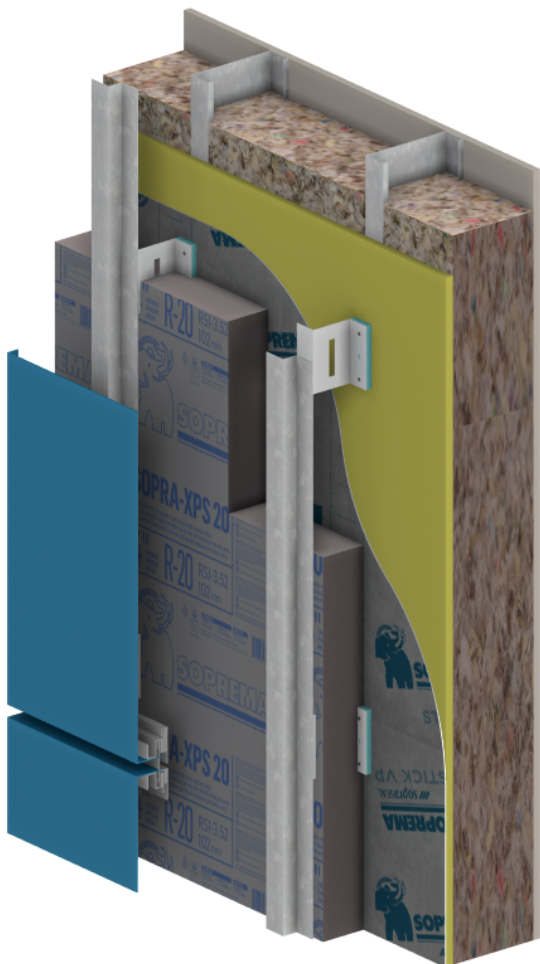




MORRISON HERSHFIELD

SOPREMA / ACS Composite Systems Split Insulated Steel Stud Wall Thermal Analysis



Presented to:

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1. INTRODUCTION

Morrison Hershfield (MH) was retained by Soprema Inc. (Soprema) to evaluate the thermal performance of the ACS-S Thermal Clip system for a variety of clip spacings, insulation types, insulation thicknesses, and a variety of backup wall configurations. This report is a summary of the analysis performed for the split insulated steel stud wall assemblies.

The ACS-S Thermal Clip is made of stainless steel with a 1/2 inch Extreme Pad rigid urethane foam thermal isolator. The girt is attached to the ACS-S Thermal Clip such that the girt is outboard of the exterior insulation, resulting in no girt penetration of the exterior insulation. The ACS-S Thermal Clips were evaluated to determine the clear field U-values and effective R-values for a variety of clip spacings and exterior insulation types.

For all configurations, the smallest ACS-S Thermal Clip was selected for the exterior insulation thickness as shown below in Table 1.1.

Table 1.1: Exterior Insulation Thickness for the ACS-S Thermal Clip System

ACS-S Thermal Clip Size (in)	Exterior Insulation Thickness in (mm)
2	1 (25)
2	2 (50)
3	3 (76)
4	4 (102)
5	5 (127)
6	6 (152)
7	7 (178)
8	8 (203)

Table 1.2 below summarizes the evaluated wall configurations, and Figure 1.1 illustrates a representative wall assembly using SOPRA-XPS 20 exterior insulation. The geometry of the ACS-S Thermal Clips were based on the drawings provided by ACS Composite Systems Inc. and Soprema, and are provided in Appendix A.

Table 1.2: Evaluated ACS-S Thermal Clip Assemblies: Split Insulated Steel Stud Wall

Exterior Insulation Type	Nominal R-Value/in	Exterior Insulation Thickness (inches)	Stud Spacing (in)	Horizontal Clip Spacing (in)	Vertical Clip Spacing (in)
SOPRA-XPS 20	R-5/in	1, 1.5*, 2*, 3, 4*, 5, 6*, 7	16, 24	16, 24	24, 36, 48
SOPRA-SPF 202	R-6.2/in	1, 2*, 3, 4*, 5, 6*, 7	16, 24	16, 24	24, 36, 48
SOPRA-ISO V PLUS	R-6/in	1, 1.5*, 2*, 2.5*, 3, 3.5*, 4*, 4.5*, 5, 5.5*, 6*, 6.5*, 7	16, 24	16, 24	24, 36, 48
Mineral Wool	R-4.3/in	1, 2*, 3, 4*, 5, 6*, 7*, 8	16, 24	16, 24	24, 36, 48

*Indicates interpolated value

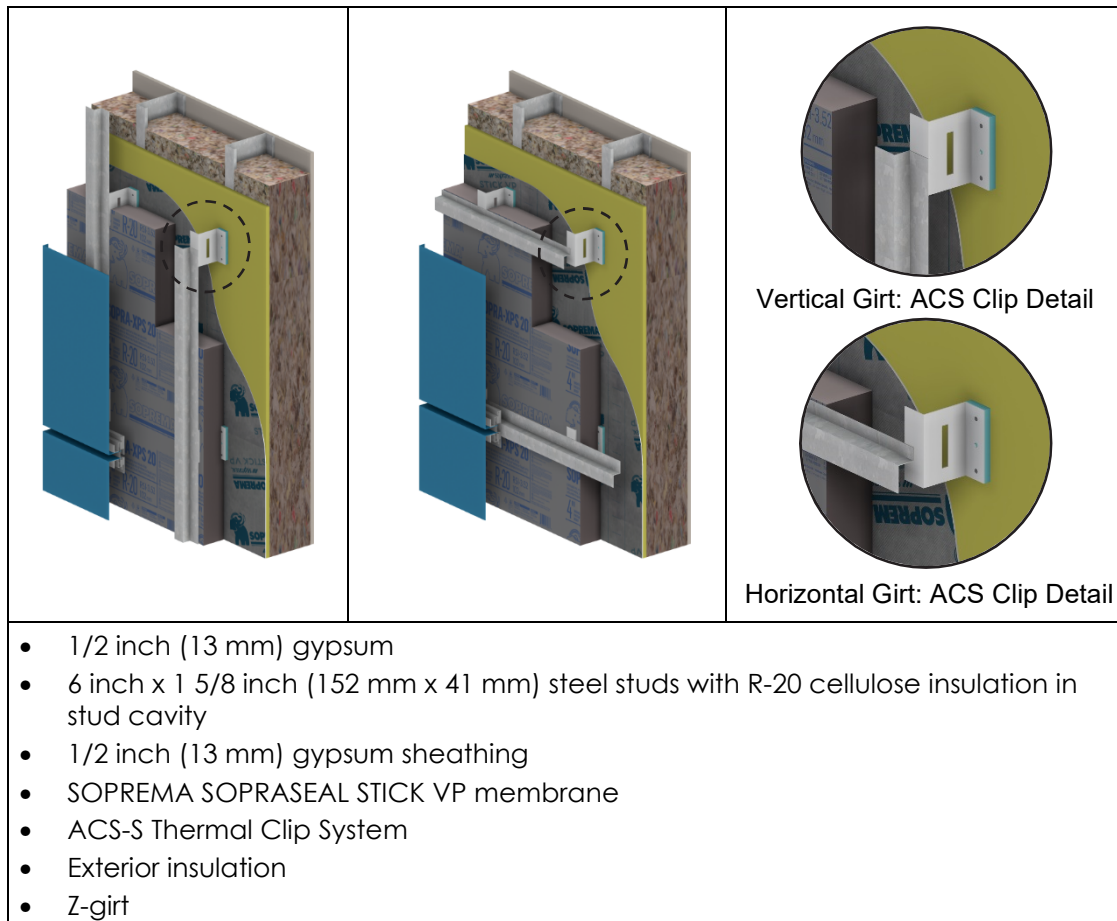


Figure 1.1: Schematic of Evaluated ACS-S Thermal Clip with Split Insulated Steel Stud Wall Assemblies

2. MODELLING PROCEDURES

The thermal performance of the different assembly scenarios was evaluated by 3D thermal modelling using the Nx software package from Siemens, which is a general purpose computer aided design (CAD) and finite element analysis (FEA) package. The thermal solver and modelling procedures utilized for this study were extensively calibrated and validated to within +/- 5% of hotbox testing for *ASHRAE Research Project 1365-RP Thermal Performance of Building Envelope Details for Mid- and High-Rise Construction and for the Building Envelope Thermal Bridging Guide*¹. The thermal analysis utilized steady-state conditions, published thermal properties of materials and information provided by Soprema and ACS Composite Systems Inc. Additional assumptions for the thermal analysis are listed in Appendix B. Further assembly information, including dimensions and materials are shown in the BETB Data Sheets provided in Appendix C.

¹ <https://www.bchydro.com/thermalguide>

3. THERMAL RESULTS

The clear field U- Values and effective R-values for all ACS-S Thermal Clip assembly configurations are shown below in Table 3.1 to Table 3.4. Example temperature profiles for each configuration are shown in the BETB Result Sheets provided in Appendix D.

Table 3.1: U-Value and Effective R-Value for ACS-S Thermal Clip with **SOPRA-XPS 20**
Exterior Insulation: Split Insulated Steel Stud Wall Assemblies

Horizontal Clip Spacing	Exterior Insulation Thickness in (mm)	Exterior Insulation 1D R-value ² (RSI)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
			R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)
16	1.0 (25)	R-5.0 (0.88)	R-17.5 (3.08)	0.057 (0.32)	R-17.5 (3.08)	0.057 (0.32)	R-17.5 (3.09)	0.057 (0.32)
	1.5 (38)	R-7.5 (1.32)	R-19.8 (3.48)*	0.051 (0.29)*	R-19.9 (3.51)*	0.050 (0.29)*	R-20.0 (3.52)*	0.050 (0.28)*
	2.0 (51)	R-10.0 (1.76)	R-22.1 (3.88)*	0.045 (0.26)*	R-22.3 (3.92)*	0.045 (0.25)*	R-22.4 (3.94)*	0.045 (0.25)*
	3.0 (76)	R-15.0 (2.64)	R-26.6 (4.68)	0.038 (0.21)	R-27.0 (4.75)	0.037 (0.21)	R-27.2 (4.79)	0.037 (0.21)
	4.0 (102)	R-20.0 (3.52)	R-30.9 (5.45)*	0.032 (0.18)*	R-31.5 (5.56)*	0.032 (0.18)*	R-31.9 (5.61)*	0.031 (0.18)*
	5.0 (127)	R-25.0 (4.40)	R-35.2 (6.19)	0.028 (0.16)	R-36.0 (6.34)	0.028 (0.16)	R-36.5 (6.42)	0.027 (0.16)
	6.0 (152)	R-30.0 (5.28)	R-39.4 (6.94)*	0.025 (0.14)*	R-40.5 (7.14)*	0.025 (0.14)*	R-41.1 (7.24)*	0.024 (0.14)*
	7.0 (178)	R-35.0 (6.16)	R-43.6 (7.67)	0.023 (0.13)	R-44.9 (7.91)	0.022 (0.13)	R-45.6 (8.04)	0.022 (0.12)
24	1.0 (25)	R-5.0 (0.88)	R-19.9 (3.50)	0.050 (0.29)	R-19.9 (3.50)	0.050 (0.29)	R-19.9 (3.51)	0.050 (0.29)
	1.5 (38)	R-7.5 (1.32)	R-22.3 (3.92)*	0.045 (0.26)*	R-22.4 (3.94)*	0.045 (0.25)*	R-22.4 (3.95)*	0.045 (0.25)*
	2.0 (51)	R-10.0 (1.76)	R-24.6 (4.34)*	0.041 (0.23)*	R-24.8 (4.37)*	0.040 (0.23)*	R-24.9 (4.39)*	0.040 (0.23)*
	3.0 (76)	R-15.0 (2.64)	R-29.3 (5.17)	0.034 (0.19)	R-29.7 (5.23)	0.034 (0.19)	R-29.8 (5.26)	0.034 (0.19)
	4.0 (102)	R-20.0 (3.52)	R-33.9 (5.97)*	0.029 (0.17)*	R-34.4 (6.06)*	0.029 (0.17)*	R-34.7 (6.10)*	0.029 (0.16)*
	5.0 (127)	R-25.0 (4.40)	R-38.4 (6.76)	0.026 (0.15)	R-39.1 (6.88)	0.026 (0.15)	R-39.4 (6.94)	0.025 (0.14)
	6.0 (152)	R-30.0 (5.28)	R-42.9 (7.55)*	0.023 (0.13)*	R-43.7 (7.70)*	0.023 (0.13)*	R-44.1 (7.77)*	0.023 (0.13)*
	7.0 (178)	R-35.0 (6.16)	R-47.2 (8.32)	0.021 (0.12)	R-48.2 (8.50)	0.021 (0.12)	R-48.8 (8.59)	0.020 (0.12)

*Indicates interpolated value

² This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, cellulose insulation, and air films all contribute an additional R-22.3 towards the nominal R-value of the entire assembly.

Table 3.2: U-Value and Effective R-Value for ACS-S Thermal Clip with **SOPRA-SPF 202**
Exterior Insulation: Split Insulated Steel Stud Wall Assemblies

Horizontal Clip Spacing	Exterior Insulation Thickness in (mm)	Exterior Insulation 1D R-value ³ (RSI)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
			R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)
16	1.0 (25)	R-6.2 (1.09)	R-18.4 (3.23)	0.054 (0.31)	R-18.4 (3.23)	0.054 (0.31)	R-18.4 (3.24)	0.054 (0.31)
	2.0 (51)	R-12.4 (2.18)	R-23.9 (4.21)*	0.042 (0.24)*	R-24.2 (4.25)*	0.041 (0.24)*	R-24.3 (4.28)*	0.041 (0.23)*
	3.0 (76)	R-18.6 (3.28)	R-29.4 (5.18)	0.034 (0.19)	R-29.9 (5.26)	0.033 (0.19)	R-30.2 (5.31)	0.033 (0.19)
	4.0 (102)	R-24.8 (4.37)	R-34.6 (6.10)*	0.029 (0.16)*	R-35.4 (6.24)*	0.028 (0.16)*	R-35.9 (6.32)*	0.028 (0.16)*
	5.0 (127)	R-31.0 (5.46)	R-39.7 (6.99)	0.025 (0.14)	R-40.9 (7.19)	0.024 (0.14)	R-41.5 (7.30)	0.024 (0.14)
	6.0 (152)	R-37.2 (6.55)	R-44.8 (7.90)*	0.022 (0.13)*	R-46.3 (8.15)*	0.022 (0.12)*	R-47.1 (8.29)*	0.021 (0.12)*
	7.0 (178)	R-43.4 (7.64)	R-49.8 (8.77)	0.020 (0.11)	R-51.6 (9.09)	0.019 (0.11)	R-52.6 (9.27)	0.019 (0.11)
24	1.0 (25)	R-6.2 (1.09)	R-20.8 (3.67)	0.048 (0.27)	R-20.8 (3.67)	0.048 (0.27)	R-20.8 (3.67)	0.048 (0.27)
	2.0 (51)	R-12.4 (2.18)	R-26.6 (4.68)*	0.038 (0.21)*	R-26.8 (4.72)*	0.037 (0.21)*	R-26.9 (4.74)*	0.037 (0.21)*
	3.0 (76)	R-18.6 (3.28)	R-32.3 (5.69)	0.031 (0.18)	R-32.7 (5.76)	0.031 (0.17)	R-32.9 (5.80)	0.030 (0.17)
	4.0 (102)	R-24.8 (4.37)	R-37.8 (6.66)*	0.026 (0.15)*	R-38.5 (6.78)*	0.026 (0.15)*	R-38.8 (6.83)*	0.026 (0.15)*
	5.0 (127)	R-31.0 (5.46)	R-43.3 (7.62)	0.023 (0.13)	R-44.1 (7.77)	0.023 (0.13)	R-44.6 (7.85)	0.022 (0.13)
	6.0 (152)	R-37.2 (6.55)	R-48.7 (8.58)*	0.021 (0.12)*	R-49.8 (8.77)*	0.020 (0.11)*	R-50.4 (8.88)*	0.020 (0.11)*
	7.0 (178)	R-43.4 (7.64)	R-54.0 (9.51)	0.019 (0.11)	R-55.4 (9.75)	0.018 (0.10)	R-56.1 (9.88)	0.018 (0.10)

*Indicates interpolated value

³ This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, cellulose insulation, and air films all contribute an additional R-22.3 towards the nominal R-value of the entire assembly.

Table 3.3: U-Value and Effective R-Value for ACS-S Thermal Clip with SOPRA-ISO V PLUS Exterior Insulation: Split Insulated Steel Stud Wall Assemblies

Horizontal Clip Spacing	Exterior Insulation Thickness in (mm)	Exterior Insulation 1D R-value ⁴ (RSI)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
			R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)
16	1.0 (25)	R-6.0 (1.06)	R-18.5 (3.26)	0.054 (0.31)	R-18.5 (3.26)	0.054 (0.31)	R-18.6 (3.27)	0.054 (0.31)
	1.5 (38)	R-9.0 (1.59)	R-21.2 (3.74)*	0.047 (0.27)*	R-21.4 (3.77)*	0.047 (0.27)*	R-21.5 (3.78)*	0.047 (0.26)*
	2.0 (51)	R-12.0 (2.11)	R-23.9 (4.21)*	0.042 (0.24)*	R-24.2 (4.26)*	0.041 (0.23)*	R-24.3 (4.28)*	0.041 (0.23)*
	2.5 (64)	R-15.0 (2.64)	R-26.5 (4.67)*	0.038 (0.21)*	R-27.0 (4.75)*	0.037 (0.21)*	R-27.2 (4.79)*	0.037 (0.21)*
	3.0 (76)	R-18.0 (3.17)	R-29.2 (5.15)	0.034 (0.19)	R-29.8 (5.24)	0.034 (0.19)	R-30.0 (5.29)	0.033 (0.19)
	3.5 (89)	R-21.0 (3.70)	R-31.7 (5.59)*	0.031 (0.18)*	R-32.4 (5.71)*	0.031 (0.18)*	R-32.8 (5.78)*	0.030 (0.17)*
	4.0 (102)	R-24.0 (4.23)	R-34.3 (6.04)*	0.029 (0.17)*	R-35.1 (6.19)*	0.028 (0.16)*	R-35.6 (6.27)*	0.028 (0.16)*
	4.5 (114)	R-27.0 (4.76)	R-36.8 (6.49)*	0.027 (0.15)*	R-37.8 (6.66)*	0.026 (0.15)*	R-38.3 (6.75)*	0.026 (0.15)*
	5.0 (127)	R-30.0 (5.28)	R-39.3 (6.92)	0.025 (0.14)	R-40.4 (7.12)	0.025 (0.14)	R-41.0 (7.23)	0.024 (0.14)
	5.5 (140)	R-33.0 (5.81)	R-41.8 (7.37)*	0.024 (0.14)*	R-43.1 (7.59)*	0.023 (0.13)*	R-43.8 (7.72)*	0.023 (0.13)*
	6.0 (152)	R-36.0 (6.34)	R-44.3 (7.80)*	0.023 (0.13)*	R-45.7 (8.05)*	0.022 (0.12)*	R-46.5 (8.19)*	0.022 (0.12)*
	6.5 (165)	R-39.0 (6.87)	R-46.7 (8.22)*	0.021 (0.12)*	R-48.3 (8.51)*	0.021 (0.12)*	R-49.2 (8.66)*	0.020 (0.12)*
24	7.0 (178)	R-42.0 (7.40)	R-49.1 (8.65)	0.020 (0.12)	R-50.9 (8.97)	0.020 (0.11)	R-51.9 (9.13)	0.019 (0.11)
	1.0 (25)	R-6.0 (1.06)	R-20.9 (3.68)	0.048 (0.27)	R-20.9 (3.69)	0.048 (0.27)	R-21.0 (3.69)	0.048 (0.27)
	1.5 (38)	R-9.0 (1.59)	R-23.7 (4.18)*	0.042 (0.24)*	R-23.9 (4.21)*	0.042 (0.24)*	R-23.9 (4.22)*	0.042 (0.24)*
	2.0 (51)	R-12.0 (2.11)	R-26.5 (4.67)*	0.038 (0.21)*	R-26.8 (4.72)*	0.037 (0.21)*	R-26.9 (4.74)*	0.037 (0.21)*
	2.5 (64)	R-15.0 (2.64)	R-29.3 (5.16)*	0.034 (0.19)*	R-29.7 (5.22)*	0.034 (0.19)*	R-29.8 (5.25)*	0.034 (0.19)*
	3.0 (76)	R-18.0 (3.17)	R-32.1 (5.65)	0.031 (0.18)	R-32.5 (5.73)	0.031 (0.17)	R-32.8 (5.77)	0.031 (0.17)
	3.5 (89)	R-21.0 (3.70)	R-34.8 (6.13)*	0.029 (0.16)*	R-35.3 (6.22)*	0.028 (0.16)*	R-35.6 (6.27)*	0.028 (0.16)*
	4.0 (102)	R-24.0 (4.23)	R-37.5 (6.60)*	0.027 (0.15)*	R-38.1 (6.72)*	0.026 (0.15)*	R-38.5 (6.77)*	0.026 (0.15)*
	4.5 (114)	R-27.0 (4.76)	R-40.2 (7.07)*	0.025 (0.14)*	R-40.9 (7.21)*	0.024 (0.14)*	R-41.3 (7.28)*	0.024 (0.14)*
	5.0 (127)	R-30.0 (5.28)	R-42.8 (7.53)	0.023 (0.13)	R-43.7 (7.69)	0.023 (0.13)	R-44.1 (7.77)	0.023 (0.13)
	5.5 (140)	R-33.0 (5.81)	R-45.4 (8.00)*	0.022 (0.12)*	R-46.4 (8.18)*	0.022 (0.12)*	R-46.9 (8.27)*	0.021 (0.12)*
	6.0 (152)	R-36.0 (6.34)	R-48.0 (8.46)*	0.021 (0.12)*	R-49.2 (8.66)*	0.020 (0.12)*	R-49.7 (8.76)*	0.020 (0.11)*
	6.5 (165)	R-39.0 (6.87)	R-50.6 (8.91)*	0.020 (0.11)*	R-51.9 (9.13)*	0.019 (0.11)*	R-52.5 (9.25)*	0.019 (0.11)*
	7.0 (178)	R-42.0 (7.40)	R-53.2 (9.37)	0.019 (0.11)	R-54.5 (9.61)	0.018 (0.10)	R-55.3 (9.73)	0.018 (0.10)

*Indicates interpolated value

⁴ This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, cellulose insulation, and air films all contribute an additional R-22.3 towards the nominal R-value of the entire assembly.

Table 3.4: U-Value and Effective R-Value for ACS-S Thermal Clip with **Mineral Wool**
Exterior Insulation: Split Insulated Steel Stud Wall Assemblies

Horizontal Clip Spacing	Exterior Insulation Thickness in (mm)	Exterior Insulation 1D R-value ⁵ (RSI)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
			R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)
16	1.0 (25)	R-4.3 (0.76)	R-16.8 (2.95)	0.060 (0.34)	R-16.8 (2.95)	0.060 (0.34)	R-16.8 (2.96)	0.060 (0.34)
	2.0 (51)	R-8.6 (1.51)	R-20.7 (3.65)*	0.048 (0.27)*	R-20.9 (3.68)*	0.048 (0.27)*	R-21.0 (3.70)*	0.048 (0.27)*
	3.0 (76)	R-12.9 (2.27)	R-24.7 (4.35)	0.040 (0.23)	R-25.0 (4.41)	0.040 (0.23)	R-25.2 (4.44)	0.040 (0.23)
	4.0 (102)	R-17.2 (3.03)	R-28.5 (5.01)*	0.035 (0.20)*	R-29.0 (5.10)*	0.035 (0.20)*	R-29.2 (5.15)*	0.034 (0.19)*
	5.0 (127)	R-21.5 (3.79)	R-32.2 (5.67)	0.031 (0.18)	R-32.9 (5.79)	0.030 (0.17)	R-33.2 (5.85)	0.030 (0.17)
	6.0 (152)	R-25.8 (4.54)	R-36.0 (6.34)*	0.028 (0.16)*	R-36.8 (6.49)*	0.027 (0.15)*	R-37.3 (6.57)*	0.027 (0.15)*
	7.0 (178)	R-30.1 (5.30)	R-39.7 (6.99)*	0.025 (0.14)*	R-40.7 (7.17)*	0.025 (0.14)*	R-41.3 (7.27)*	0.024 (0.14)*
	8.0 (203)	R-34.4 (6.06)	R-43.3 (7.63)	0.023 (0.13)	R-44.6 (7.85)	0.022 (0.13)	R-45.2 (7.96)	0.022 (0.13)
24	1.0 (25)	R-4.3 (0.76)	R-19.1 (3.37)	0.052 (0.30)	R-19.1 (3.37)	0.052 (0.30)	R-19.1 (3.37)	0.052 (0.30)
	2.0 (51)	R-8.6 (1.51)	R-23.3 (4.10)*	0.043 (0.24)*	R-23.4 (4.12)*	0.043 (0.24)*	R-23.5 (4.13)*	0.043 (0.24)*
	3.0 (76)	R-12.9 (2.27)	R-27.4 (4.82)	0.037 (0.21)	R-27.7 (4.87)	0.036 (0.21)	R-27.8 (4.89)	0.036 (0.20)
	4.0 (102)	R-17.2 (3.03)	R-31.3 (5.52)*	0.032 (0.18)*	R-31.7 (5.59)*	0.032 (0.18)*	R-31.9 (5.62)*	0.031 (0.18)*
	5.0 (127)	R-21.5 (3.79)	R-35.2 (6.21)	0.028 (0.16)	R-35.8 (6.30)	0.028 (0.16)	R-36.1 (6.35)	0.028 (0.16)
	6.0 (152)	R-25.8 (4.54)	R-39.2 (6.91)*	0.026 (0.14)*	R-39.9 (7.02)*	0.025 (0.14)*	R-40.2 (7.08)*	0.025 (0.14)*
	7.0 (178)	R-30.1 (5.30)	R-43.1 (7.59)*	0.023 (0.13)*	R-43.9 (7.73)*	0.023 (0.13)*	R-44.3 (7.80)*	0.023 (0.13)*
	8.0 (203)	R-34.4 (6.06)	R-46.9 (8.26)	0.021 (0.12)	R-47.8 (8.42)	0.021 (0.12)	R-48.3 (8.51)	0.021 (0.12)

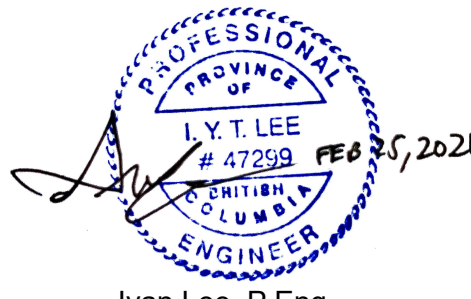
*Indicates interpolated value

We believe that this report meets your objectives for evaluating the thermal performance for the ACS-S Thermal Clip system with split insulated steel stud wall assemblies. If you have any questions or comments related to the above, please do not hesitate to contact the undersigned.

Morrison Hershfield Limited



Katie Hay, P.Eng.
Building Science Consultant

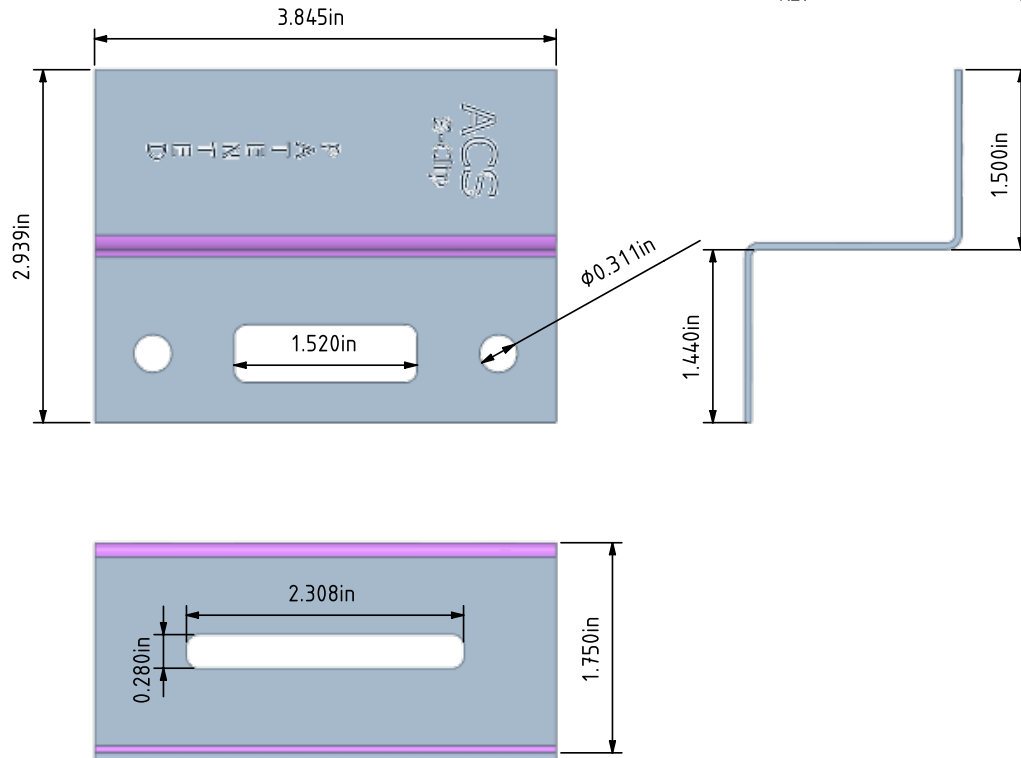


Ivan Lee, P.Eng.
Building Science Consultant

⁵ This value is the nominal R-value of the exterior insulation ONLY. Additional components, such as the sheathing, cellulose insulation, and air films all contribute an additional R-22.3 towards the nominal R-value of the entire assembly.

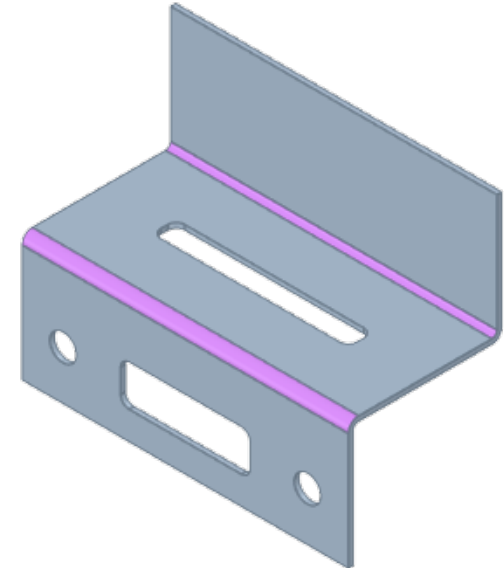
APPENDIX A: DETAIL DRAWINGS

NOTES:



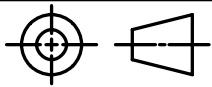
REVISION HISTORY

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THIRD ANGLE PROJECTION



CONTRACT NO.

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TREATMENT

NEXT ASSY

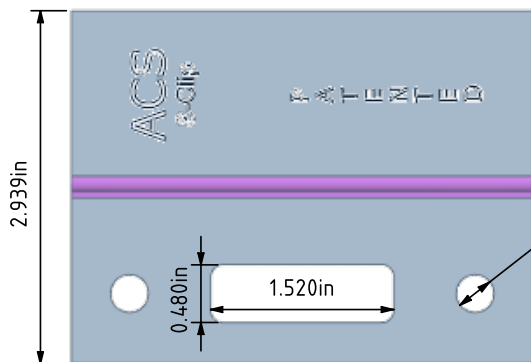
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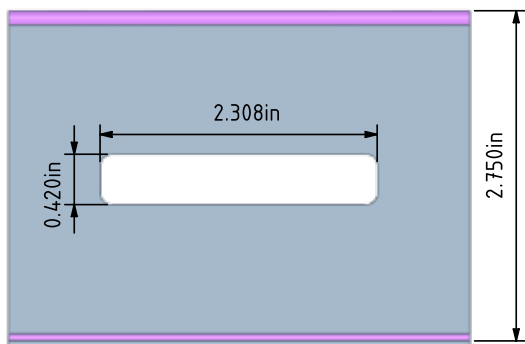
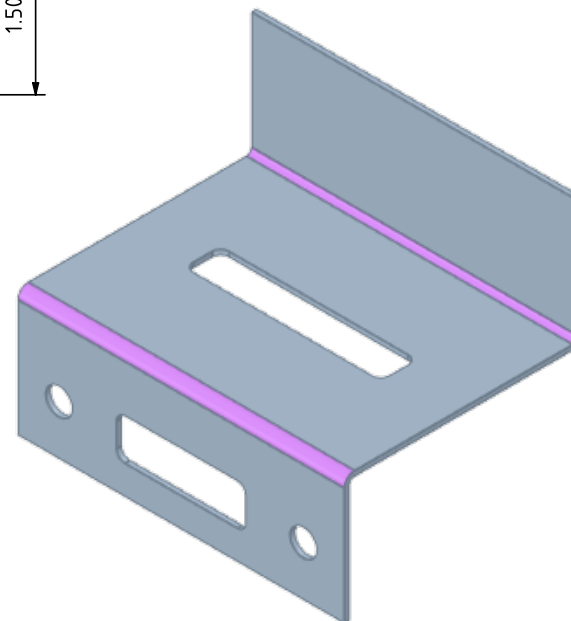
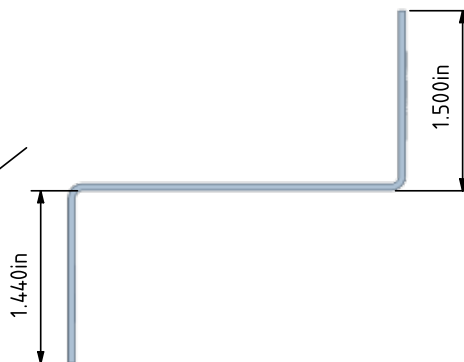
APPLICATION



NOTES:



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REV	DESCRIPTION	INCRP BY	DATE	CHECKED

INIT	APPROVALS	DATE	INIT	APPROVALS	DATE

CONTRACT NO.		MATERIAL

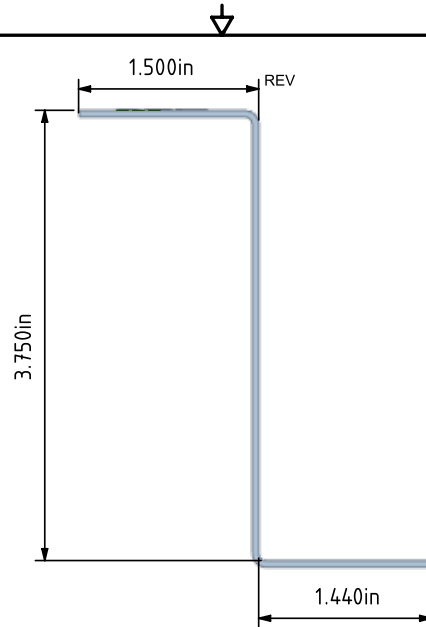
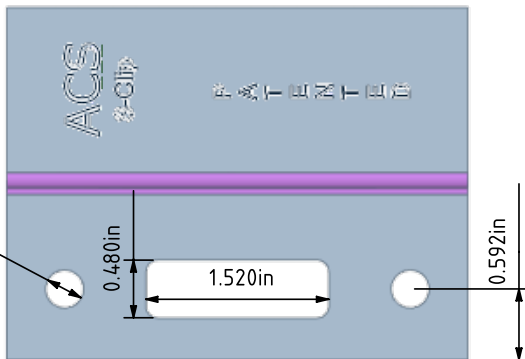
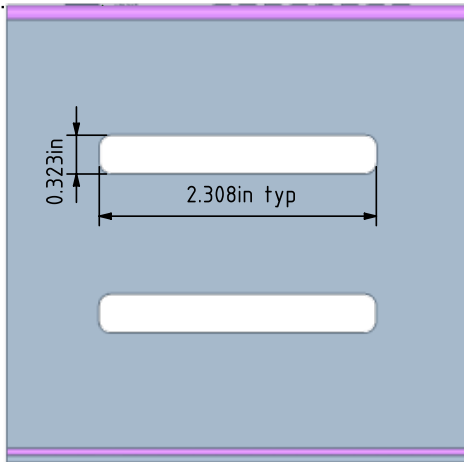
NEXT ASSY		USED ON	SIMILAR TO

APPLICATION	

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TITLE	
3in Solid Clip	
SIZE	CAGE CODE
B	
DWG NO.	REV
	2
SCALE	SHEET

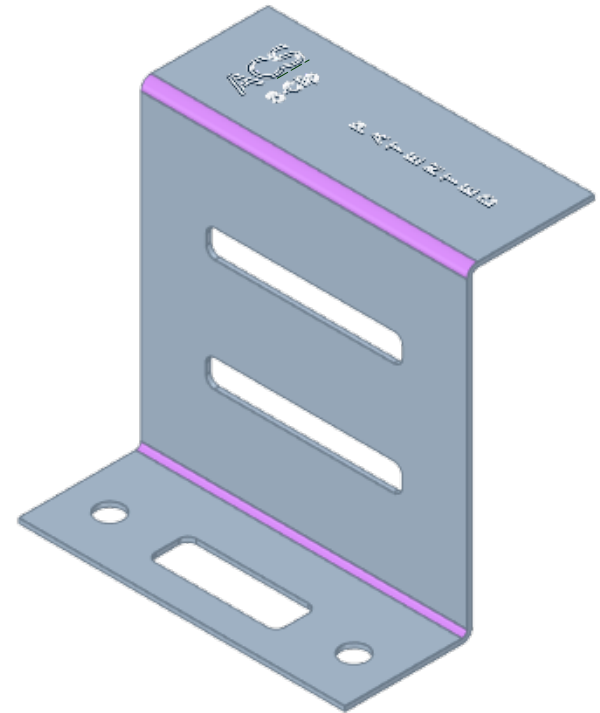


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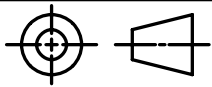
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QTY		REQD		NO.					
PARTS LIST						ACS Composite Systems			
INIT	APPROVALS	DATE	INIT	APPROVALS	DATE	TITLE			
						4in Solid Clip			
						SIZE			
						CAGE CODE			
						DWG NO.			
						REV			
						2			
						SCALE			
						SHEET			

THIRD ANGLE PROJECTION



CONTRACT NO.

MATERIAL

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NEXT ASSY

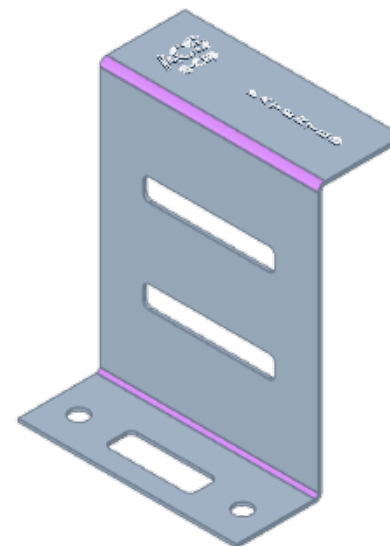
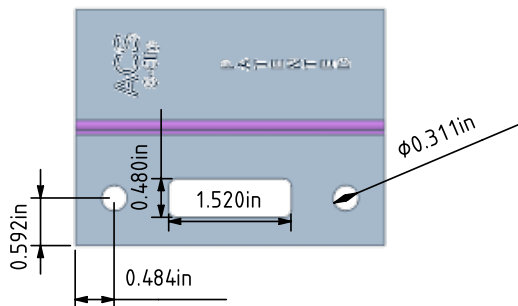
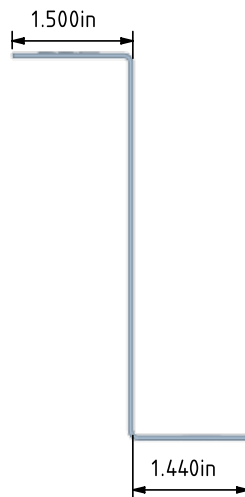
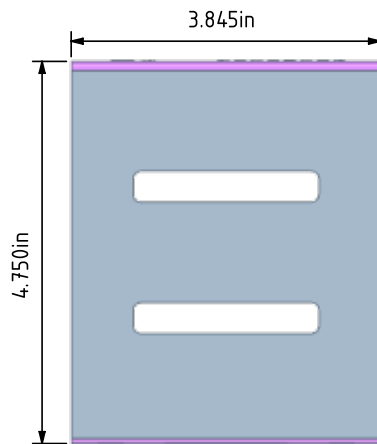
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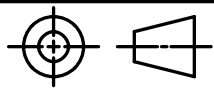
PARTS LIST

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QTY	REQD	NO.						
INIT	APPROVALS	DATE	INIT	APPROVALS	DATE	ACS Composite Systems		
						TITLE		
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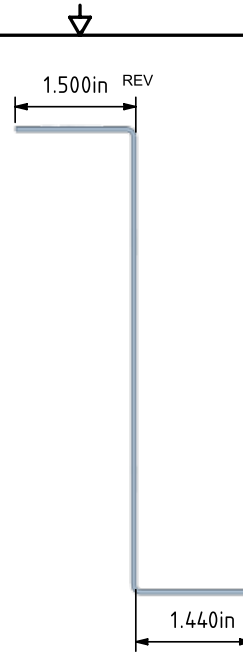
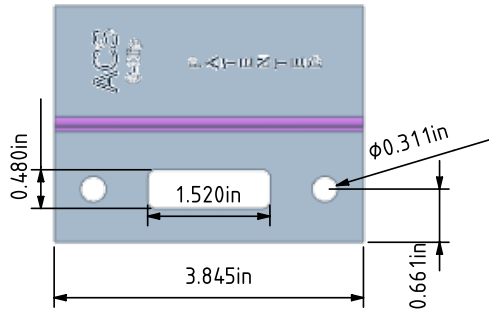
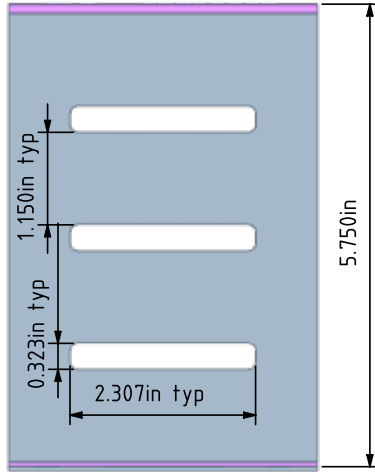


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THIRD ANGLE PROJECTION

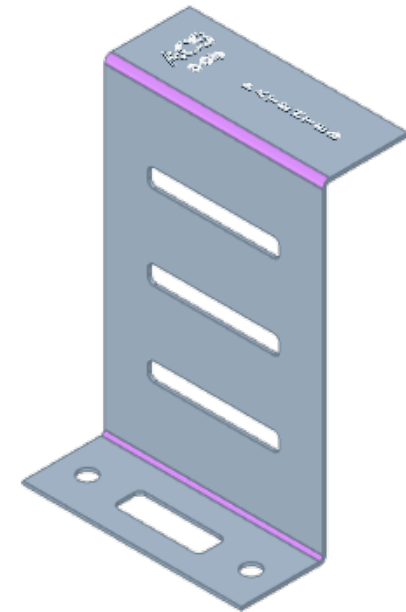


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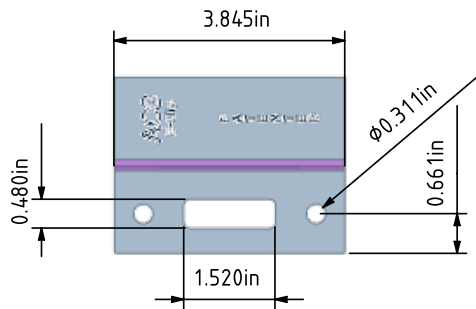
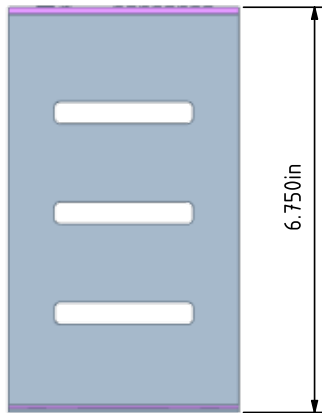
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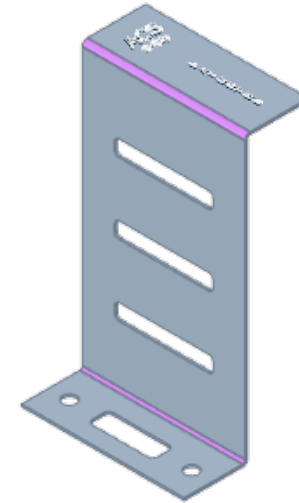
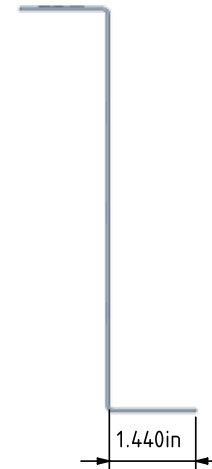
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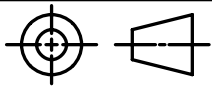
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QTY	REQD	NO.	IDENTIFYING NO.			OR DESCRIPTION					
PARTS LIST											
INIT	APPROVALS		DATE	INIT	APPROVALS		DATE	ACS Composite Systems			
								TITLE			
								7in Solid Clip			
								SIZE	CAGE CODE	DWG NO.	REV
								B			2
								SCALE			SHEET

THIRD ANGLE PROJECTION



CONTRACT NO.

MATERIAL

FINISH

TREATMENT

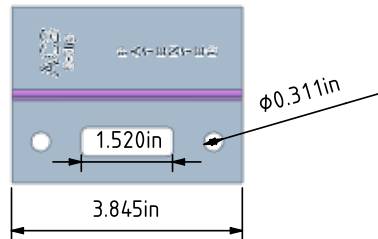
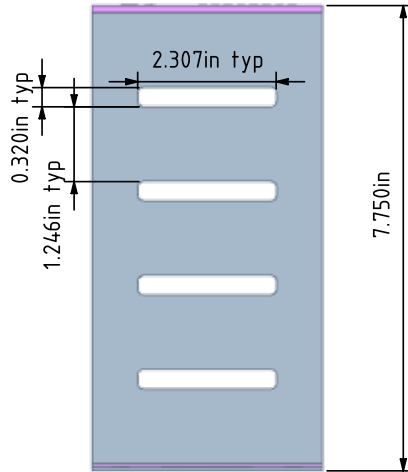
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USED ON

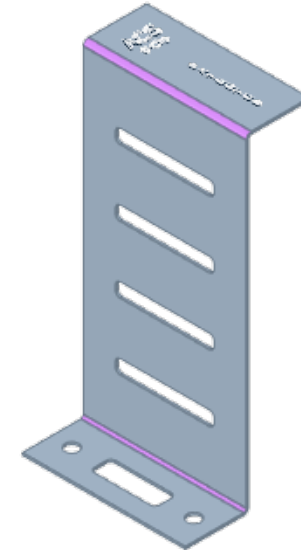
SIMILAR TO

APPLICATION

NOTES:



REVISION HISTORY				
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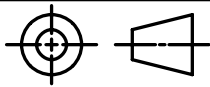


-2 QTY REQD		-1 ITEM NO.	PART OR IDENTIFYING NO.			NOMENCLATURE OR DESCRIPTION						
PARTS LIST												
INIT	APPROVALS		DATE	INIT	APPROVALS		DATE	ACS Composite Systems				
								TITLE				
								8in Solid Clip				
								SIZE B	CAGE CODE	DWG NO.		REV 2
								SCALE			SHEET	



CONTRACT NO.		MATERIAL	
		FINISH	
		TREATMENT	
NEXT ASSY	USED ON	SIMILAR TO	
APPLICATION			

THIRD ANGLE PROJECTION



APPENDIX B: MODELLING PARAMETERS AND ASSUMPTIONS

1. GENERAL MODELLING APPROACH

For this report, a steady-state conduction model was used. The following parameters were also assumed:

- Material properties were taken from information provided by Soprema Inc., ACS Composite Systems Inc., and ASHRAE Handbook – Fundamentals for common materials.
- Enclosed air spaces were modelled with an equivalent thermal conductivity of the air that includes the impacts of convection and radiation within the enclosure. Calculations for this equivalent conductivity were based on ISO 10077.
- Interior/exterior air films were taken from Table 10, p. 26.21 of 2017 ASHRAE Handbook – Fundamentals depending on surface orientation. The exterior air films were based on an exterior wind speed of 15 mph.
- In ASHRAE 1365-RP, for rain screen cavity systems, most lightweight claddings have an insignificant impact on the thermal performance other than shielding the insulation from direct wind exposure. The cladding and secondary structure outboard of the clip system were not explicitly modelled, but were incorporated into the exterior film coefficient.
- From the calibration in 1365-RP, contact resistances between materials were modelled and varied between R-0.01 and R-0.2 depending on the materials and interfaces.
- Insulation and other components were considered tight to adjacent interfaces.
- The clear field transmittances included in this analysis include uniform thermal bridges such as studs, clips, and girts.

2. TEMPERATURE INDEX

The temperature index is the ratio of the surface temperature relative to the interior and exterior temperatures. The temperature index has a value between 0 and 1, where 0 is the exterior temperature and 1 is the interior temperature. If T_i is known, Equation 1 can be rearranged for $T_{surface}$. This arrangement allows the modelled surface temperatures to be applicable to any climate.

$$T_i = \frac{T_{surface} - T_{outside}}{T_{inside} - T_{outside}} \quad \text{EQ 1}$$

Note, these indices shown in the temperature profiles for this analysis are for general information only and are not intended to predict in-service surface temperatures subject to transient conditions, variable heating systems, and/ or interior obstructions that restrict heating of the assembly. For full limitations of this modeling approach, see ASHRAE 1365-RP.

3. BOUNDARY CONDITIONS

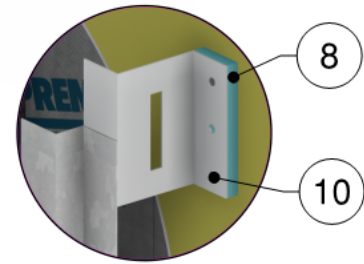
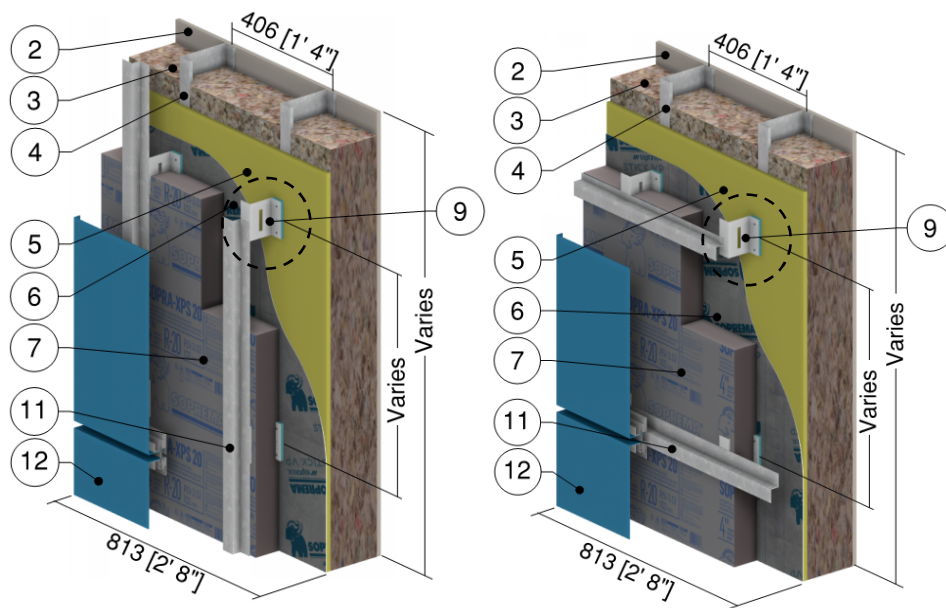
Table B3.1: Boundary Conditions

Boundary Location	Combined Convective and Radiation Heat Transfer Coefficient BTU/h ft ² °F (W/m ² K)
Exterior Wall Surfaces with Generic Cladding	1.5 (8.3)
Interior Walls	1.5 (8.3)

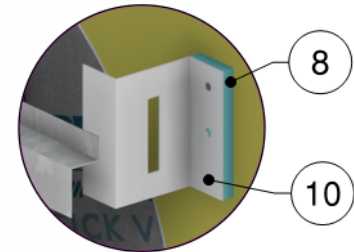
APPENDIX C: BUILDING ENVELOPE THERMAL BRIDGING GUIDE DATA SHEETS

Detail 2.1

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with SOPREMA SOPRA-XPS 20 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



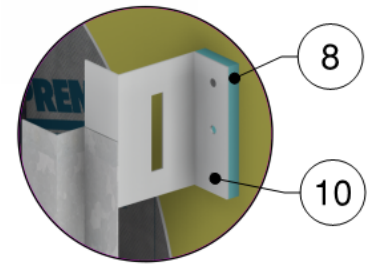
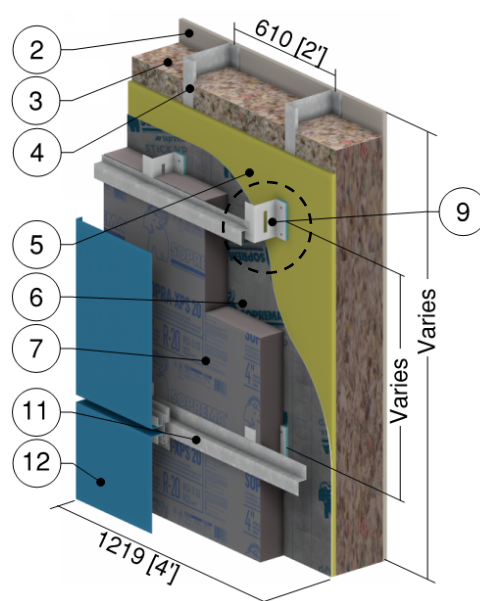
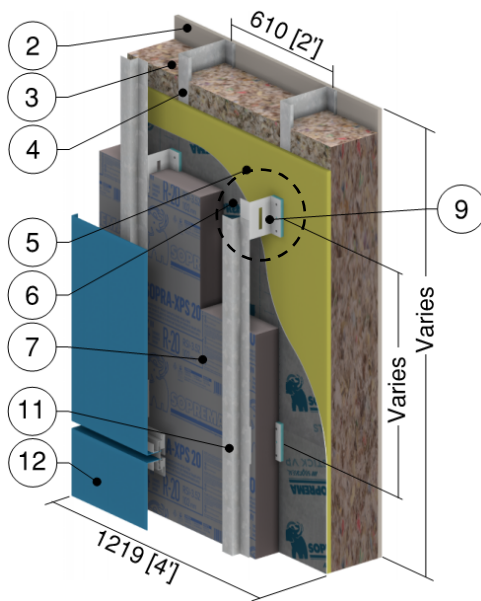
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu-in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	SOPRA-XPS 20 Exterior Insulation	Varies	0.20 (0.029)	R-5.0 to R-35.0 (0.88 RSI to 6.16 RSI)	2.5 (40)	0.29 (1220)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

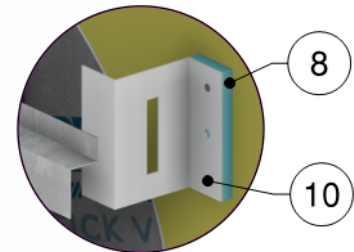
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.2

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with SOPREMA SOPRA-XPS 20 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



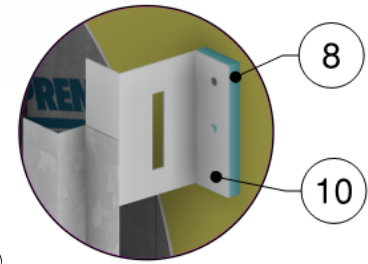
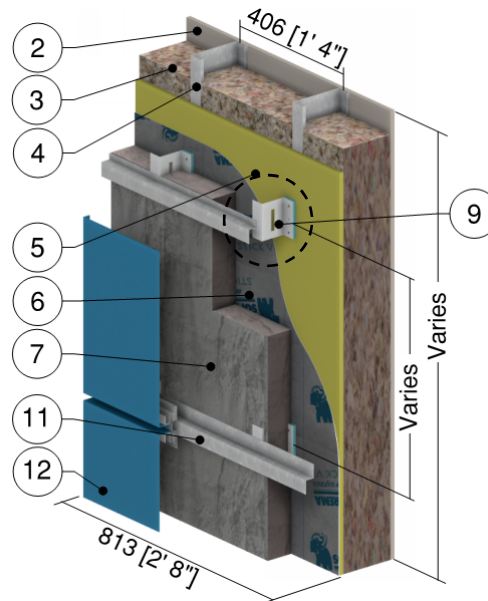
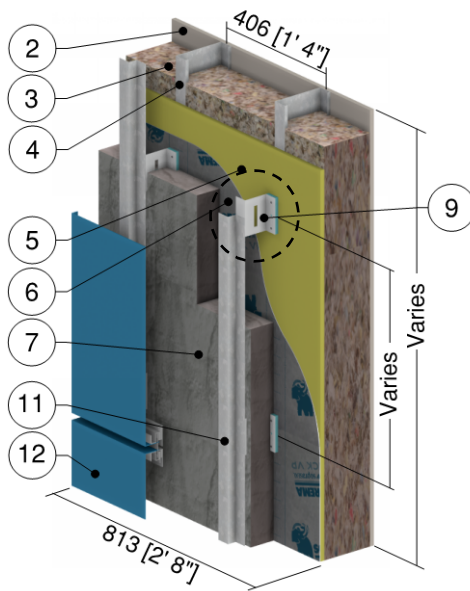
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	SOPRA-XPS 20 Exterior Insulation	Varies	0.20 (0.029)	R-5.0 to R-35.0 (0.88 RSI to 6.16 RSI)	2.5 (40)	0.29 (1220)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

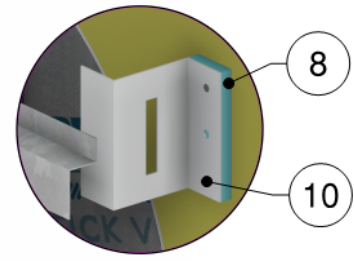
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.3

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with SOPREMA SOPRA-SPF 202 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



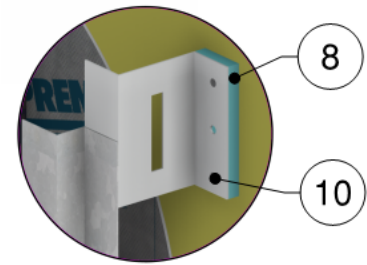
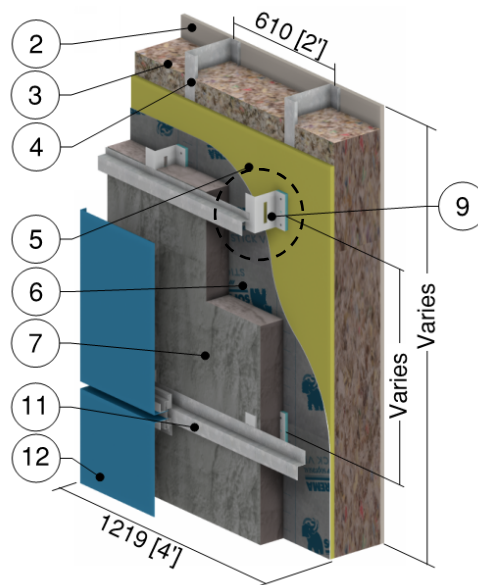
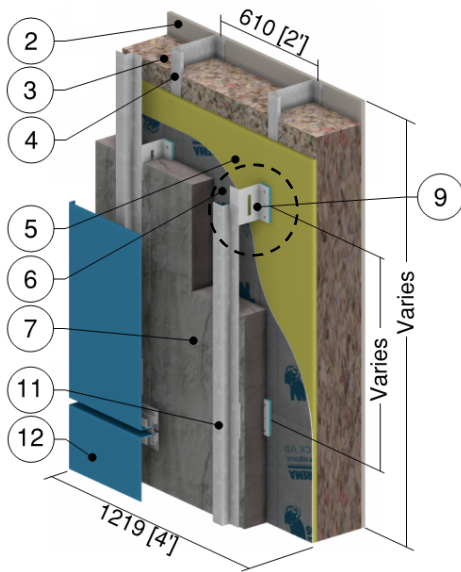
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft²·hr·°F (W/m K)	Nominal Resistance hr·ft²·°F/Btu (m²K/W)	Density lb/ft³ (kg/m³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	SOPRA-SPF 202 Exterior Insulation	Varies	0.16 (0.023)	R-6.2 to R-43.4 (1.09 RSI to 7.64 RSI)	1.8 (28)	0.29 (1220)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

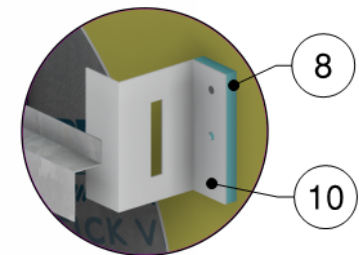
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.4

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with SOPREMA SOPRA-SPF 202 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



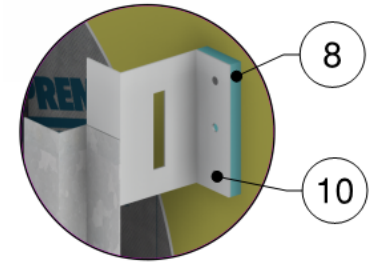
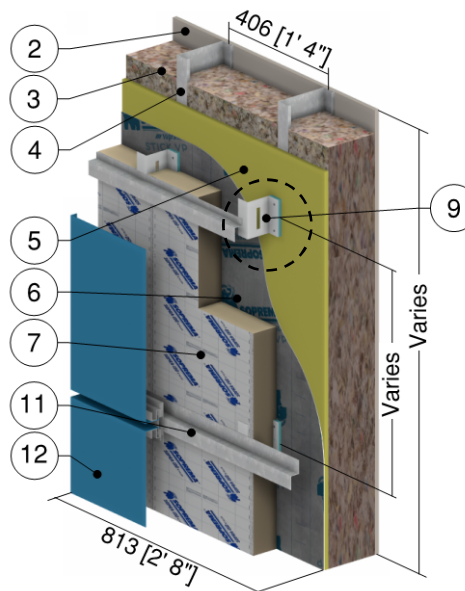
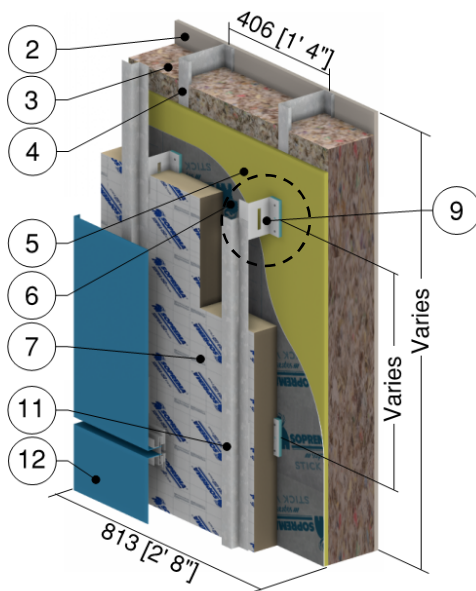
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	SOPRA-SPF 202 Exterior Insulation	Varies	0.16 (0.023)	R-6.2 to R-43.4 (1.09 RSI to 7.64 RSI)	1.8 (28)	0.29 (1220)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

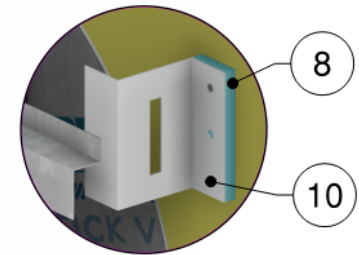
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.5

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with SOPREMA SOPRA-ISO V PLUS and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



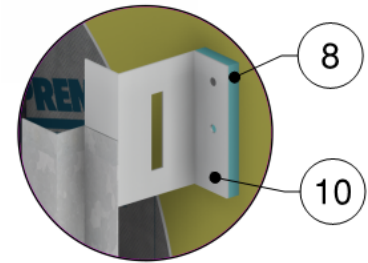
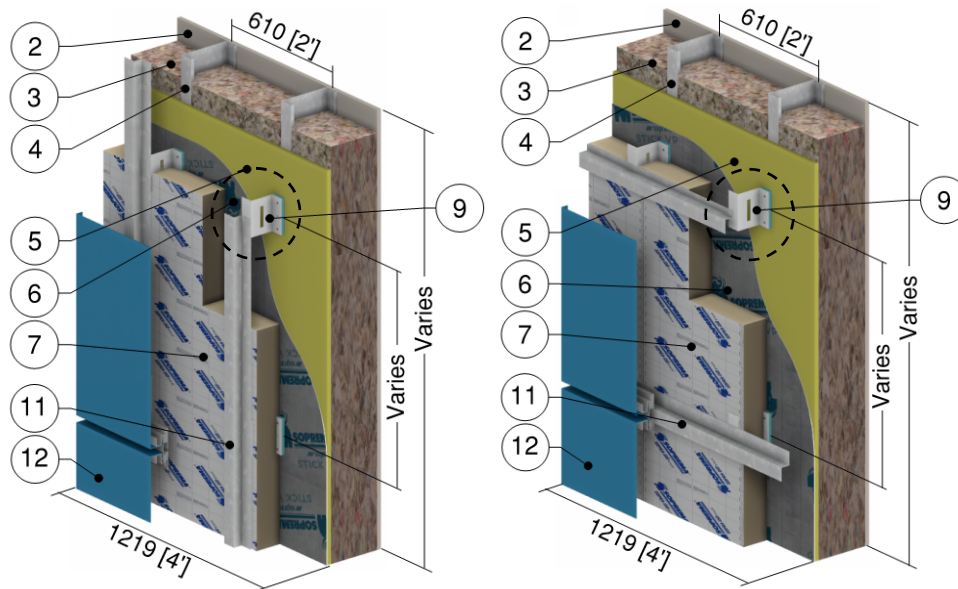
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu-in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	SOPRA-ISO V PLUS Exterior Insulation	Varies	0.17 (0.024)	R-6.0 to R-42.0 (1.06 RSI to 7.40 RSI)	1.9 (30)	0.36 (1500)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

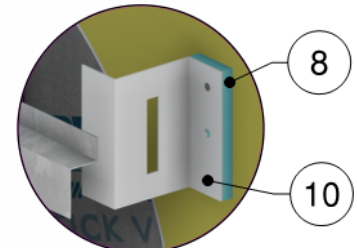
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.6

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with SOPREMA SOPRA-ISO V PLUS and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



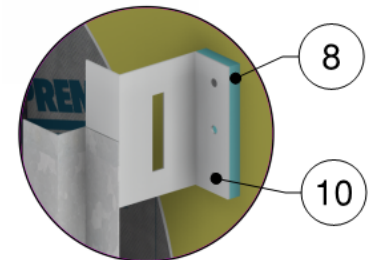
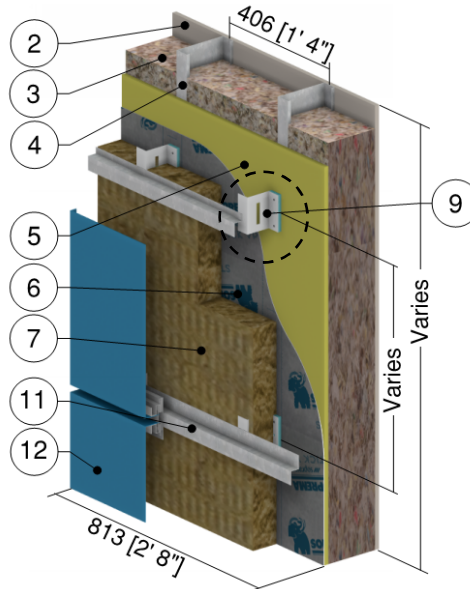
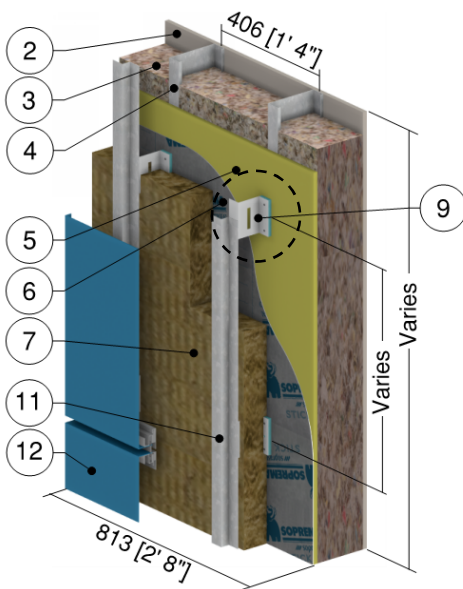
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	SOPRA-ISO V PLUS Exterior Insulation	Varies	0.17 (0.024)	R-6.0 to R-42.0 (1.06 RSI to 7.40 RSI)	1.9 (30)	0.36 (1500)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

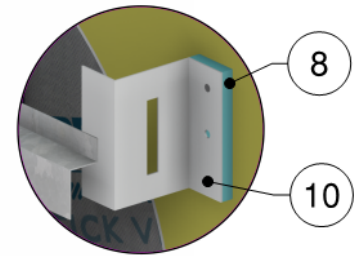
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.7

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Mineral Wool and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



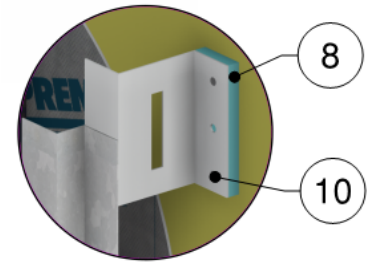
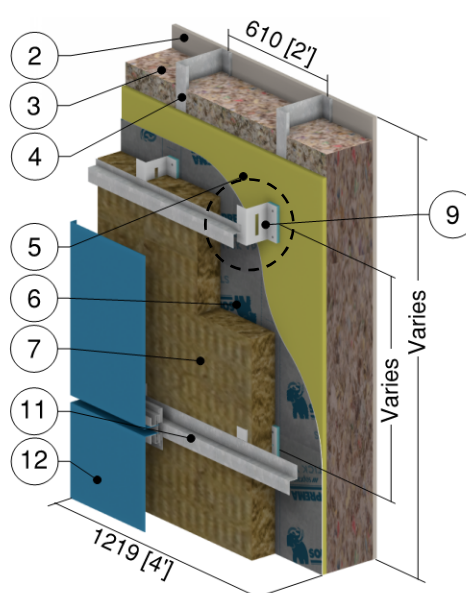
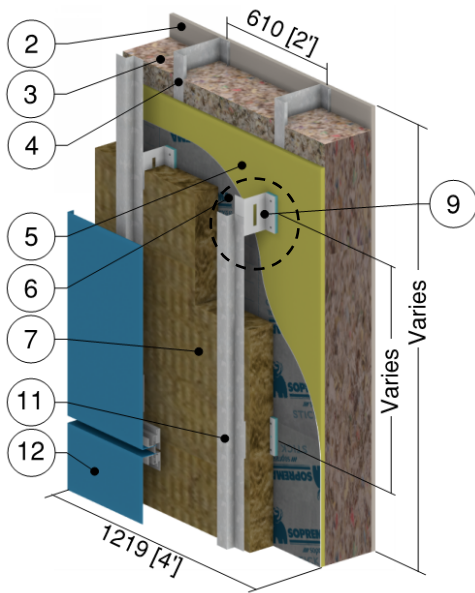
Horizontal Girt: ACS Clip Detail

ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	Exterior Mineral Wool Insulation	Varies	0.23 (0.034)	R-4.3 to R-34.4 (0.76 RSI to 6.06 RSI)	1.8 (28)	0.29 (1220)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

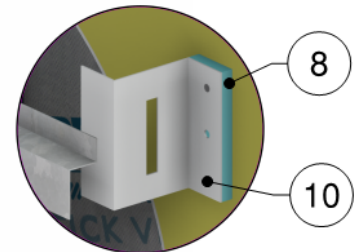
¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

Detail 2.8

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with Mineral Wool and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



Vertical Girt: ACS Clip Detail



Horizontal Girt: ACS Clip Detail

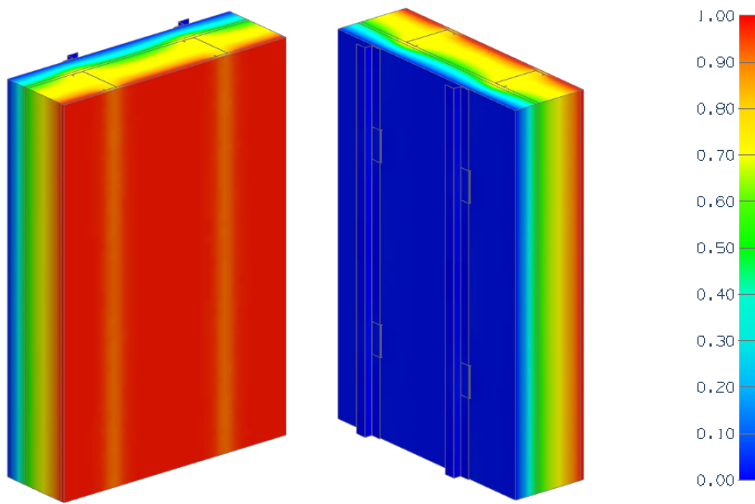
ID	Component	Thickness Inches (mm)	Conductivity Btu·in / ft ² ·hr·°F (W/m K)	Nominal Resistance hr·ft ² ·°F/Btu (m ² K/W)	Density lb/ft ³ (kg/m ³)	Specific Heat Btu/lb·°F (J/kg K)
1	Interior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-
2	Gypsum Board	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
3	Cellulose Insulation in Stud Cavity	6" (152)	0.30 (0.043)	R-20.0 (3.52 RSI)	1.2 (19)	0.33 (1400)
4	6" x 1 5/8" Steel Studs	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
5	Exterior Sheathing	1/2" (13)	1.1 (0.16)	R-0.5 (0.09 RSI)	50 (800)	0.26 (1090)
6	SOPREMA SOPRASEAL STICK VP membrane	-	-	-	-	-
7	Exterior Mineral Wool Insulation	Varies	0.23 (0.034)	R-4.3 to R-34.4 (0.76 RSI to 6.06 RSI)	1.8 (28)	0.29 (1220)
8	Thermal Break	1/2" (13)	0.13 (0.019)	-	2.1 (33)	0.50 (2100)
9	ACS-S Thermal Clip	16 Gauge	118 (17)	-	500 (8000)	0.13 (530)
10	Fastener	1/4" (6.4) Ø	347 (50)	-	489 (7830)	0.12 (500)
11	Girt	18 Gauge	430 (62)	-	489 (7830)	0.12 (500)
12	Cladding with 1/2" vented airspace incorporated into exterior heat transfer coefficient					
13	Exterior Film ¹	-	-	R-0.7 (0.12 RSI)	-	-

¹ Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation

APPENDIX D: BUILDING ENVELOPE THERMAL BRIDGING GUIDE RESULT SHEETS

Detail 2.1

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with SOPREMA SOPRA-XPS 20 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o , R_o	"Clear wall" U- and R-value

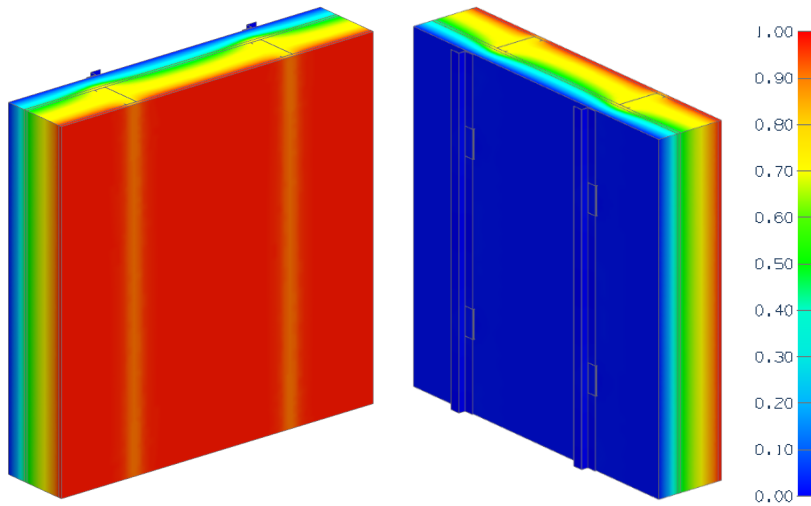
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-5.0 (0.88)	R-27.3 (4.80)	R-17.5 (3.08)	0.057 (0.32)	R-17.5 (3.08)	0.057 (0.32)	R-17.5 (3.09)	0.057 (0.32)
R-7.5 (1.32)	R-29.8 (5.24)	R-19.8 (3.48)*	0.051 (0.29)*	R-19.9 (3.51)*	0.050 (0.29)*	R-20.0 (3.52)*	0.050 (0.28)*
R-10.0 (1.76)	R-32.3 (5.68)	R-22.1 (3.88)*	0.045 (0.26)*	R-22.3 (3.92)*	0.045 (0.25)*	R-22.4 (3.94)*	0.045 (0.25)*
R-15.0 (2.64)	R-37.3 (6.56)	R-26.6 (4.68)	0.038 (0.21)	R-27.0 (4.75)	0.037 (0.21)	R-27.2 (4.79)	0.037 (0.21)
R-20.0 (3.52)	R-42.3 (7.44)	R-30.9 (5.45)*	0.032 (0.18)*	R-31.5 (5.56)*	0.032 (0.18)*	R-31.9 (5.61)*	0.031 (0.18)*
R-25.0 (4.40)	R-47.3 (8.33)	R-35.2 (6.19)	0.028 (0.16)	R-36.0 (6.34)	0.028 (0.16)	R-36.5 (6.42)	0.027 (0.16)
R-30.0 (5.28)	R-52.3 (9.21)	R-39.4 (6.94)*	0.025 (0.14)*	R-40.5 (7.14)*	0.025 (0.14)*	R-41.1 (7.24)*	0.024 (0.14)*
R-35.0 (6.16)	R-57.3 (10.09)	R-43.6 (7.67)	0.023 (0.13)	R-44.9 (7.91)	0.022 (0.13)	R-45.6 (8.04)	0.022 (0.12)

*Indicates interpolated value

Detail 2.2

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with SOPREMA SOPRA-XPS 20 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o , R_o	"Clear wall" U- and R-value

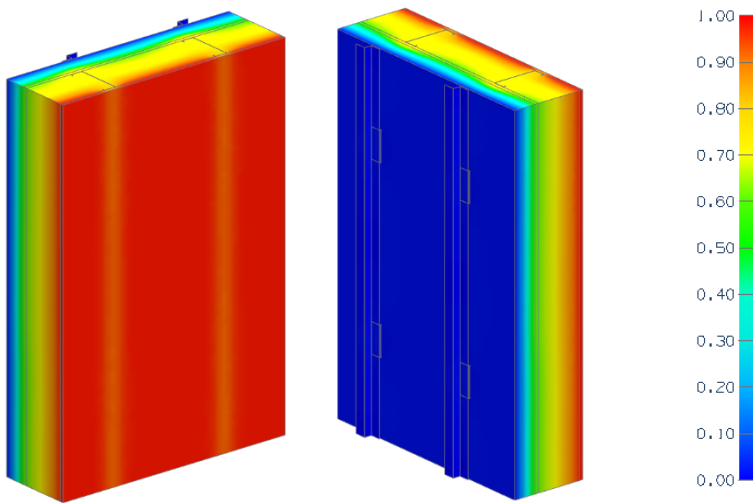
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-5.0 (0.88)	R-27.3 (4.80)	R-19.9 (3.50)	0.050 (0.29)	R-19.9 (3.50)	0.050 (0.29)	R-19.9 (3.51)	0.050 (0.29)
R-7.5 (1.32)	R-29.8 (5.24)	R-22.3 (3.92)*	0.045 (0.26)*	R-22.4 (3.94)*	0.045 (0.25)*	R-22.4 (3.95)*	0.045 (0.25)*
R-10.0 (1.76)	R-32.3 (5.68)	R-24.6 (4.34)*	0.041 (0.23)*	R-24.8 (4.37)*	0.040 (0.23)*	R-24.9 (4.39)*	0.040 (0.23)*
R-15.0 (2.64)	R-37.3 (6.56)	R-29.3 (5.17)	0.034 (0.19)	R-29.7 (5.23)	0.034 (0.19)	R-29.8 (5.26)	0.034 (0.19)
R-20.0 (3.52)	R-42.3 (7.44)	R-33.9 (5.97)*	0.029 (0.17)*	R-34.4 (6.06)*	0.029 (0.17)*	R-34.7 (6.10)*	0.029 (0.16)*
R-25.0 (4.40)	R-47.3 (8.33)	R-38.4 (6.76)	0.026 (0.15)	R-39.1 (6.88)	0.026 (0.15)	R-39.4 (6.94)	0.025 (0.14)
R-30.0 (5.28)	R-52.3 (9.21)	R-42.9 (7.55)*	0.023 (0.13)*	R-43.7 (7.70)*	0.023 (0.13)*	R-44.1 (7.77)*	0.023 (0.13)*
R-35.0 (6.16)	R-57.3 (10.09)	R-47.2 (8.32)	0.021 (0.12)	R-48.2 (8.50)	0.021 (0.12)	R-48.8 (8.59)	0.020 (0.12)

*Indicates interpolated value

Detail 2.3

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with SOPREMA SOPRA-SPF 202 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o , R_o	"Clear wall" U- and R-value

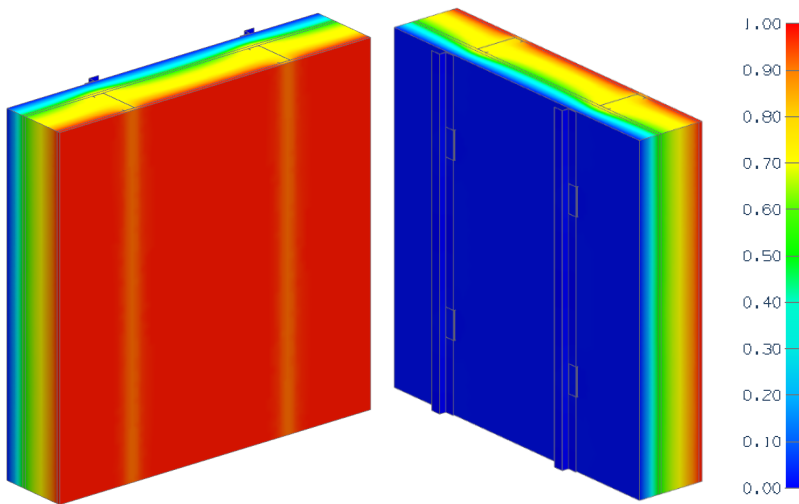
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-6.2 (1.09)	R-28.5 (5.01)	R-18.4 (3.23)	0.054 (0.31)	R-18.4 (3.23)	0.054 (0.31)	R-18.4 (3.24)	0.054 (0.31)
R-12.4 (2.18)	R-34.7 (6.11)	R-23.9 (4.21)*	0.042 (0.24)*	R-24.2 (4.25)*	0.041 (0.24)*	R-24.3 (4.28)*	0.041 (0.23)*
R-18.6 (3.28)	R-40.9 (7.20)	R-29.4 (5.18)	0.034 (0.19)	R-29.9 (5.26)	0.033 (0.19)	R-30.2 (5.31)	0.033 (0.19)
R-24.8 (4.37)	R-47.1 (8.29)	R-34.6 (6.10)*	0.029 (0.16)*	R-35.4 (6.24)*	0.028 (0.16)*	R-35.9 (6.32)*	0.028 (0.16)*
R-31.0 (5.46)	R-53.3 (9.38)	R-39.7 (6.99)	0.025 (0.14)	R-40.9 (7.19)	0.024 (0.14)	R-41.5 (7.30)	0.024 (0.14)
R-37.2 (6.55)	R-59.5 (10.47)	R-44.8 (7.90)*	0.022 (0.13)*	R-46.3 (8.15)*	0.022 (0.12)*	R-47.1 (8.29)*	0.021 (0.12)*
R-43.4 (7.64)	R-65.7 (11.57)	R-49.8 (8.77)	0.020 (0.11)	R-51.6 (9.09)	0.019 (0.11)	R-52.6 (9.27)	0.019 (0.11)

*Indicates interpolated value

Detail 2.4

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with SOPREMA SOPRA-SPF 202 and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o , R_o	"Clear wall" U- and R-value

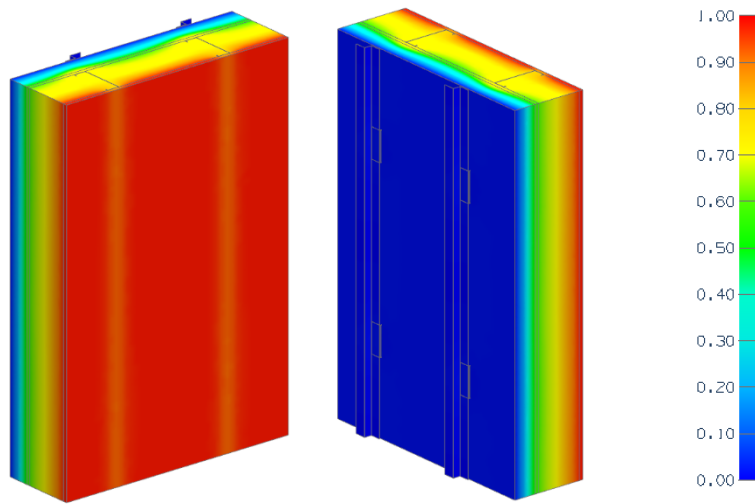
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-6.2 (1.09)	R-28.5 (5.01)	R-20.8 (3.67)	0.048 (0.27)	R-20.8 (3.67)	0.048 (0.27)	R-20.8 (3.67)	0.048 (0.27)
R-12.4 (2.18)	R-34.7 (6.11)	R-26.6 (4.68)*	0.038 (0.21)*	R-26.8 (4.72)*	0.037 (0.21)*	R-26.9 (4.74)*	0.037 (0.21)*
R-18.6 (3.28)	R-40.9 (7.20)	R-32.3 (5.69)	0.031 (0.18)	R-32.7 (5.76)	0.031 (0.17)	R-32.9 (5.80)	0.030 (0.17)
R-24.8 (4.37)	R-47.1 (8.29)	R-37.8 (6.66)*	0.026 (0.15)*	R-38.5 (6.78)*	0.026 (0.15)*	R-38.8 (6.83)*	0.026 (0.15)*
R-31.0 (5.46)	R-53.3 (9.38)	R-43.3 (7.62)	0.023 (0.13)	R-44.1 (7.77)	0.023 (0.13)	R-44.6 (7.85)	0.022 (0.13)
R-37.2 (6.55)	R-59.5 (10.47)	R-48.7 (8.58)*	0.021 (0.12)*	R-49.8 (8.77)*	0.020 (0.11)*	R-50.4 (8.88)*	0.020 (0.11)*
R-43.4 (7.64)	R-65.7 (11.57)	R-54.0 (9.51)	0.019 (0.11)	R-55.4 (9.75)	0.018 (0.10)	R-56.1 (9.88)	0.018 (0.10)

*Indicates interpolated value

Detail 2.5

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with SOPREMA SOPRA-ISO V PLUS and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R _{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U _o , R _o	"Clear wall" U- and R-value

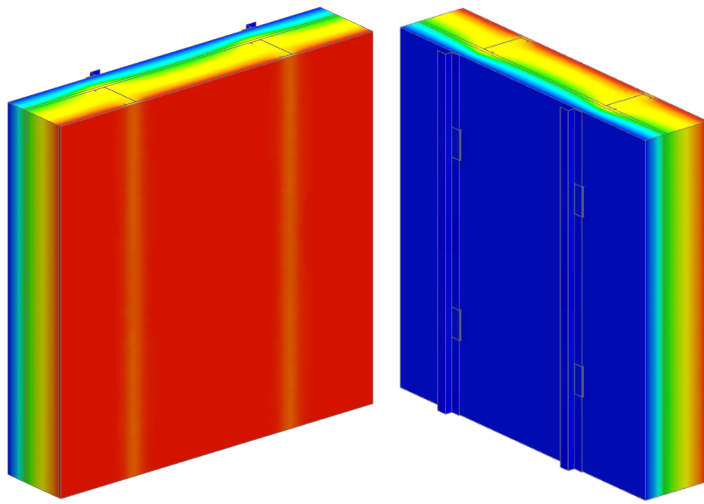
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R _{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)	R _o ft ² ·hr·°F / Btu (m ² K / W)	U _o Btu/ft ² ·hr ·°F (W/m ² K)
R-6.0 (1.06)	R-28.3 (4.98)	R-18.5 (3.26)	0.054 (0.31)	R-18.5 (3.26)	0.054 (0.31)	R-18.6 (3.27)	0.054 (0.31)
R-9.0 (1.59)	R-31.3 (5.51)	R-21.2 (3.74)*	0.047 (0.27)*	R-21.4 (3.77)*	0.047 (0.27)*	R-21.5 (3.78)*	0.047 (0.26)*
R-12.0 (2.11)	R-34.3 (6.04)	R-23.9 (4.21)*	0.042 (0.24)*	R-24.2 (4.26)*	0.041 (0.23)*	R-24.3 (4.28)*	0.041 (0.23)*
R-15.0 (2.64)	R-37.3 (6.56)	R-26.5 (4.67)*	0.038 (0.21)*	R-27.0 (4.75)*	0.037 (0.21)*	R-27.2 (4.79)*	0.037 (0.21)*
R-18.0 (3.17)	R-40.3 (7.09)	R-29.2 (5.15)	0.034 (0.19)	R-29.8 (5.24)	0.034 (0.19)	R-30.0 (5.29)	0.033 (0.19)
R-21.0 (3.70)	R-43.3 (7.62)	R-31.7 (5.59)*	0.031 (0.18)*	R-32.4 (5.71)*	0.031 (0.18)*	R-32.8 (5.78)*	0.030 (0.17)*
R-24.0 (4.23)	R-46.3 (8.15)	R-34.3 (6.04)*	0.029 (0.17)*	R-35.1 (6.19)*	0.028 (0.16)*	R-35.6 (6.27)*	0.028 (0.16)*
R-27.0 (4.76)	R-49.3 (8.68)	R-36.8 (6.49)*	0.027 (0.15)*	R-37.8 (6.66)*	0.026 (0.15)*	R-38.3 (6.75)*	0.026 (0.15)*
R-30.0 (5.28)	R-52.3 (9.21)	R-39.3 (6.92)	0.025 (0.14)	R-40.4 (7.12)	0.025 (0.14)	R-41.0 (7.23)	0.024 (0.14)
R-33.0 (5.81)	R-55.3 (9.73)	R-41.8 (7.37)*	0.024 (0.14)*	R-43.1 (7.59)*	0.023 (0.13)*	R-43.8 (7.72)*	0.023 (0.13)*
R-36.0 (6.34)	R-58.3 (10.26)	R-44.3 (7.80)*	0.023 (0.13)*	R-45.7 (8.05)*	0.022 (0.12)*	R-46.5 (8.19)*	0.022 (0.12)*
R-39.0 (6.87)	R-61.3 (10.79)	R-46.7 (8.22)*	0.021 (0.12)*	R-48.3 (8.51)*	0.021 (0.12)*	R-49.2 (8.66)*	0.020 (0.12)*
R-42.0 (7.40)	R-64.3 (11.32)	R-49.1 (8.65)	0.020 (0.12)	R-50.9 (8.97)	0.020 (0.11)	R-51.9 (9.13)	0.019 (0.11)

*Indicates interpolated value

Detail 2.6

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with SOPREMA SOPRA-ISO V PLUS and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o, R_o	"Clear wall" U- and R-value

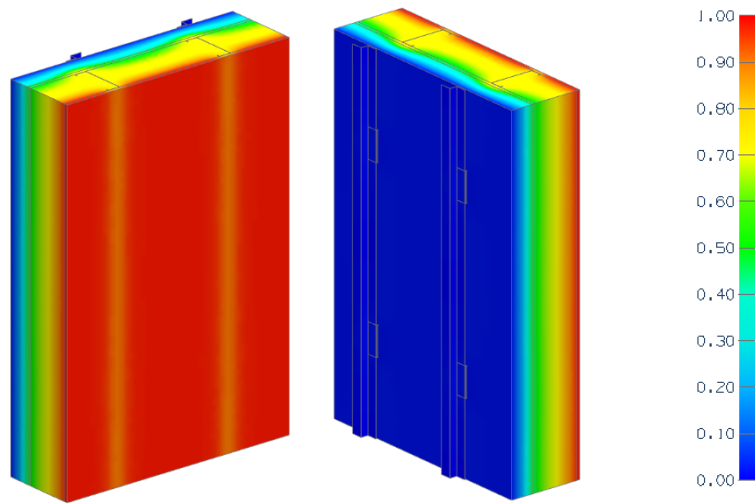
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-6.0 (1.06)	R-28.3 (4.98)	R-20.9 (3.68)	0.048 (0.27)	R-20.9 (3.69)	0.048 (0.27)	R-21.0 (3.69)	0.048 (0.27)
R-9.0 (1.59)	R-31.3 (5.51)	R-23.7 (4.18)*	0.042 (0.24)*	R-23.9 (4.21)*	0.042 (0.24)*	R-23.9 (4.22)*	0.042 (0.24)*
R-12.0 (2.11)	R-34.3 (6.04)	R-26.5 (4.67)*	0.038 (0.21)*	R-26.8 (4.72)*	0.037 (0.21)*	R-26.9 (4.74)*	0.037 (0.21)*
R-15.0 (2.64)	R-37.3 (6.56)	R-29.3 (5.16)*	0.034 (0.19)*	R-29.7 (5.22)*	0.034 (0.19)*	R-29.8 (5.25)*	0.034 (0.19)*
R-18.0 (3.17)	R-40.3 (7.09)	R-32.1 (5.65)	0.031 (0.18)	R-32.5 (5.73)	0.031 (0.17)	R-32.8 (5.77)	0.031 (0.17)
R-21.0 (3.70)	R-43.3 (7.62)	R-34.8 (6.13)*	0.029 (0.16)*	R-35.3 (6.22)*	0.028 (0.16)*	R-35.6 (6.27)*	0.028 (0.16)*
R-24.0 (4.23)	R-46.3 (8.15)	R-37.5 (6.60)*	0.027 (0.15)*	R-38.1 (6.72)*	0.026 (0.15)*	R-38.5 (6.77)*	0.026 (0.15)*
R-27.0 (4.76)	R-49.3 (8.68)	R-40.2 (7.07)*	0.025 (0.14)*	R-40.9 (7.21)*	0.024 (0.14)*	R-41.3 (7.28)*	0.024 (0.14)*
R-30.0 (5.28)	R-52.3 (9.21)	R-42.8 (7.53)	0.023 (0.13)	R-43.7 (7.69)	0.023 (0.13)	R-44.1 (7.77)	0.023 (0.13)
R-33.0 (5.81)	R-55.3 (9.73)	R-45.4 (8.00)*	0.022 (0.12)*	R-46.4 (8.18)*	0.022 (0.12)*	R-46.9 (8.27)*	0.021 (0.12)*
R-36.0 (6.34)	R-58.3 (10.26)	R-48.0 (8.46)*	0.021 (0.12)*	R-49.2 (8.66)*	0.020 (0.12)*	R-49.7 (8.76)*	0.020 (0.11)*
R-39.0 (6.87)	R-61.3 (10.79)	R-50.6 (8.91)*	0.020 (0.11)*	R-51.9 (9.13)*	0.019 (0.11)*	R-52.5 (9.25)*	0.019 (0.11)*
R-42.0 (7.40)	R-64.3 (11.32)	R-53.2 (9.37)	0.019 (0.11)	R-54.5 (9.61)	0.018 (0.10)	R-55.3 (9.73)	0.018 (0.10)

*Indicates interpolated value

Detail 2.7

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Mineral Wool and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o , R_o	"Clear wall" U- and R-value

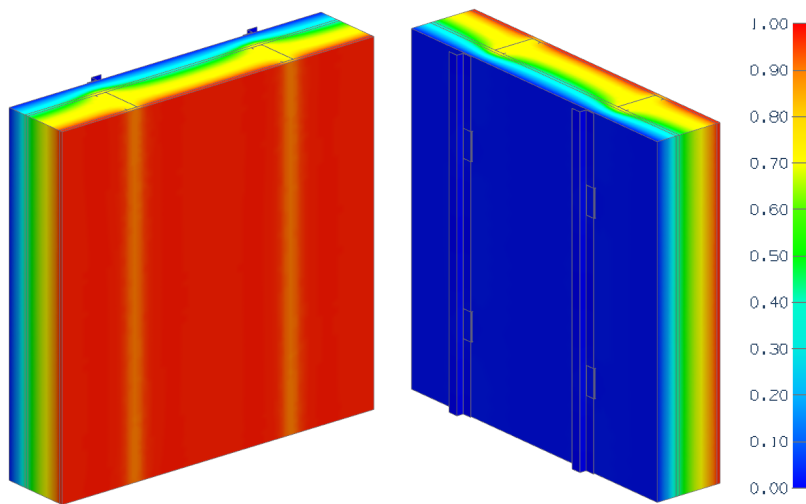
Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-4.3 (0.76)	R-26.6 (4.68)	R-16.8 (2.95)	0.060 (0.34)	R-16.8 (2.95)	0.060 (0.34)	R-16.8 (2.96)	0.060 (0.34)
R-8.6 (1.51)	R-30.9 (5.44)	R-20.7 (3.65)*	0.048 (0.27)*	R-20.9 (3.68)*	0.048 (0.27)*	R-21.0 (3.70)*	0.048 (0.27)*
R-12.9 (2.27)	R-35.2 (6.19)	R-24.7 (4.35)	0.040 (0.23)	R-25.0 (4.41)	0.040 (0.23)	R-25.2 (4.44)	0.040 (0.23)
R-17.2 (3.03)	R-39.5 (6.95)	R-28.5 (5.01)*	0.035 (0.20)*	R-29.0 (5.10)*	0.035 (0.20)*	R-29.2 (5.15)*	0.034 (0.19)*
R-21.5 (3.79)	R-43.8 (7.71)	R-32.2 (5.67)	0.031 (0.18)	R-32.9 (5.79)	0.030 (0.17)	R-33.2 (5.85)	0.030 (0.17)
R-25.8 (4.54)	R-48.1 (8.47)	R-36.0 (6.34)*	0.028 (0.16)*	R-36.8 (6.49)*	0.027 (0.15)*	R-37.3 (6.57)*	0.027 (0.15)*
R-30.1 (5.30)	R-52.4 (9.22)	R-39.7 (6.99)*	0.025 (0.14)*	R-40.7 (7.17)*	0.025 (0.14)*	R-41.3 (7.27)*	0.024 (0.14)*
R-34.4 (6.06)	R-56.7 (9.98)	R-43.3 (7.63)	0.023 (0.13)	R-44.6 (7.85)	0.022 (0.13)	R-45.2 (7.96)	0.022 (0.13)

*Indicates interpolated value

Detail 2.8

Exterior and Interior Insulated 6" x 1 5/8" Steel Stud (24" o.c.) Wall Assembly with Mineral Wool and ACS-S Thermal Clip Supporting Metal Cladding with R-20 Cellulose Insulation in Stud Cavity - Clear Wall



View from Interior

View from Exterior

Thermal Performance Indicators

Assembly 1D (Nominal) R-Value	R_{1D}	R-22.3 (3.92 RSI) + exterior insulation
Transmittance / Resistance	U_o, R_o	"Clear wall" U- and R-value

Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-value (RSI)	R_{1D} ft ² ·hr·°F / Btu (m ² K / W)	24" Vertical Spacing		36" Vertical Spacing		48" Vertical Spacing	
		R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)	R_o ft ² ·hr·°F / Btu (m ² K / W)	U_o Btu/ft ² ·hr ·°F (W/m ² K)
R-4.3 (0.76)	R-26.6 (4.68)	R-19.1 (3.37)	0.052 (0.30)	R-19.1 (3.37)	0.052 (0.30)	R-19.1 (3.37)	0.052 (0.30)
R-8.6 (1.51)	R-30.9 (5.44)	R-23.3 (4.10)*	0.043 (0.24)*	R-23.4 (4.12)*	0.043 (0.24)*	R-23.5 (4.13)*	0.043 (0.24)*
R-12.9 (2.27)	R-35.2 (6.19)	R-27.4 (4.82)	0.037 (0.21)	R-27.7 (4.87)	0.036 (0.21)	R-27.8 (4.89)	0.036 (0.20)
R-17.2 (3.03)	R-39.5 (6.95)	R-31.3 (5.52)*	0.032 (0.18)*	R-31.7 (5.59)*	0.032 (0.18)*	R-31.9 (5.62)*	0.031 (0.18)*
R-21.5 (3.79)	R-43.8 (7.71)	R-35.2 (6.21)	0.028 (0.16)	R-35.8 (6.30)	0.028 (0.16)	R-36.1 (6.35)	0.028 (0.16)
R-25.8 (4.54)	R-48.1 (8.47)	R-39.2 (6.91)*	0.026 (0.14)*	R-39.9 (7.02)*	0.025 (0.14)*	R-40.2 (7.08)*	0.025 (0.14)*
R-30.1 (5.30)	R-52.4 (9.22)	R-43.1 (7.59)*	0.023 (0.13)*	R-43.9 (7.73)*	0.023 (0.13)*	R-44.3 (7.80)*	0.023 (0.13)*
R-34.4 (6.06)	R-56.7 (9.98)	R-46.9 (8.26)	0.021 (0.12)	R-47.8 (8.42)	0.021 (0.12)	R-48.3 (8.51)	0.021 (0.12)

*Indicates interpolated value