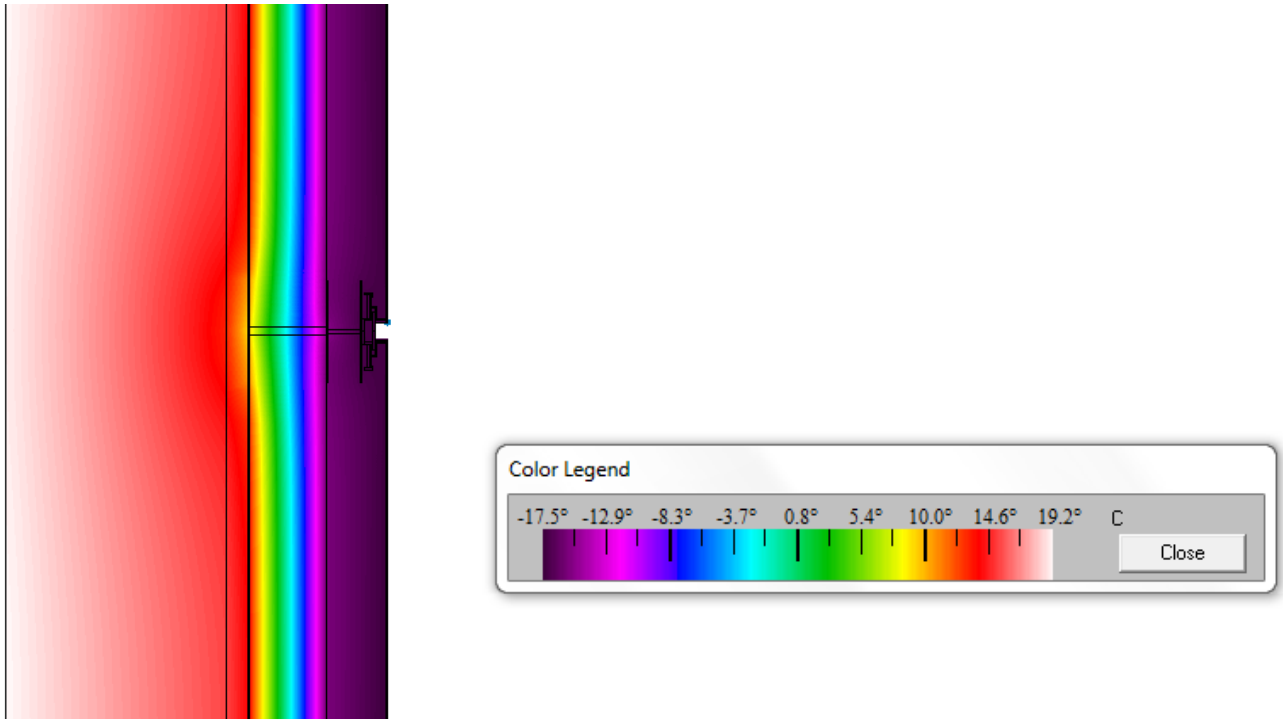

Figure 3: Modeled temperature distribution of wall assembly “a)” with the bracket. Interior drywall and the studs are not shown in this figure but taken into account in modeling.

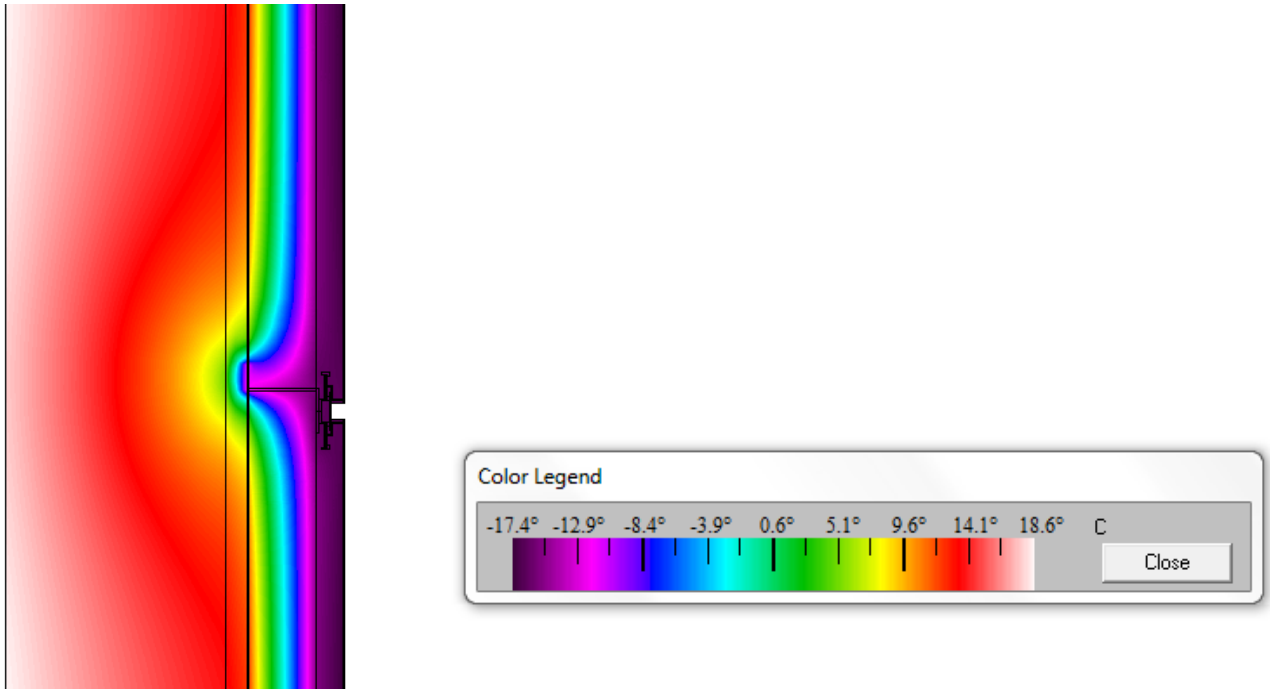

Figure 4: Modeled temperature distribution of wall assembly “b)” with Z-furring. Interior drywall and the studs are not shown in this figure but taken into account in modeling.