

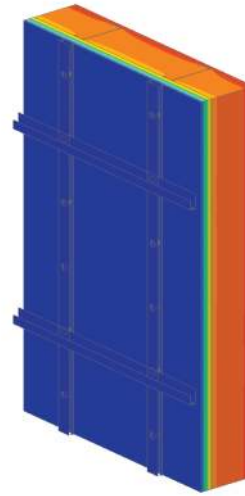
# CI-System™ Thermal Performance

## 3D THERMAL MODELING OVERVIEW

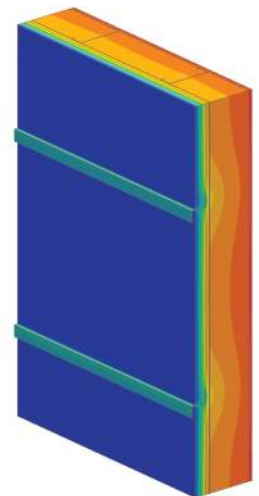
With 95%-98% exterior insulation effectiveness, the Knight CI-System™ rain screen attachment easily meets the requirements of ASHRAE 90.1-2007/2010/2013. The CI-System, with only thermally isolated fasteners penetrating the exterior thermal insulation, meets ASHRAE's definition of ci, or continuous insulation: *insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings...*

The thermal isolators on the fasteners, ThermaStop™ washers, prevent lateral heat flow to the steel girts, reducing fin effects. From previous modeling, these fin effects typically reduce the system by an additional R-1. The Knight CI-System barely reduces the percent effectiveness as the insulation becomes higher in R-value (typically thicker). However, with continuous vertical and horizontal girts penetrating the insulation, the property of diminishing effectiveness is far more noticeable. Additionally, the placement of secondary horizontal rails with the CI-System has been found to have negligible effects on the thermal performance of the assembly.

## KNIGHT CI-SYSTEM



## HORIZONTAL Z-GIRT



## ABOUT 3D THERMAL MODELING

For the 3D thermal analysis, Knight Wall used the expert services provided by Morrison-Hershfield. The CAD/FEA analysis software NX, from Siemens, was used for the modeling and evaluation. Using this software, MH had previously conducted a research project for the American Society of Heating, Cooling, Refrigeration and Air-Conditioning Engineers (ASHRAE) in which the 3D thermal model software was developed and calibrated to within 5% of hotbox measurements using more than 30 different guarded hotbox case studies. Please feel free to contact Knight Wall Systems for the full report.

## MODELED ASSEMBLY

- Interior Air Film
- 1/2" Interior Drywall
- 6" Steel Studs @ 16" O.C.
- 1/2" Exterior Sheathing\* (only modeled on continuous vertical & horizontal girt assemblies)
- Exterior Rigid Insulation
- Various Attachment Assemblies
- Exterior Air Film

Rigid Insulation Thermal Performance							
Attachment System Configuration	Thickness Rated R-Value	1.55" R-10.1	2" R-13	2.5" R-15.8	3" R-19	3.5" R-22.1	4" R-25.2
<b>Exterior Rigid Insulation Only:</b>							
Vertical Z-Girts 16" O.C.	Effective R-Value	8.3	9.2	10	10.8	11.5	12
	U-Factor	0.121	0.109	0.100	0.093	0.087	0.083
	Overall % Effect.	62%	57%	52%	49%	45%	42%
Horizontal Z-Girts 24" O.C.	Effective R-Value	9.3	10.6	11.7	12.8	13.7	14.5
	U-Factor	0.107	0.094	0.086	0.078	0.073	0.069
	Overall % Effect.	70%	65%	61%	58%	54%	51%
Knight Wall CI-System* 16" O.C.	Effective R-Value	12.5	15.3	17.9	20.8	23.6	26.4
	U-Factor	0.080	0.066	0.056	0.048	0.042	0.038
	Overall % Effect.	98%	97%	97%	96%	95%	95%
<b>Exterior Insulation + R-19 Batt Insulation in Stud Cavity<sup>1</sup>:</b>							
Knight Wall CI-System* 16" O.C.	Effective R-Value	21.7	24.4	26.9	29.8	32.4	35
	U-Factor	0.046	0.041	0.037	0.034	0.031	0.029
	Overall % Effect.	70%	72%	73%	75%	75%	76%
<b>Exterior Insulation + 1.5" SPF Insulation (R-9.8) in Stud Cavity<sup>2</sup>:</b>							
Knight Wall CI-System* 16" O.C.	Effective R-Value	18.8	21.6	24.1	27	29.6	32.3
	U-Factor	0.053	0.046	0.041	0.037	0.034	0.031
	Overall % Effect.	83%	85%	85%	86%	86%	86%

1. Adding R-19 to a Knight CI-System continuous insulated wall assembly adds, on average, an additional effective R-8.9

2. Adding 1.5" SPF (R-9.8) to the Knight CI-System continuous insulated wall assembly adds, on average, an additional effective R-6.1

\* Knight Wall's CI-System was modeled without the use of exterior gypsum sheathing. By adding gypsum sheathing to the wall assembly, the effective R-value will increase by approximately R-0.4.

+ Units - R-Value: hr-ft<sup>2</sup>·°F/BTU U-Factor: BTU/hr-ft<sup>2</sup>·°F

Full 3-dimensional thermal analysis report available upon request. Morrison Hershfield Report No. 18140040.00, December 16, 2013