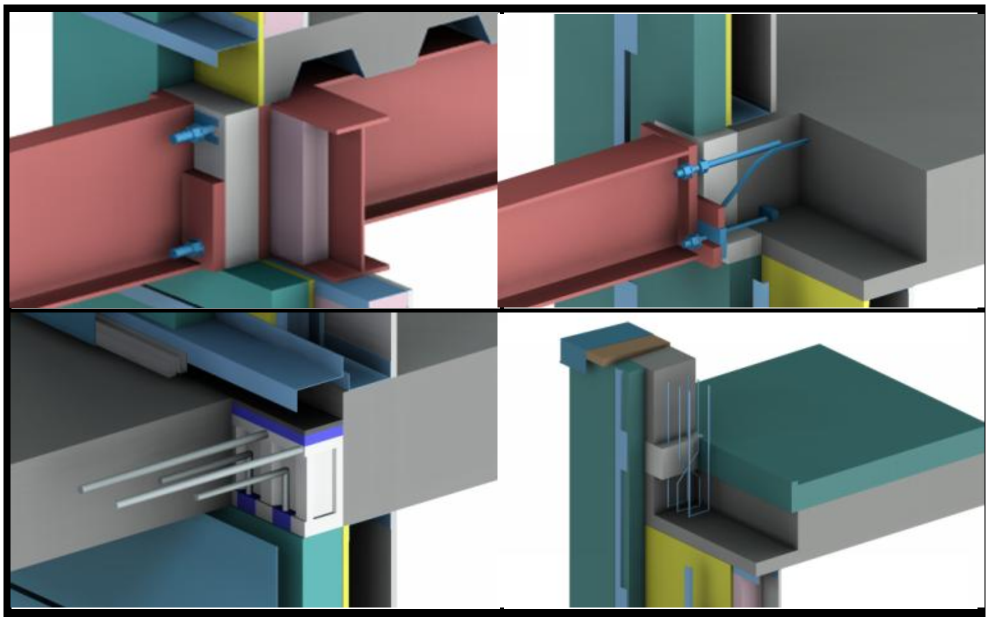
REPORT

# Thermal Break Technology for Various Construction Types



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# 1. INTRODUCTION

Morrison Hershfield Ltd. (MH) was retained by Schöck Bauteile GmbH (Shoeck) to evaluate the thermal performance of their thermal break technology for a variety of common details. This report summarizes the predicted thermal performance of 18 different scenarios for various types of construction.

For this report, 5 types of details were examined:

A. Steel stud assembly with a cantilevered concrete balcony

B. Steel stud assembly at a concrete parapet and roof deck

C. Structural steel beam penetration through a steel stud assembly

D. Concrete floor slab to structural steel beam connection

E. Interior insulated poured-in place concrete at wall to floor slab interface

Each of these detail groups consists of the conventional construction method alongside the comparative thermal break solution offered by Schöck. Several types of steel stud clear walls were used in the analysis of scenarios A-D and were exterior insulated, or split insulated (exterior and interior insulated) with horizontal or vertical clip cladding attachments. For the steel beam connection details C and D, additional thermal isolator pad solutions were also investigated alongside the Schöck solutions. Tables 1-5 summarize the assemblies modeled for this report. In the detail numbering, the suffixes denote the following:

**CC** – Conventional Construction

**TI** – Thermal Isolator Solution

**SA** – Schöck Assembly Solution

More information on each detail, including model dimensions, material properties and assembly images are shown in Appendix A. In addition, the thermal information in this report is also included in the *"Building Envelope Thermal Bridging Guide: Analysis, Applications and Insights"*[1], which contains methodology and a catalogue of details to assist designers in reducing thermal bridging in buildings. The Schöck details can be compared to a wider variety of similar types of construction details contained in the guide. Also included in the guide is a simple cost benefit analysis that includes construction costs and energy use/savings for a variety of design strategies, including scenarios utilizing Schöck products.

[1] Guide to be published in April, 2014

**Table 1:** Cantilevered Concrete Projections with Steel Stud Assemblies

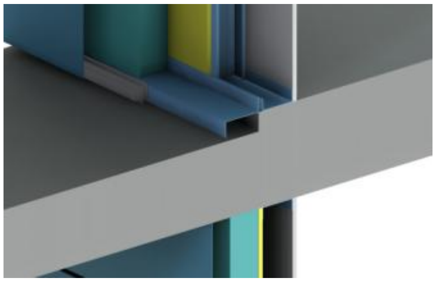
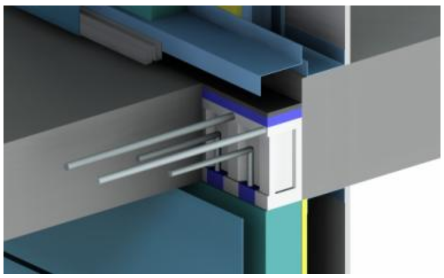
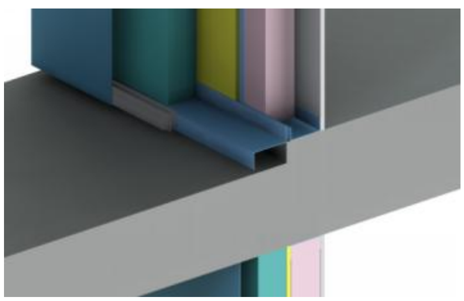
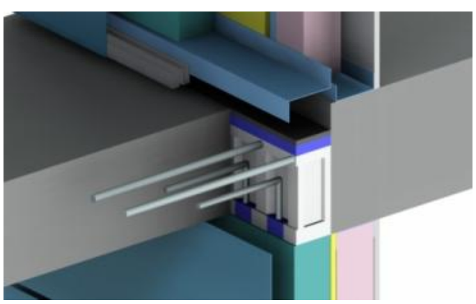
| Detail | | Wall Assembly | Additional Detail Description |
|---|---|---|---|
| Conventional Construction |  | R-15 Exterior Insulated Steel Stud Assembly | • **A01-CC:** Without insulation at curb, continuous concrete projection<br>• **A02-CC:** With insulation at curb, continuous concrete projection |
| Manufactured Thermal Break (Isokorb CM20) |  | R-15 Exterior Insulated Steel Stud Assembly | • **A03-SA**: Without insulation at curb, Isokorb CM20 thermal break at concrete projection<br>• **A04-SA**: With insulation at curb, Isokorb CM20 thermal break at concrete projection |
| Conventional Construction |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **A05-CC:** Without insulation at curb, continuous concrete projection<br>• **A06-CC:** With insulation at curb, continuous concrete projection |
| Manufactured Thermal Break (Isokorb CM20) |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **A07-SA**: Without insulation at curb, Isokorb CM20 thermal break at concrete projection<br>• **A08-SA**: With insulation at curb, Isokorb CM20 thermal break at concrete projection |

**Table 2:** Concrete Parapets with Concrete Roof Decks and Steel Stud Walls

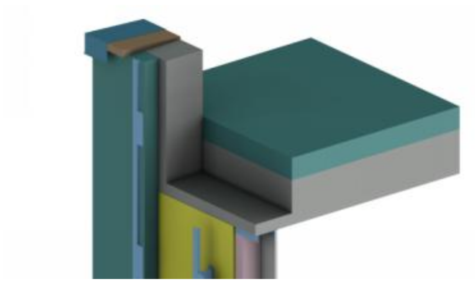
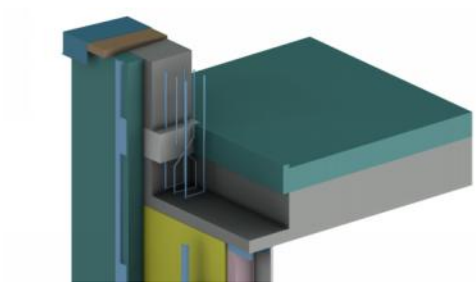
| Detail | | Wall Assembly | Detail |
|---|---|---|---|
| Conventional Construction |  | R-15/R-12 Split Insulated Steel Stud Assembly, R-20 Insulated Roof Deck | • **B01-CC**: Parapet insulated on exterior side only, continuous concrete parapet bypassing interior insulation |
| Manufactured Thermal Break (Isokorb AXT1) |  | R-15/R-12 Split Insulated Steel Stud Assembly, R-20 Insulated Roof Deck | • **B02-SA**: Parapet insulated on exterior side only, Isokorb AXT1 thermal break at roof insulation level |

**Table 3:** Structural Steel Beam Penetrations through Steel Stud Walls

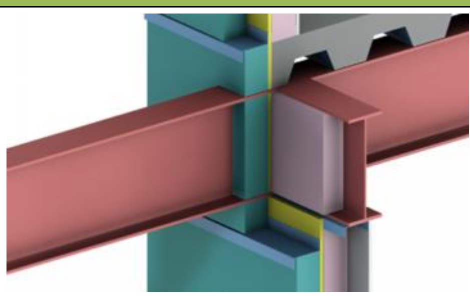
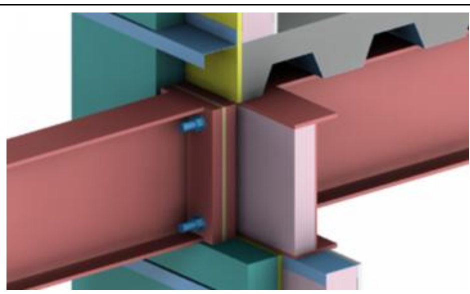
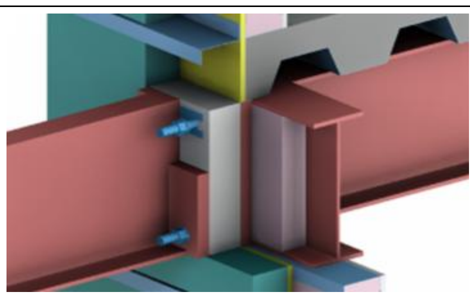
| Detail | | Wall Assembly | Additional Detail Description |
|---|---|---|---|
| Conventional Construction |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **C01-CC**: Uninterrupted steel beam |
| Thermal Isolator Pad |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **C02-TI**: Steel beams separated by:<br>o 5 mm pad, stainless steel bolts<br>o 5 mm pad, steel bolts<br>o 5 mm pad, stainless steel bolts, with R-10 Insulation outboard of flanges<br>o 10 mm pad, stainless steel bolts<br>o 10 mm pad, steel bolts |
| Manufactured Thermal Break (Isokorb S22) |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **C03-SA**: Steel Beam separated by Isokorb S22 thermal break |

**Table 4:** Structural Steel Beam Connections to Concrete Floor Slabs

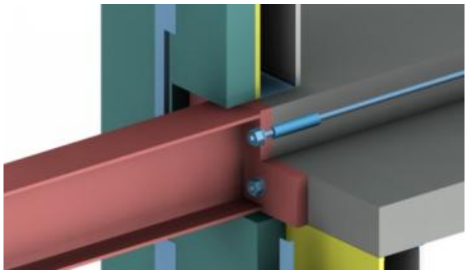
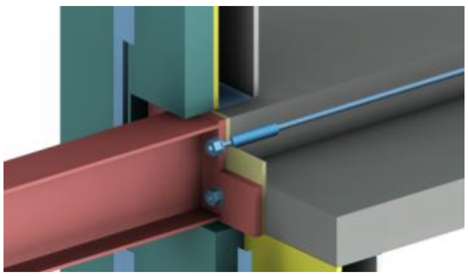
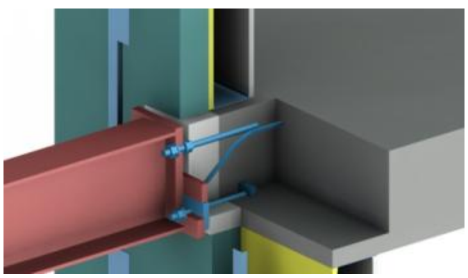
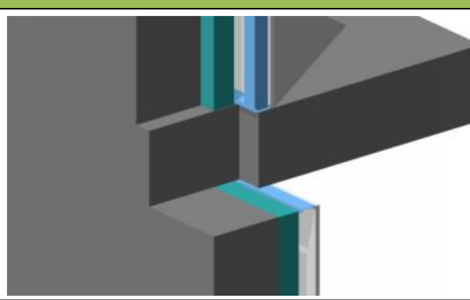
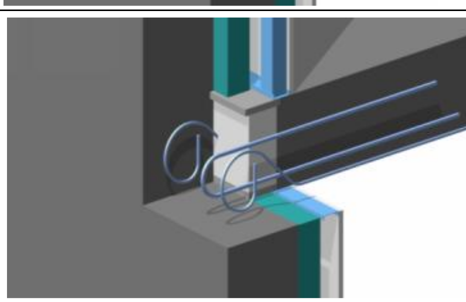
| Detail | | Wall Assembly | Detail |
|---|---|---|---|
| Conventional Construction |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **D01-CC**: Steel beam bypassing exterior insulation with direct connection to concrete |
| Thermal Isolator Pad |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **D02-TI**: Steel beam bypassing exterior insulation with 10 mm isolator pad at slab connection |
| Manufactured Thermal Break (Isokorb KS14) |  | R-15/R-12 Split Insulated Steel Stud Assembly | • **D03-SA**:Steel beam outboard of exterior insulation with Isokorb KS14 thermal break at slab connection, in line with exterior insulation |

**Table 5:** Interior Insulated Concrete Walls at the Floor Slab Interface

| Detail | | Wall Assembly | Detail |
|---|---|---|---|
| Conventional Construction |  | R-10 Interior Insulated Poured-in-Place Concrete | • **E01-CC**: Continuous concrete connection between wall and floor slab, bypassing insulation |
| Manufactured Thermal Break (Isokorb Rutherma DF) |  | R-10 Interior Insulated Poured-in-Place Concrete | • **E02-SA**: Concrete wall and floor slab connection with Isokorb Rutherma DF thermal break |

# 2. THERMAL ANALYSIS

Thermal analysis was completed using 3D heat transfer software from Siemens called Nx. The analysis utilized steady-state conditions, published thermal properties of materials, and information provided by Schöck for their product. The objectives of the thermal analysis were:

1. Determine thermal transmittance (U-value, linear transmittance and point transmittance) for all the scenarios listed in Tables 1-5.

2. Provide temperature indices for all scenarios at locations of interest for evaluating the risk of condensation.

For more information regarding the assumptions used for thermal modeling see Appendix B.

## 2.1 Thermal Transmittance

The thermal performance for each assembly was analyzed using the methodology put forth by ASHRAE 1365-RP[2]. Tables 6-11 show the thermal transmittance for each scenario. Each table contains the scenario reference, a brief description, the clear field U-value (thermal performance of the wall or roof away from the connection detail), the overall U-value of the modeled assembly, the linear or point transmittance of the connection detail and the percent reduction in heat loss. The percent reduction is based on the comparison between the linear or point transmittance of the detail and the conventional construction detail. More detailed results information for each scenario is given in Appendix B. R-value versions of the following Tables 6-11 are given in Appendix C.

### 2.1.1 Cantilevered Concrete

**Table 6:** Thermal Transmittance of Cantilevered Concrete Projections with Exterior Insulated Steel Stud Assemblies

| Scenario | | Description | Clear Wall U-value Btu/ft²·hr·°F (W/m²K) | Overall U-value Btu/ft²·hr·°F (W/m²K) | Ψ Btu/ft·hr·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | A01-CC | Without insulation at curb | 0.088 (0.50) | 0.148 (0.84) | 0.584 (1.011) | - |
| | A02-CC | With insulation at curb | 0.088 (0.50) | 0.138 (0.78) | 0.485 (0.840) | 17% |
| Manufactured Thermal Break (Isokorb CM20) | A03-SA | Without insulation at curb | 0.088 (0.50) | 0.115 (0.65) | 0.261 (0.452) | 55% |
| | A04-SA | With insulation at curb | 0.088 (0.50) | 0.100 (0.57) | 0.117 (0.203) | 80% |

2 Details of the model and calibration can be found in ASHRAE 1365-RP "Thermal Performance of Building Envelope Details for Mid- and High-Rise Construction", 2011

**Table 7:** Thermal Transmittance of Cantilevered Concrete Projections with Exterior and Interior Insulated Steel Stud Assemblies

| Scenario | | Description | Clear Wall U-value Btu/ft²·hr·°F (W/m²K) | Overall U-value Btu/ft²·hr·°F (W/m²K) | Ψ Btu/ft·hr·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | A05-CC | Without insulation at curb | 0.054 (0.31) | 0.116 (0.66) | 0.612 (1.059) | - |
| | A06-CC | With insulation at curb | 0.054 (0.31) | 0.108 (0.61) | 0.528 (0.914) | 14% |
| Manufactured Thermal Break (Isokorb CM20) | A07-SA | Without insulation at curb | 0.054 (0.31) | 0.087 (0.49) | 0.319 (0.551) | 48% |
| | A08-SA | With insulation at curb | 0.054 (0.31) | 0.073 (0.42) | 0.189 (0.327) | 69% |

### 2.1.2 Concrete Parapets

**Table 8:** Thermal transmittance of Concrete Parapets with Concrete Roof Decks and Steel Stud Walls

| Scenario | | Description | Clear Wall U-value Btu/ft²·hr·°F (W/m²K) | Clear Roof U-value Btu/ft²·hr·°F (W/m²K) | Overall U-value Btu/ft²·hr·°F (W/m²K) | Ψ Btu/ft·hr·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|---|
| Conventional Construction | B01-CC | Continuous concrete parapet bypassing interior wall and roof insulation | 0.053 (0.30) | 0.046 (0.26) | 0.104 (0.59) | 0.396 (0.686) | - |
| Manufactured Thermal Break (Isokorb AXT1) | B02- SA | Concrete parapet and roof separated by AXT1 Thermal Break | 0.053 (0.30) | 0.046 (0.26) | 0.058 (0.33) | 0.058 (0.100) | 87% |

### 2.1.3 Steel to Steel Connection

**Table 9:** Thermal transmittance of Structural Steel Beam Penetrations through Steel Stud Walls

| Scenario | | Description | Clear Wall U-value Btu/ft² ·hr ·°F (W/m²K) | Overall U-value Btu/ft² ·hr ·°F (W/m²K) | X Btu/hr ·°F (W/K) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | C01-CC | Uninterrupted steel beam | 0.054 (0.31) | 0.146 (0.83) | 1.73 (0.92) | - |
| Thermal Isolator Pad | C02-TI | 5 mm isolator pad, stainless steel bolts | 0.054 (0.31) | 0.167 (0.95) | 2.17 (1.15) | -26% |
| | | 5 mm isolator pad, steel bolts | 0.054 (0.31) | 0.170 (0.97) | 2.24 (1.19) | -30% |
| | | 5 mm pad, stainless steel bolts, R-10 outboard of flanges | 0.054 (0.31) | 0.156 (0.89) | 1.80 (1.03) | -12% |
| | | 10 mm isolator pad, stainless steel bolts | 0.054 (0.31) | 0.150 (0.85) | 1.82 (0.97) | -5% |
| | | 10 mm isolator pad, steel bolts | 0.054 (0.31) | 0.153 (0.87) | 1.89 (1.00) | -9% |
| | | 19 mm isolator pad, steel bolts | 0.054 (0.31) | 0.145 (0.82) | 1.71(0.91) | 1% |
| | | 25 mm isolator pad, steel bolts | 0.054 (0.31) | 0.140 (0.80) | 1.61(0.86) | 7% |
| Manufactured Thermal Break (Isokorb S22) | C03-SA | Steel beam separated by Isokorb S22 thermal break | 0.054 (0.31) | 0.107 (0.61) | 0.91 (0.48) | 48% |

### 2.1.4 Steel to Concrete Connection

**Table 10:** Thermal transmittance of Structural Steel Beam Connections to Concrete Floor Slabs

| Scenario | | Description | Clear Wall U-value Btu/ft² ·hr ·°F (W/m²K) | Overall U-value Btu/ft² ·hr ·°F (W/m²K) | X Btu/hr ·°F (W/K) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | D01-CC | Steel beam bypassing exterior insulation | 0.07 (0.41) | 0.137 (0.78) | 1.24 (0.66) | - |
| Thermal Isolator Pad | D02-TI | 10mm Isolator pad between steel beam and concrete | 0.07 (0.41) | 0.121 (0.69) | 0.91 (0.48) | 27% |
| Manufactured Thermal Break (Isokorb KS14) | D03-SA | Isokorb KS14 thermal break between steel beam and concrete | 0.07 (0.41) | 0.082 (0.47) | 0.07 (0.04) | 94% |

### 2.1.5 Poured-in Place Concrete Wall to Floor Slab

**Table 11:** Thermal transmittance of Interior Insulated Concrete Walls at the Floor Slab Interface

| Scenario | | Description | Clear Wall U-value Btu/ft² ·hr ·°F (W/m²K) | Overall U-value Btu/ft² ·hr ·°F (W/m²K) | Ψ Btu/ft ·hr ·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | E01-CC | Continuous concrete floor to wall connection, bypassing interior insulation | 0.082 (0.47) | 0.134 (0.76) | 0.447 (0.773) | - |
| Manufactured Thermal Break (Isokorb Rutherma DF) | E02-SA | Concrete wall and floor separated by Rutherma DF Thermal Break | 0.082 (0.47) | 0.103 (0.58) | 0.179 (0.310) | 60% |

## 2.2 Interior Slab Surface Temperatures

Temperature indices are noted for key locations for evaluating of the risk of condensation. The indices are in non-dimensionalized format between 0 and 1 (0 representing the exterior temperature, 1 representing the interior temperature) so they can be applicable to any temperature difference. Further information on the temperature indices are given in Appendix B. Along with the temperature indices, surface temperatures are given for the following design conditions, which are conditions representative of a cold climate:

- **Exterior temperature**: -18$^0$C
- **Interior Temperature**: 21$^0$C
- **Indoor Relative Humidity**: 35%
- **Indoor Dewpoint**: 5$^0$C

The lowest temperature indices for the concrete/beam surfaces exposed to interior air conditions were found for each scenario. Note that for fully exterior insulated assemblies, it was assumed that the vapour barrier is at the plane of the sheathing, while with the insulated stud cavities, the vapour barrier was assumed to be at the plane of the interior gypsum. The key location for evaluating the risk of condensation was assumed to be at the vapour barrier. Concrete/beam temperature indices and subsequent surface temperatures are given in Tables 12-17 for each scenario along with an indication if the assembly meets the representative cold climate design conditions for condensation resistance. Locations and other temperature indices are shown with each results data sheet in Appendix B. 2-D section temperature profiles for each scenario under the same example design conditions are given in Appendix D.

### 2.2.1 Cantilevered Concrete

**Table 12:** Coldest Temperature on the Concrete Floor at the Vapour Barrier for Cantilevered Concrete Projections with Exterior Insulated Steel Stud Assemblies

| Scenario | | Description | Coldest Interior Concrete Surface Temperature Index | Concrete Temperature at Example Design Conditions (-18°C Exterior & 21°C Interior) | Critical RH % at 21°C based on Concrete Temperature |
|---|---|---|---|---|---|
| Conventional Construction | A01-CC | Without insulation at curb | 0.45 | -1 | 23% |
| | A02-CC | With insulation at curb | 0.57 | 4 | 33% |
| Manufactured Thermal Break (Isokorb CM20) | A03-SA | Without insulation at curb | 0.60 | 5 | 36% |
| | A04-SA | With insulation at curb | 0.77 | 12 | 57% |

**Table 13:** Coldest Temperature on the Concrete Floor at the Vapour Barrier for Cantilevered Concrete Projections with Exterior and Interior Insulated Steel Stud Assemblies

| Scenario | | Description | Coldest Interior Concrete Surface Temperature Index | Concrete Temperature at Example Design Conditions (-18°C Exterior & 21°C Interior) | Critical RH % at 21°C based on Concrete Temperature |
|---|---|---|---|---|---|
| Conventional Construction | A05-CC | Without insulation at curb | 0.64 | 7 | 41% |
| | A06-CC | With insulation at curb | 0.70 | 9 | 47% |
| Manufactured Thermal Break (Isokorb CM20) | A07-SA | Without insulation at curb | 0.77 | 12 | 57% |
| | A08-SA | With insulation at curb | 0.85 | 15 | 69% |

### 2.2.2 Concrete Parapet

**Table 14:** Coldest Temperature on Concrete Ceiling for Concrete Parapets with Concrete Roof Decks and Steel Stud Walls

| Scenario | | Description | Coldest Interior Concrete Surface Temperature Index | Concrete Temperature at Example Design Conditions (-18°C Exterior & 21°C Interior) | Critical RH % at 21°C based on Concrete Temperature |
|---|---|---|---|---|---|
| Conventional Construction | B01-CC | Continuous concrete parapet bypassing interior and roof insulation | 0.69 | 9 | 47% |
| Manufactured Thermal Break (Isokorb AXT1) | B02- SA | Concrete parapet and roof separated by AXT1 Thermal Break | 0.90 | 17 | 79% |

### 2.2.3 Steel to Steel Connection

**Table 15:** Coldest Temperature on Steel Beam at Vapour Barrier for Structural Steel Beam Connections to Concrete Floor Slabs

| Scenario | | Description | Temperature Index | Beam Temperature at Example Design Conditions (-18°C Exterior & 21°C Interior) | Critical RH % at 21°C based on Beam Surface Temperature |
|---|---|---|---|---|---|
| Conventional Construction | C01-CC | Uninterrupted steel beam | 0.52 | 2 | 29% |
| Thermal Isolator Pad | C02-TI | 5 mm isolator pad, stainless steel bolts | 0.33 | -5 | 17% |
| | | 5 mm isolator pad, steel bolts | 0.32 | -5 | 17% |
| | | 5 mm pad, stainless steel bolts, R-10 outboard of flanges | 0.39 | -3 | 20% |
| | | 10 mm isolator pad, stainless steel bolts | 0.42 | -2 | 21% |
| | | 10 mm isolator pad, steel bolts | 0.41 | -2 | 21% |
| | | 19 mm isolator pad, steel bolts | 0.48 | 1 | 27% |
| | | 25 mm isolator pad, steel bolts | 0.51 | 2 | 29% |
| Manufactured Thermal Break (Isokorb S22) | C03-SA | Steel beam separated by Isokorb S22 thermal break | 0.79 | 13 | 61% |

### 2.2.4 Steel to Concrete Connection

**Table 16:** Coldest Temperature on the Concrete Floor for Structural Steel Beam Connections to Concrete Floor Slabs

| Scenario | | Description | Temperature Index | Concrete Temperature at Example Design Conditions (-18°C Exterior & 21°C Interior) | Critical RH % at 21°C based on Concrete Surface Temperature |
|---|---|---|---|---|---|
| Conventional Construction | D01-CC | Steel beam bypassing exterior insulation | 0.40 | -2 | 21% |
| Thermal Isolator Pad | D02-TI | 10mm Isolator pad between steel beam and concrete | 0.54 | 3 | 31% |
| Manufactured Thermal Break (Isokorb KS14) | D03-SA | Isokorb KS14 thermal break between steel beam and concrete | 0.84 | 15 | 70% |

### 2.2.1 Poured-in Place Concrete Wall to Floor Slab

**Table 17:** Coldest Temperature on the Concrete Floor at the Vapour Barrier for Interior Insulated Concrete Walls

| Scenario | | Description | Temperature Index | Concrete Temperature at Example Design Conditions (-18°C Exterior & 21°C Interior) | Critical RH % at 21°C based on Concrete Surface Temperature |
|---|---|---|---|---|---|
| Conventional Construction | E01-CC | Continuous concrete floor to wall connection, bypassing interior insulation | 0.57 | 4 | 33% |
| Manufactured Thermal Break (Rutherma DF) | E02-SA | Concrete wall and floor separated by Rutherma DF Thermal Break | 0.70 | 9 | 47% |

# 3. SUMMARY

The Schöck products evaluated in this study demonstrate effective solutions to minimize the impact of thermal bridging at common interface details.  The Schöck solutions provide significant improvements in reducing the thermal transmittance and risk of condensation compared to current common practice.

Continuous concrete slab projections have very high linear transmittances. The Schöck Isokorb CM20 can reduce that heat loss by a large amount, but by how much depends on the detailing. For the scenario without insulation at the curb, there is a gap in the insulation between the Isokorb system and the exterior insulation, and the linear transmittance is reduced by over 50%. When there is insulation at the curb, the linear transmittance is reduced by almost 80%. This highlights the importance of a holistic approach for reducing thermal bridging and how a small amount of insulation can make a difference if the large thermal bridges are dealt with using products like the Isokorb system.

The concrete parapets can also result in a large amount of heat loss, especially in low-rise buildings. With the Schöck AXT1 system, the heat loss is reduced by over 85% compared to common practice. Moreover, the AXT1 system is likely cheaper and more effective to use the AXTI system than wrapping the entire parapet in insulation.  The AXT1 system is more effective, and has lower linear transmittance than a fully insulated parapet tall parapet, because the geometric thermal bridge is eliminated with the AXT1 system.  A geometric thermal bridge for a fully insulated parapet is a result of heat flowing to the parapet and increased surface area exposed to the exterior.  A direct comparable parapet was not evaluated as part of this study but examples of fully insulated parapets are included in the Thermal Bridging Guide, which also includes construction cost comparisons.  The following graphics illustrate the difference between a parapet with AXT1 and a fully insulated parapet.  Note the clear wall assemblies are slightly different.

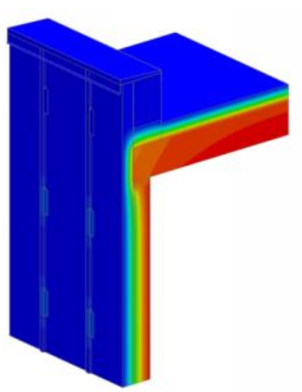


**Figure 1.** A parapet with the AXT1 system.  The roof insulation is carried to the exterior insulation at the same level via the AXT1 system. The parapet is cold (blue),indicating less heat flow and a more efficient system.

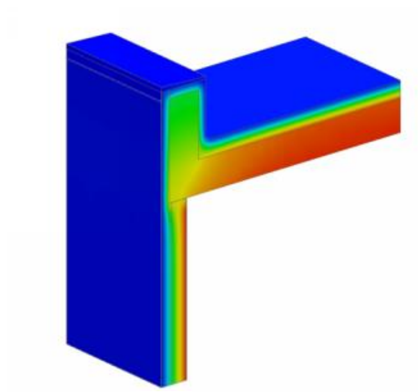


**Figure 2.** A parapet with the insulation wrapped around the parapet structure.  The parapet is warm (green), indicating more heat flow and a less efficient system.

Steel beams penetrating the envelope may be a concern with heat loss.  However, a greater concern is often the risk of condensation at cold surfaces. For the evaluated scenarios, the isolator pads did not provide an effective solution.  This is partially because of the assumed large flanges on the beams that are required to support cantilevered beams. This detail results in less insulation around the beam and increased conductive area (fin effect) at the connection. The other reason is that the isolator pads provide little thermal resistance to overcome the increased conductive area created by the flanges at the connection. The heat flow is reduced by almost 50% using the Isokorb S22 system for the same assumptions as the isolator pads. Moreover, the risk of condensation is minimized with the Isokorb S22 system. The Isokorb S22 system is effective because the thermal break is much thicker, provides effective thermal resistance, and aligns with the exterior insulation around it.

With the steel beam to concrete floor connection, the isolator pads reduce the heat flow by almost 30% compared to over 90% for the Isokorb KS14 system. The risk of condensation is also greatly reduced with the Isokorb KS14 system. In comparison the benefit of the isolator pads is marginal. It is also important to recognize that the thermally broken steel beams appear to offer significant reductions in heat flow for balcony applications than the thermally broken cantilevered concrete solution (Isokorb CM20).

The interior insulated concrete wall at the floor slab interface is a major source of heat loss, on par with continuous concrete balconies. With the Schöck Rutherma DF, the thermal transmittance is reduced by over 60% compared to common construction. Other options to minimize thermal bridging at the floor slabs is to insulate outboard of the concrete structure and/or utilize precast concrete assemblies that are insulated at the floor slab. In comparison, these options are a larger deviation from this common construction practice than for the Rutherma DF system. The Rutherma DF system is a solution that has the potential to integrate into interior insulated poured-in-place concrete construction and make the insulation effective, which is not current practice for this type of construction.

Finally, readers should recognize that the Schöck products in this report were evaluated strictly in terms of thermal performance. There are other considerations that designers need to consider alongside thermal performance, such as structural requirements. Schöck has technical manuals that have been developed for these purposes.

Yours truly,

Morrison Hershfield Limited

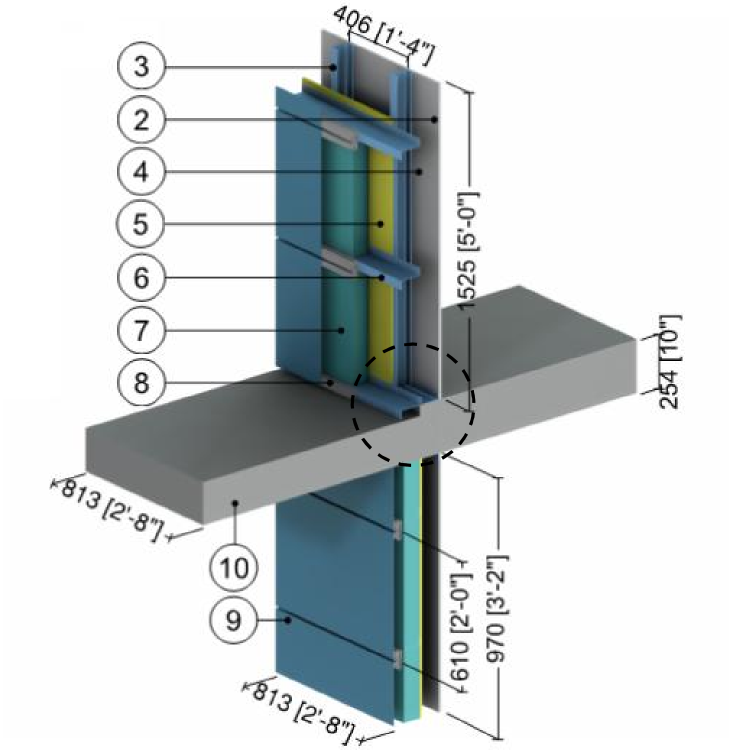
Neil Norris, M.A.Sc.
*Building Science Consultant*

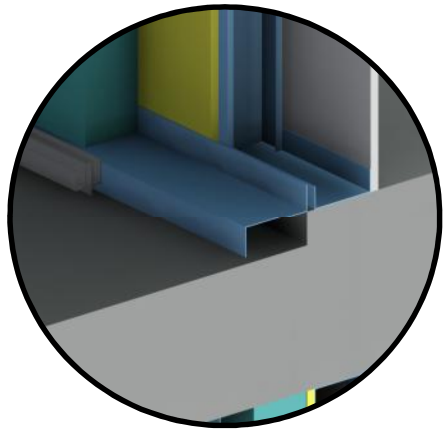
Patrick Roppel, P.Eng.
*Building Science Specialist*

# APPENDIX A: Material and Assembly Data Sheets

# Detail A01-CC

**Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Uninsulated Curb**



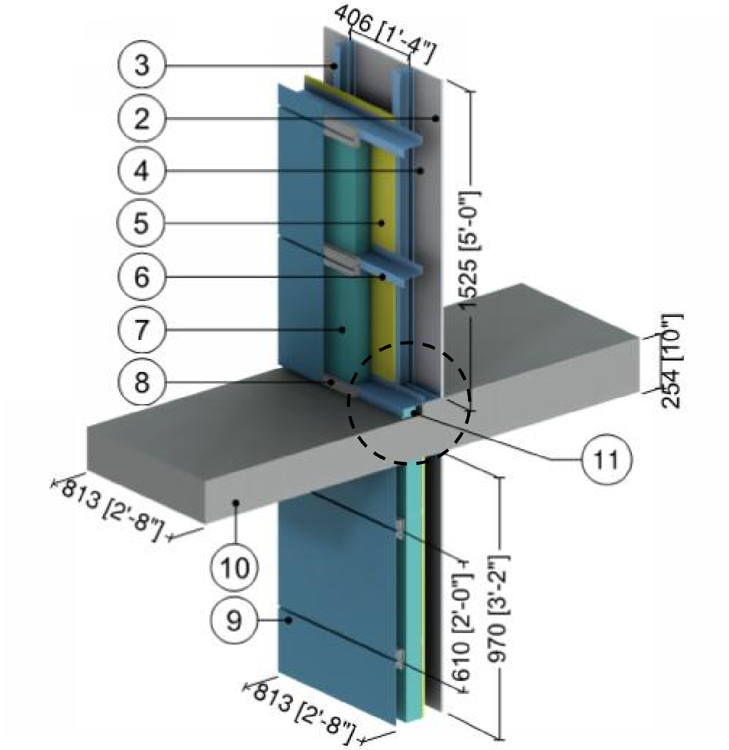
Balcony Stepdown Detail

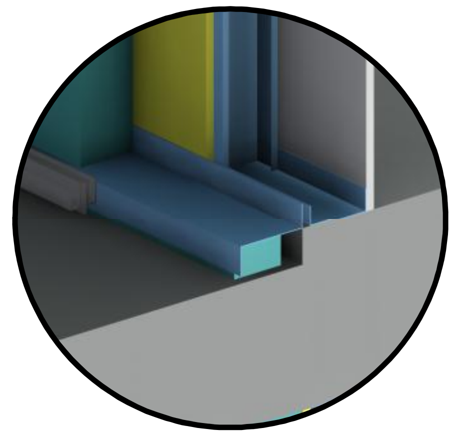
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8” (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-Girt with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Panel Clip | 14 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 9 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 10 | Concrete Slab | 8” (204) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 11 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A02-CC

## Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Insulated Curb



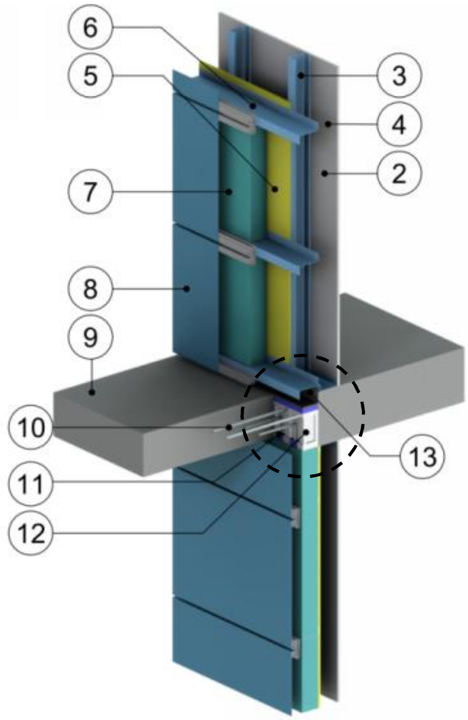
Balcony Stepdown Detail

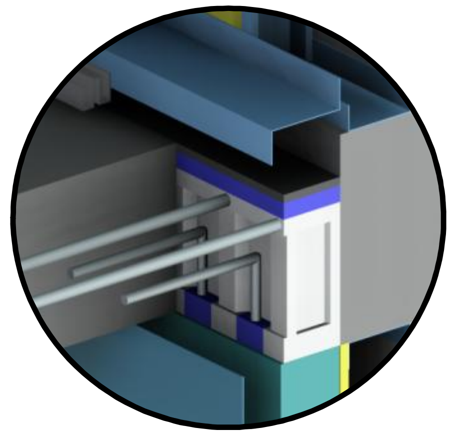
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / $ft^2 \cdot hr \cdot {}^oF$ (W/m K) | Nominal Resistance $hr \cdot ft^2 \cdot {}^oF/Btu$ ($m^2K/W$) | Density $lb/ft^3$ ($kg/m^3$) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8” (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-Girt with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Panel Clip | 14 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 9 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 10 | Concrete Slab | 8” (204) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 11 | Curb Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 12 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A03-SA

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Uninsulated Curb**



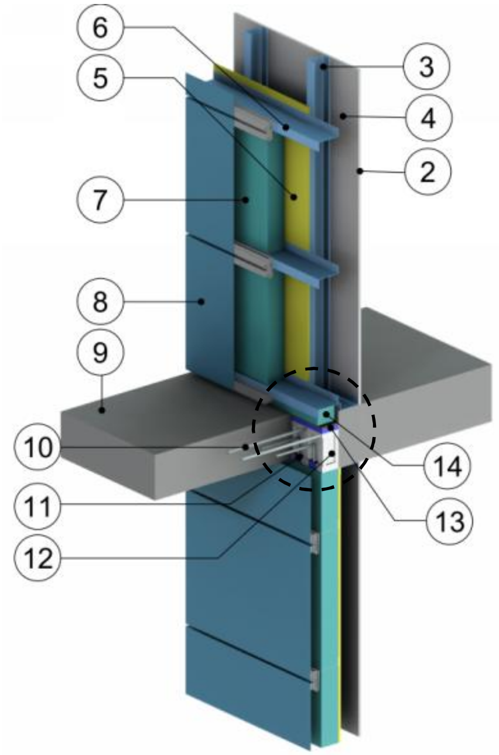
Thermally Broken Slab Detail
(Isokorb CM20)

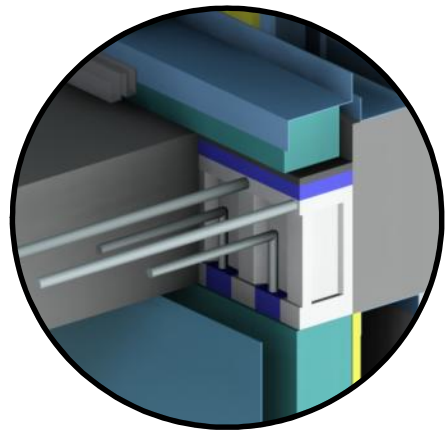
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Films (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8" x 1 5/8" Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8" (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts w/ 1 1/2" Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3" (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½" vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8" (203) | 12 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Stainless Steel Rebar | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 11 | HDPE Plastic Sleeve | - | 1.7 (0.25) | - | 59 (950) | 0.48 (2000) |
| | UHPC Concrete Mix | - | 5.5 (0.80) | - | 140 (2250) | 0.20 (850) |
| 12 | Polystyrene Hard Foam Insulation | 3" (76) | 0.217 (0.031) | R-14.7 (2.58 RSI) | 66 (1060) | 0.35 (1500) |
| 13 | Cement Board | 1/2" (13) | 1.7 (0.25) | - | 72 (1150) | 0.20 (850) |
| 14 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A04-SA

## Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Insulated Curb



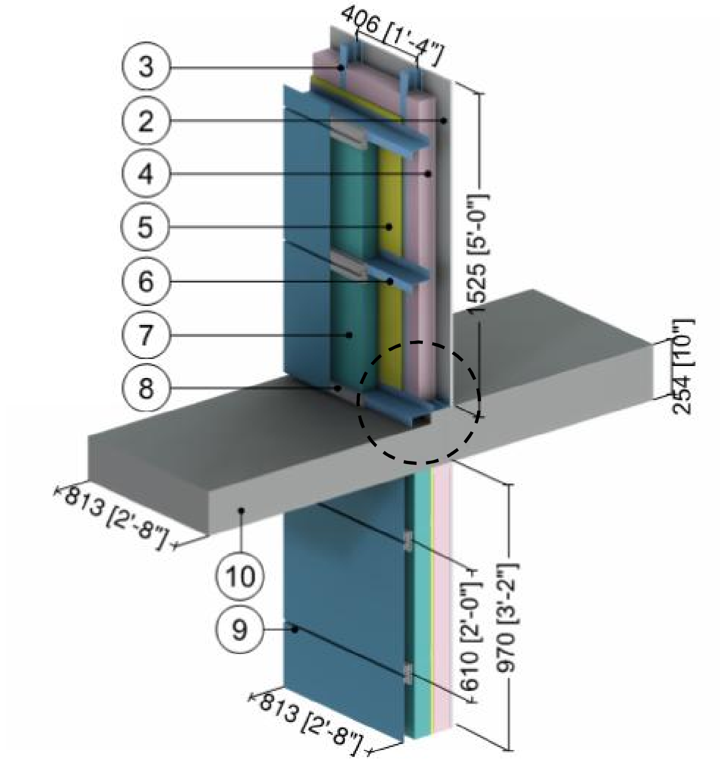
Thermally Broken Slab Detail
(Isokorb CM20)

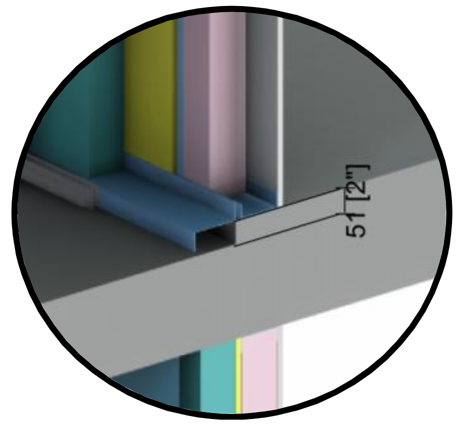
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Films (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8” (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts w/ 1 1/2" Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8” (203) | 12 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Stainless Steel Rebar | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 11 | HDPE Plastic Sleeve | - | 1.7 (0.25) | - | 59 (950) | 0.48 (2000) |
| | UHPC Concrete Mix | - | 5.5 (0.80) | - | 140 (2250) | 0.20 (850) |
| 12 | Polystyrene Hard Foam Insulation | 3 1/8” (80) | 0.217 (0.031) | R-14.7 (2.58 RSI) | 66 (1060) | 0.35 (1500) |
| 13 | Cement Board | 1/2” (13) | 1.7 (0.25) | - | 72 (1150) | 0.20 (850) |
| 14 | Curb Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 15 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A05-CC

**Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Uninsulated Curb**



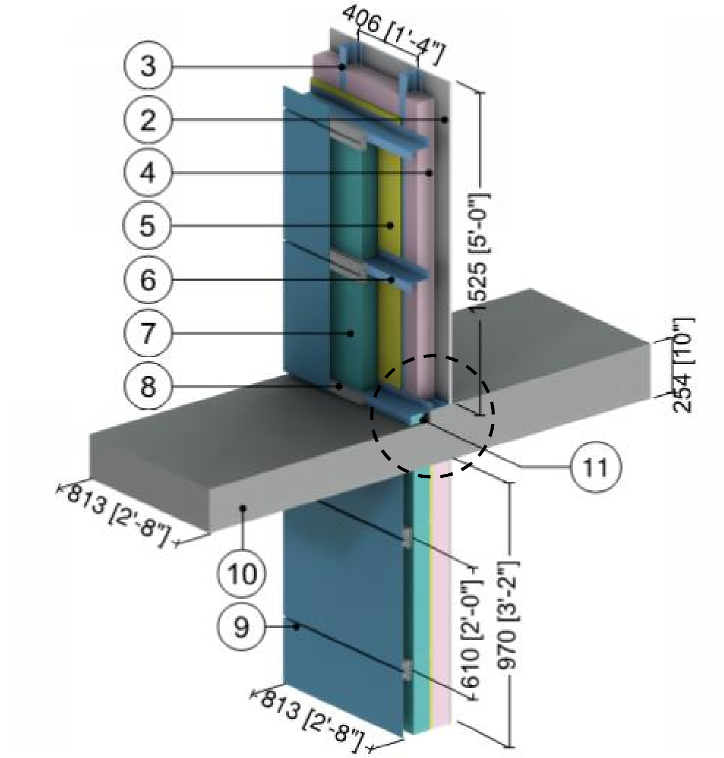

Balcony Stepdown Detail

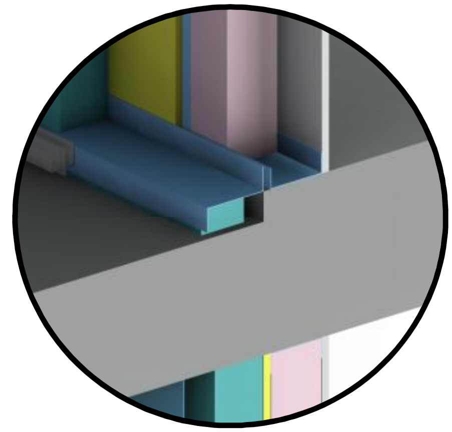
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fiberglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-Girt with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Panel Clip | 14 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 9 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 10 | Concrete Slab | 8” (204) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 11 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A06-CC

**Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Insulated Curb**



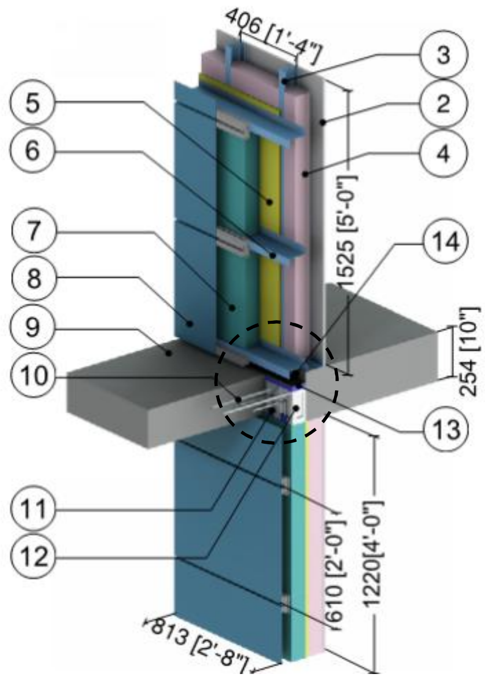
Balcony Stepdown Detail

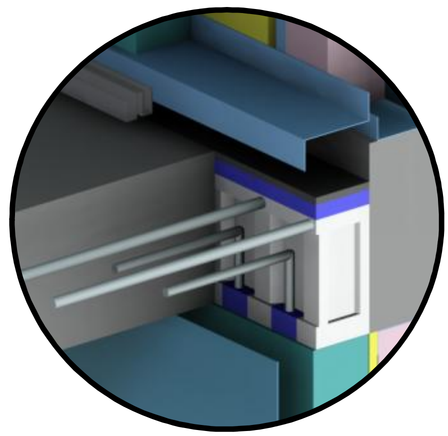
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fiberglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-Girt with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Panel Clip | 14 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 9 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 10 | Concrete Slab | 8” (204) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 11 | Curb Insulation | - | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 12 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A07-SA

## Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Uninsulated Curb



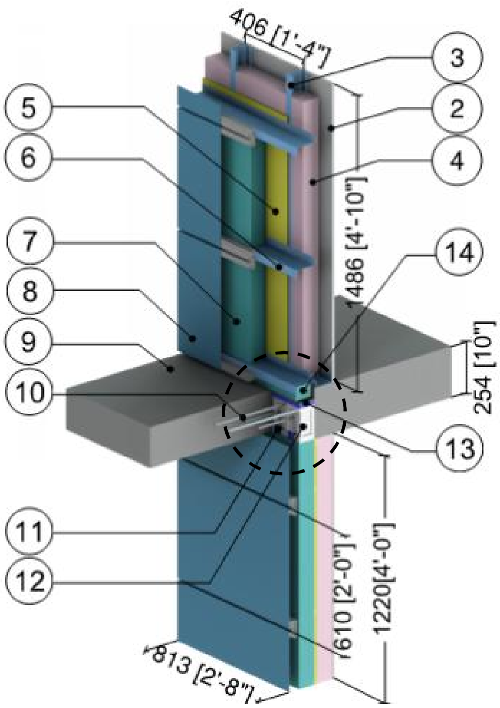
Thermally Broken Slab Detail
(Isokorb CM20)

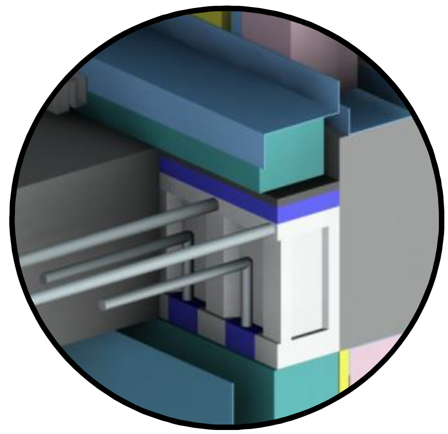
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Films (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fibreglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts w/ 1 1/2" Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8” (203) | 12 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Stainless Steel Rebar | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 11 | HDPE Plastic Sleeve | - | 1.7 (0.25) | - | 59 (950) | 0.48 (2000) |
| 11 | UHPC Concrete Mix | - | 5.5 (0.80) | - | 140 (2250) | 0.20 (850) |
| 12 | Polystyrene Hard Foam Insulation | 3 1/8” (80) | 0.2 (0.031) | R-14.7 (2.58 RSI) | 66 (1060) | 0.35 (1500) |
| 13 | Cement Board | 1/2” (13) | 1.7 (0.25) | - | 72 (1150) | 0.20 (850) |
| 14 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 A08-SA

## Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Insulated Curb



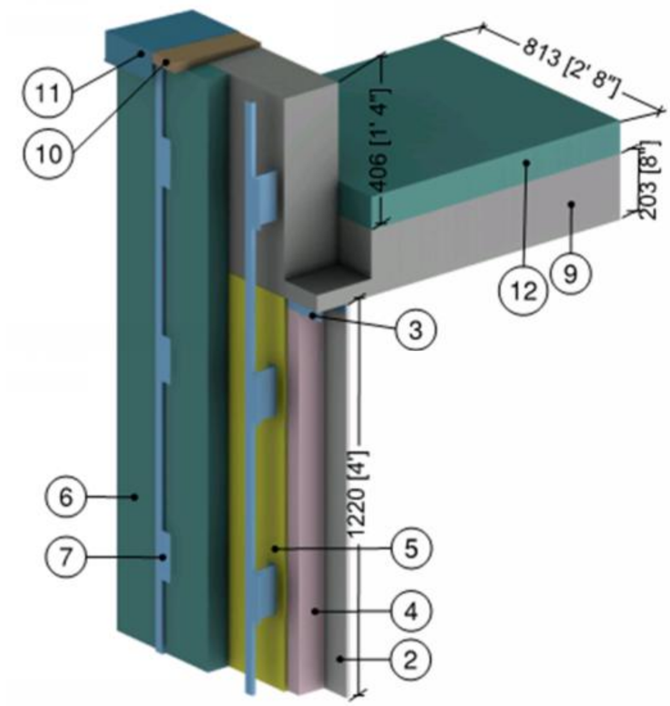
Thermally Broken Slab Detail
(Isokorb CM20)

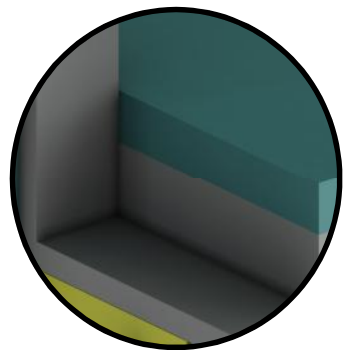
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Films (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fibreglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts w/ 1 1/2" Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8” (203) | 12 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Stainless Steel Rebar | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 11 | HDPE Plastic Sleeve | - | 1.7 (0.25) | - | 59 (950) | 0.48 (2000) |
| | UHPC Concrete Mix | - | 5.5 (0.80) | - | 140 (2250) | 0.20 (850) |
| 12 | Polystyrene Hard Foam Insulation | 3 1/8” (80) | 0.217 (0.031) | R-14.7 (2.58 RSI) | 66 (1060) | 0.35 (1500) |
| 13 | Cement Board | 1/2” (13) | 1.7 (0.25) | - | 72 (1150) | 0.20 (850) |
| 14 | Curb Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 15 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 B01-CC

## Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Intermittent Vertical Z Girts (16” o.c.) Supporting Metal Cladding –Concrete Roof Deck at Continuous Concrete Parapet



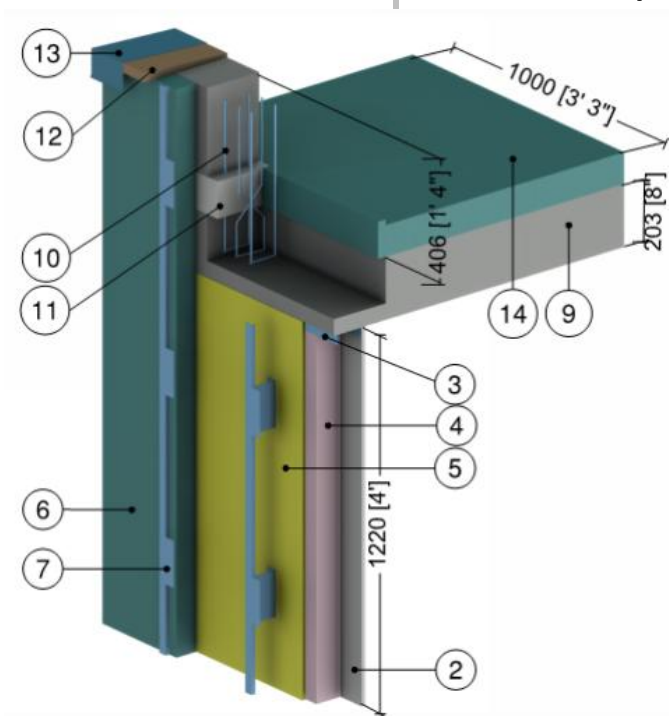
Continuous Concrete Parapet Detail

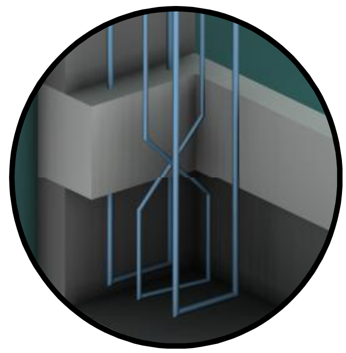
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft$^2$·hr·°F (W/m K) | Nominal Resistance hr·ft$^2$·°F/Btu (m$^2$K/W) | Density lb/ft$^3$ (kg/m$^3$) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.7 (0.12 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fiberglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2’” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 7 | Intermittent Vertical Z-Girts with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab and Parapet | 8” (203) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Wood Blocking | 5/8” (16) | 0.69 (0.10) | R-1.0 (0.18 RSI) | 31 (500) | 0.45 (1880) |
| 11 | Steel Cap Flashing | 18 Gauge | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 12 | Rigid Roof Insulation | 4 (102) | 0.20 (0.029) | R-20 (3.50 RSI) | 1.8 (28) | 0.29 (1220) |
| 13 | Flashing & roof finish material are incorporated into exterior heat transfer coefficient | | | | | |
| 14 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 B02-SA

## Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Intermittent Vertical Z Girts (16” o.c.) Supporting Metal Cladding –Concrete Roof Deck at Isokorb AXT1 Thermally Broken Concrete Parapet



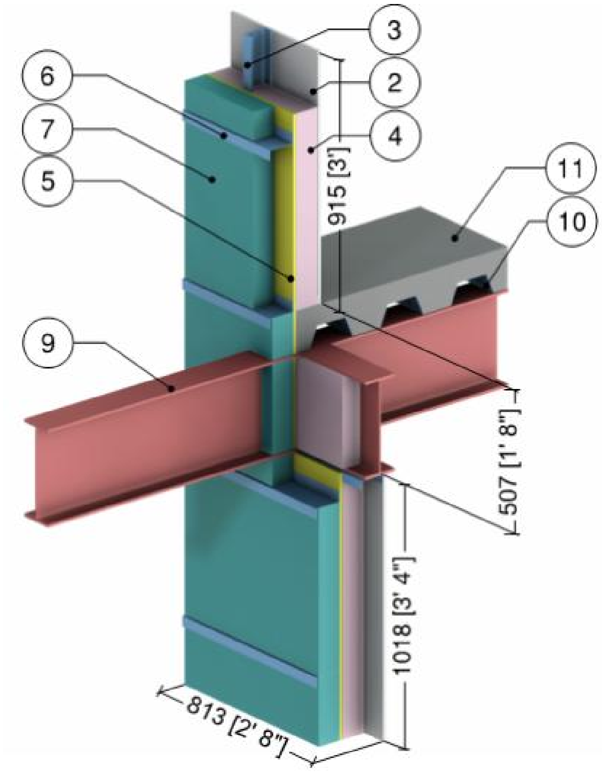
Thermally Broken Parapet Detail (Isokorb AXT1)

| 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 (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.7 (0.12 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fiberglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2’” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 7 | Intermittent Vertical Z-Girts with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab and Parapet | 8” (203) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Stainless Steel Rebar | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 11 | Polystyrene Hard Foam Insulation | 4 3/4” (120) | 0.217 (0.031) | R-22.0 (3.87 RSI) | 66 (1060) | 0.35 (1500) |
| 12 | Wood Blocking | 5/8” (16) | 0.69 (0.10) | R-1.0 (0.18 RSI) | 31 (500) | 0.45 (1880) |
| 13 | Steel Cap Flashing | 18 Gauge | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 14 | Rigid Roof Insulation | 4 (102) | 0.20 (0.029) | R-20 (3.50 RSI) | 1.8 (28) | 0.29 (1220) |
| 15 | Flashing & roof finish material are incorporated into exterior heat transfer coefficient | | | | | |
| 16 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 C01-CC

**Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Structural Steel Floor Intersection with Uninterrupted Beam**

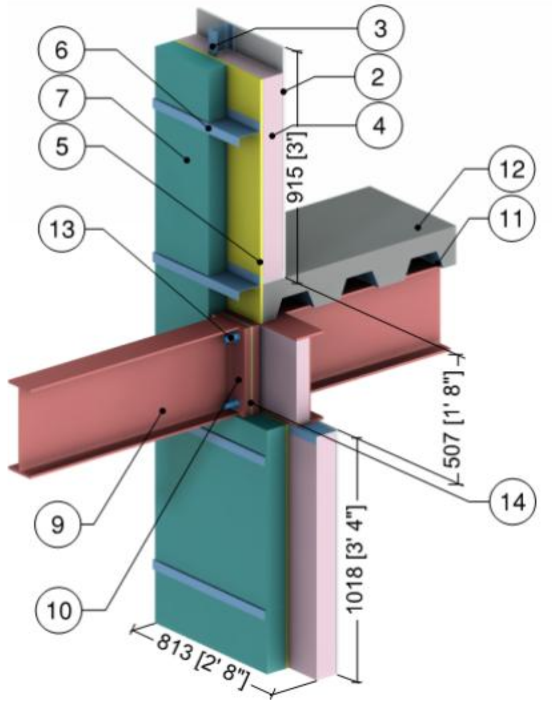



| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fibreglass Batt Insulation | 3 5/8” (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts with 1 ½” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Steel Through Beam W14x26 (W360x39) | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 10 | Steel Deck | 1/16” (1.6) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 11 | Concrete Topping | 6” (152) | 6.3 (0.9) | - | 120 (1920) | 0.20 (850) |
| 12 | Exterior Film (left side)[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 C02-TI

## Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Structural Steel Floor Intersection with Isolator Pad

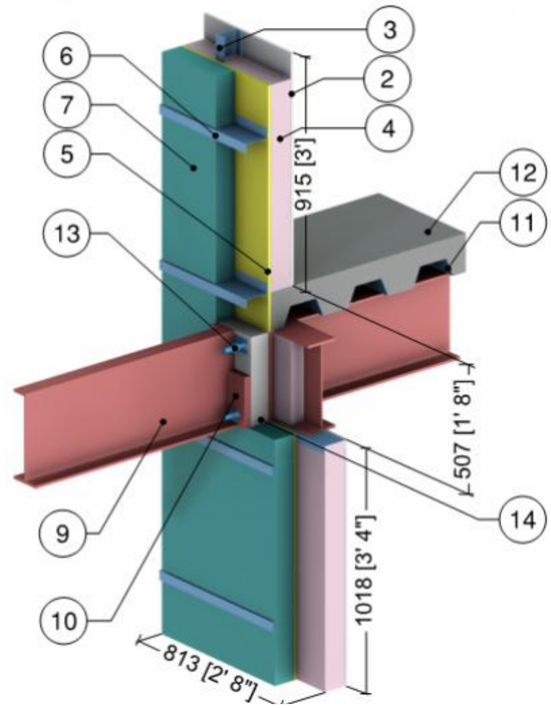



| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8" x 1 5/8" Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fibreglass Batt Insulation | 3 5/8" (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts with 1 ½" Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3" (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½" vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Steel Beam W14x26 (W360x39) | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 10 | Steel Bearing Plates | 1 3/16" (30) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 11 | Steel Deck | 1/16" (1.6) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 12 | Concrete Topping | 6" (152) | 6.3 (0.9) | - | 120 (1920) | 0.20 (850) |
| 13 | Steel or Stainless Steel Bolts | - | 347 (50) to 118 (17) | - | 500 (8000) | 0.12 (500) |
| 14 | Polymer Thermal Isolator Pad | 3/16"(5) to 1" (25) | 1.7 (0.25) | R0.1 (0.02 RSI) to R-0.6 (0.10 RSI) | 137 (2200) | 0.31 (1300) |
| 15 | Exterior Film (left side)[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 C03-SA

## Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Structural Steel Floor Intersection with Isokorb S22 Thermally Broken Beam

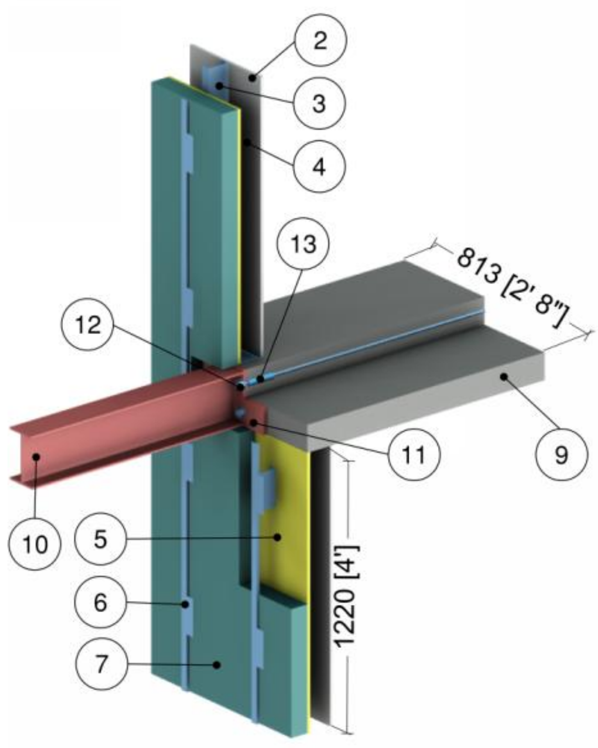



| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8" x 1 5/8" Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Fibreglass Batt Insulation | 3 5/8" (92) | 0.29 (0.044) | R-12.0 (2.11 RSI) | 0.9 (14) | 0.17 (710) |
| 5 | Exterior Sheathing | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Horizontal Z-girts with 1 ½" Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3" (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½" vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Steel Beam W14x26 (W360x39) | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 10 | Steel Bearing Plates | 1 3/16" (30) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 11 | Steel Deck | 1/16" (1.6) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 12 | Concrete Topping | 6" (152) | 6.3 (0.9) | - | 120 (1920) | 0.20 (850) |
| Isokorb S22 Thermal Break | | | | | | |
| 13 | Stainless Steel Bolts, Plates and HSS | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 14 | Polystyrene Hard Foam Insulation | 3 1/8" (80) | 0.217 (0.031) | R-14.5 (2.6 RSI) | 66 (1060) | 0.35 (1500) |
| 15 | Exterior Film (left side)[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 D01-CC

**Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Intermittent Vertical Z-girts (16” o.c.) Supporting Metal Cladding – Concrete Floor to Steel Beam Connection**

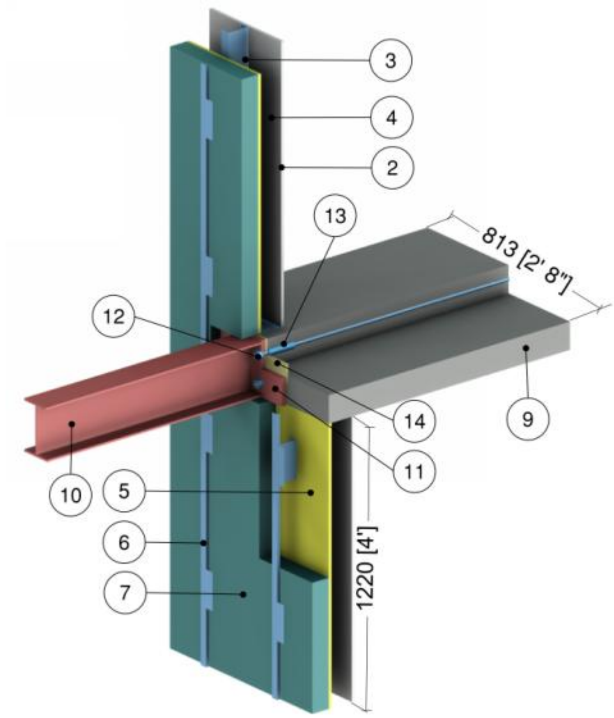



| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8” (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Intermittent Vertical Z-Girts with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8 5/8” (220) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Steel Beam W8x18 (W200x27) | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 11 | Steel Bearing Plates | 3/4” (20) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 12 | Steel Bolts and Rebar | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 13 | Stainless Steel Anchors | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 14 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 D02-TI

## Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Intermittent Vertical Z-girts (16” o.c.) Supporting Metal Cladding – Concrete Floor to Steel Beam with a Thermal Isolator Pad Connection




| 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 (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8” (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Intermittent Vertical Z-Girts with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8 5/8” (220) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Steel Beam W8x18 (W200x27) | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 11 | Steel Bearing Plates | 3/4” (20) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 12 | Steel Bolts and Rebar | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 13 | Stainless Steel Anchors | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 14 | Polymer Thermal Isolator Pad | 3/8” (10) | 1.7 (0.25) | R-0.23 (0.04 RSI) | 137 (2200) | 0.31 (1300) |
| 15 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to R-0.7 (0.12 RSI) | - | - |

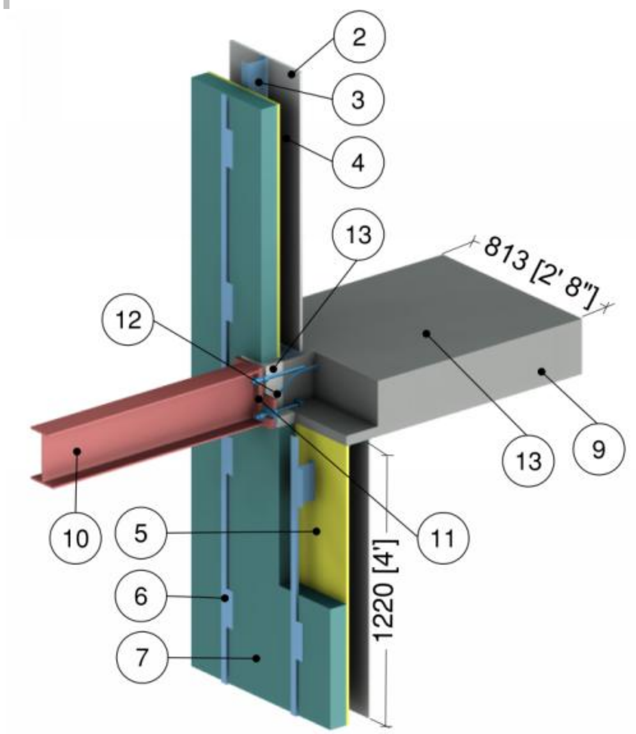
[1] Value selected from table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundamentals depending on surface orientation



Schöck Innovative Building Solutions

# Detail D03-SA

## Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Intermittent Vertical Z-girts (16” o.c.) Supporting Metal Cladding – Concrete Floor to Steel Beam with Isokorb Ks14 Connection

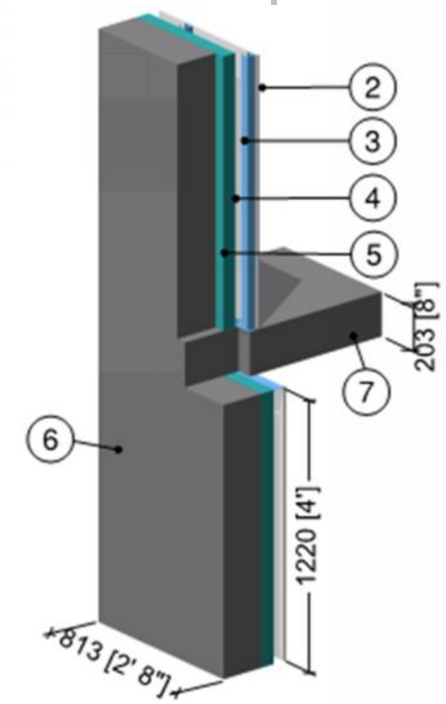


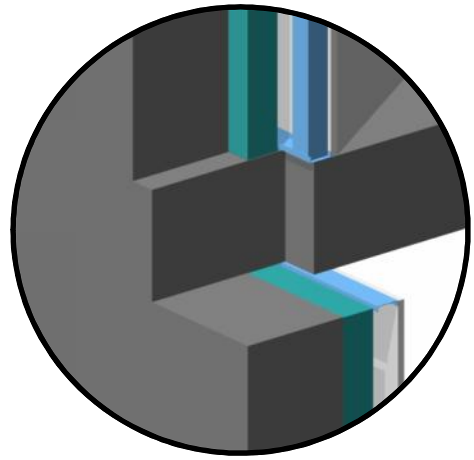

| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 3 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air Cavity | 3 5/8” (92) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Exterior Sheathing | 1/2” (13) | 1.1 (0.16) | R-0.5 (0.09 RSI) | 50 (800) | 0.26 (1090) |
| 6 | Intermittent Vertical Z-Girts with 1 1/2” Flange | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 7 | Exterior Insulation | 3” (76) | - | R-15 (2.64 RSI) | 1.8 (28) | 0.29 (1220) |
| 8 | Metal Cladding with ½” vented airspace incorporated into exterior heat transfer coefficient | | | | | |
| 9 | Concrete Slab | 8 5/8” (220) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 10 | Steel Beam W8x18 (W200x27) | - | 347 (50) | - | 489 (7830) | 0.12 (500) |
| 11 | Steel Bearing Plate with Butt Stop | 3/4” (20) | 347 (50) | - | 489 (7830) | 0.12 (500) |
| Isokorb KS14 Thermal Break | | | | | | |
| 12 | Stainless Steel Reinforcement | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 13 | Polystyrene Hard Foam Insulation | 3 1/8” (80) | 0.217 (0.031) | R-14.5 (2.6 RSI) | 66 (1060) | 0.35 (1500) |
| 14 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) to 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 E01-CC

## Interior Insulated Concrete Mass Wall with 1 5/8” Steel Studs (16” o.c.) Supporting Interior Finish – Continuous Concrete Floor Slab Intersection



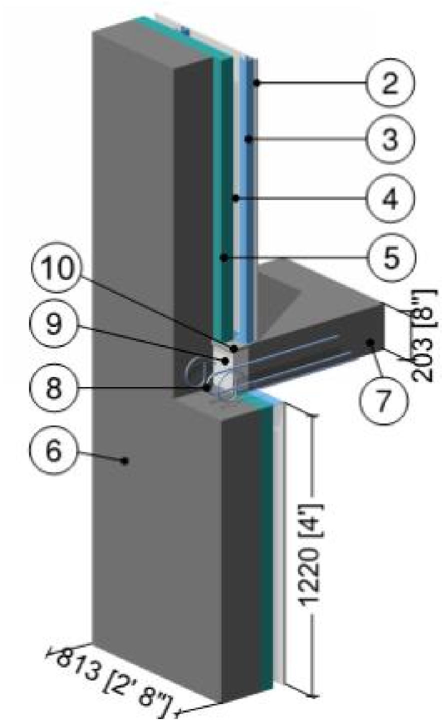
Continuous Concrete Slab Detail

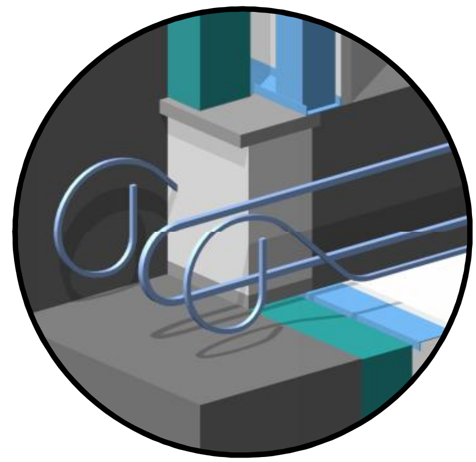
| ID | Component | Thickness Inches (mm) | Conductivity Btu·in / ft²·hr·°F (W/m K) | Nominal Resistance hr·ft²·°F/Btu (m²K/W) | Density lb/ft³ (kg/m³) | Specific Heat Btu/lb·°F (J/kg K) |
|---|---|---|---|---|---|---|
| 1 | Interior Film (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 1 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air in Stud Cavity | 1 5/8” (41) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Continuous Insulation | 2 1/2" (64) | - | R-10.0 (1.76 RSI) | 1.8 (28) | 0.29 (1220) |
| 6 | Concrete Wall | 8” (203) | 12.5 (1.8) | R-0.64 (0.11 RSI) | 140 (2250) | 0.20 (850) |
| 7 | Concrete Slab | 8” (203) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 8 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) | - | - |

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

# Detail E02-SA

## Interior Insulated Concrete Mass Wall with 1 5/8” Steel Studs (16” o.c.) Supporting Interior Finish – Isokorb Rutherma DF Thermally Broken Concrete Floor Slab Intersection



Thermally Broken Slab Detail
(Rutherma DF)

| 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 (right side)[1] | - | - | R-0.6 (0.11 RSI) to R-0.9 (0.16 RSI) | - | - |
| 2 | Gypsum Board | 1/2" (13) | 1.1 (0.16) | R-0.5 (0.08 RSI) | 50 (800) | 0.26 (1090) |
| 3 | 1 5/8” x 1 5/8” Steel Studs with Top and Bottom Tracks | 18 Gauge | 430 (62) | - | 489 (7830) | 0.12 (500) |
| 4 | Air in Stud Cavity | 1 5/8” (41) | - | R-0.9 (0.16 RSI) | 0.075 (1.2) | 0.24 (1000) |
| 5 | Continuous Insulation | 2 1/2" (64) | - | R-10.0 (1.76 RSI) | 1.8 (28) | 0.29 (1220) |
| 6 | Concrete Wall | 8” (203) | 12.5 (1.8) | R-0.64 (0.11 RSI) | 140 (2250) | 0.20 (850) |
| 7 | Concrete Slab | 8” (203) | 12.5 (1.8) | - | 140 (2250) | 0.20 (850) |
| 8 | Stainless Steel Reinforcement | - | 118 (17) | - | 500 (8000) | 0.12 (500) |
| 9 | Polystyrene Hard Foam Insulation | 2 3/8” (60) | 0.217 (0.031) | R-10.9 (1.93 RSI) | 66 (1060) | 0.35 (1500) |
| 10 | Cement Board | 1/2” (13) | 1.7 (0.25) | - | 72 (1150) | 0.20 (850) |
| 11 | Exterior Film (left side)[1] | - | - | R-0.2 (0.03 RSI) | - | - |

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

## APPENDIX B: Thermal Results Data Sheets

## *General Modeling Approach*

For this report, a steady-state conduction model was used. Air cavities were assumed to have an effective thermal conductivity which includes the effects of cavity convection. Interior/exterior air films were taken from Table 1, p. 26.1 of 2009 ASHRAE Handbook – Fundaments depending on surface orientation. From the calibration in 1365-RP, contact resistances between materials were modeled. The temperature difference between interior and exterior was modeled as a dimensionless temperature index between 0. These values, along with other modeling parameters, are given in ASHRAE 1365-RP, Chapter 5.

## *Thermal Transmittance*

The methodology presented in ASHRAE 1365-RP separates the thermal performance of assemblies and details in order to simplify heat loss calculations. For the assemblies, a characteristic area is modeled and the heat flow through that area is found. To find the effects of thermal bridges in details (such as slab edges), the assembly is modeled with and without the detail. The difference in heat loss between the two models is then prescribed to that detail. This allows the thermal transmittances to be divided into three categories: clear field, linear and point transmittances.

The clear field transmittance is the heat flow from the wall or roof assembly, including uniformly distributed thermal bridges that are not practical to account for on an individual basis, such as structural framing, brick ties and cladding supports. This is treated the same as in standard practice, defined as a U-value, Uo (heat flow per area). For a specific area of opaque wall, this can be converted into an overall heat flow per temperature difference, Qo.

The linear transmittance is the additional heat flow caused by details that can be defined by a characteristic length, L. This includes slab edges, corners, parapets, and transitions between assemblies. The linear transmittance is a heat flow per length, and is represented by psi (Ψ).

The point transmittance is the heat flow caused by thermal bridges that occur only at single, infrequent locations. This includes building components such as pipe penetrations and intersections between linear details. The point transmittance is a single additive amount of heat, represented by chi (χ).

With these thermal quantities the overall heat flow can be found simple by adding all the components together, as given in equation 1.

$$Q = \Sigma\, Q_{thermalbridge} + Q_o = \Sigma\,(\Psi \cdot L) + \Sigma\,(\chi) + Q_o \qquad \text{EQ 1}$$

Equation 1 gives the overall heat flow for a given building size. For energy modeling, or comparisons to standards and codes, often it is more useful to present equation 1 as a heat flow per area. Knowing that the opaque wall area is $A_{total}$, and U=Q/At$_{otal}$, equation 2 can be derived.

$$U = \frac{\Sigma\,(\Psi \cdot L) + \Sigma\,(\chi)}{A_{Total}} + U_o \qquad \text{EQ 2}$$

Since the linear and point transmittances are simply added amounts of heat flow, they can be individually included or excluded depending on design requirements.

## *Temperature Index*

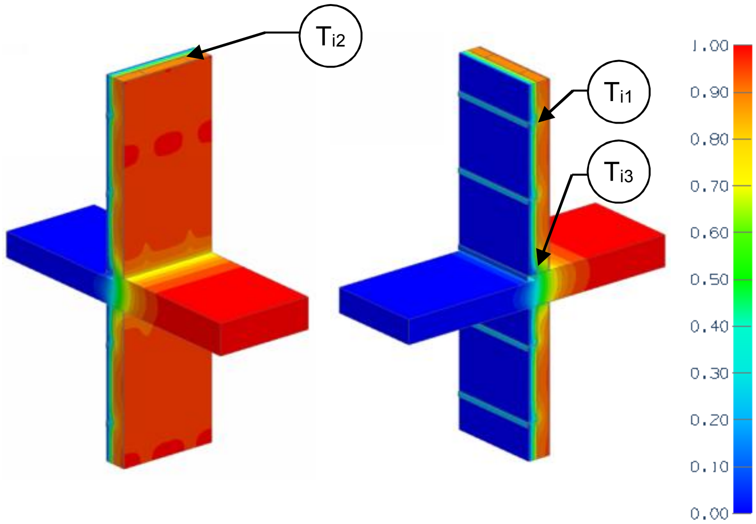
For condensation concerns, the thermal model can also provide surface temperatures of assembly components to help locate potential areas of risk. In order to be applicable for any climate (varying indoor and outdoor temperatures), the temperatures can been non-dimensionalized into a temperature index, $T_i$, as shown below in Equation 3.

$$T_i = \frac{T_{surface} - T_{outside}}{T_{inside} - T_{outside}} \qquad \text{EQ 3}$$

The 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 3 can be rearranged for $T_{surface}$. These temperatures are given at steady state conductive heat flow with constant heat transfer coefficients. These are meant to give guidance in terms of potential areas of concern from condensation. Limitations of these values are discussed in ASHRAE 1365-RP.

# Detail A01-CC

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Uninsulated Curb**




View from Interior        View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP

## Nominal (1D) vs. Assembly Performance Indicators

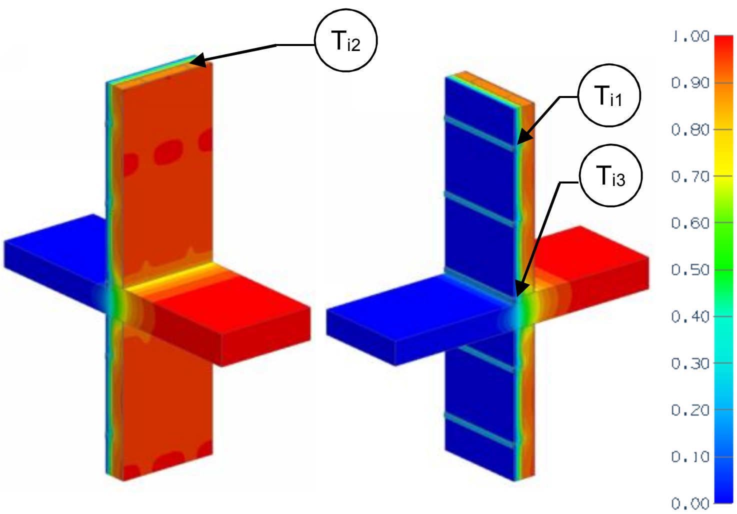
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-11.3 (1.99) | 0.088 (0.50) | R-6.8 (1.19) | 0.148 (0.84) | 0.584 (1.011) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.71 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.86 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.45 | Min T on slab exposed to interior air, at sheathing between studs |

# Detail A02-CC

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Insulated Curb**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

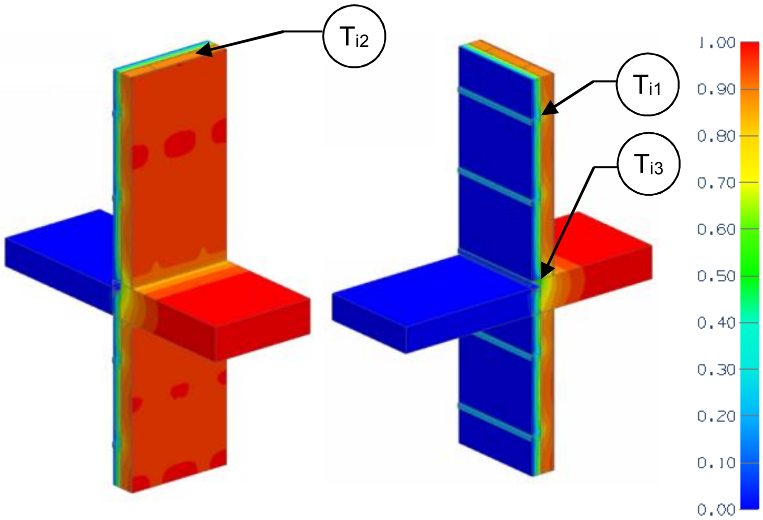
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-11.3 (1.99) | 0.088 (0.50) | R-7.3 (1.28) | 0.138 (0.78) | 0.485 (0.840) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.71 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.86 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.57 | Min T on slab exposed to interior air, at sheathing between studs |

# Detail A03-SA

**Exterior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Uninsulated Curb**




View from Interior　　View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | “clear wall” U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

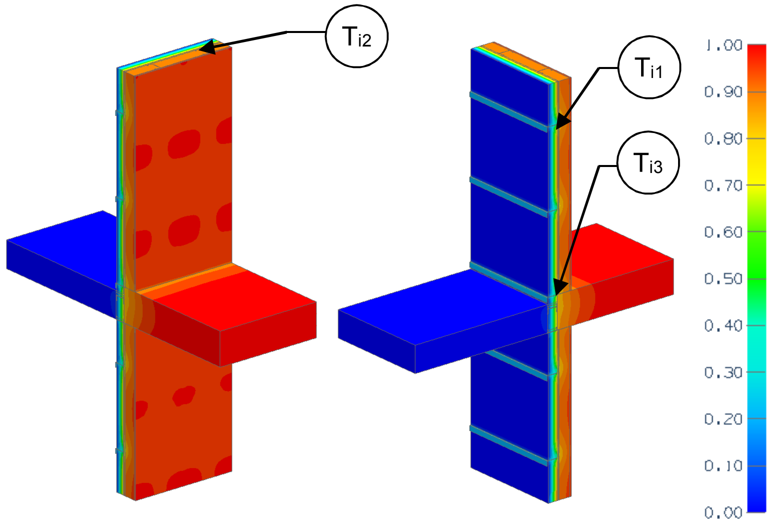
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-11.3 (1.99) | 0.088 (0.50) | R-8.7 (1.53) | 0.115 (0.65) | 0.261 (0.452) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.71 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.86 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.60 | Min T on slab exposed to interior air, at sheathing between studs |

# Detail A04-SA

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Insulated Curb**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

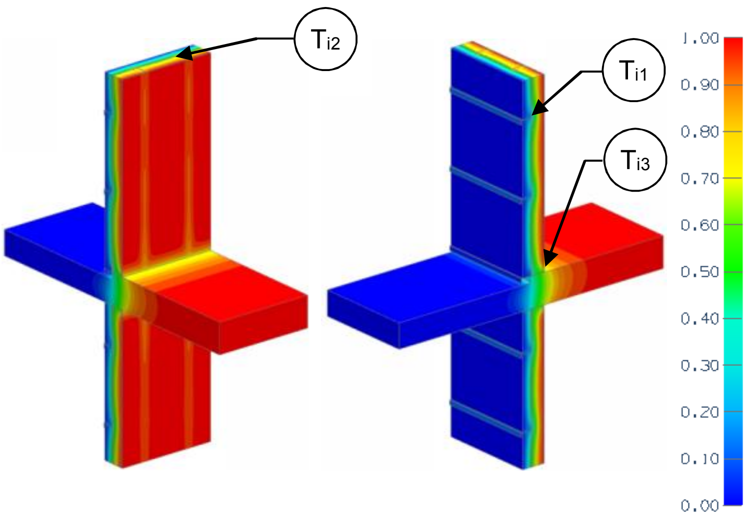
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-11.3 (1.99) | 0.088 (0.50) | R-10.0 (1.76) | 0.100 (0.57) | 0.117 (0.203) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.71 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.86 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.77 | Min T on slab exposed to interior air, at sheathing between studs |

# Detail A05-CC

## Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Un-insulated concrete slab intersection




View from Interior  View from Exterior

### Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance | $U_o$, $R_o$ | "clear wall" U- and R-value, without slab |
| Transmittance / Resistance | U, R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

### Nominal (1D) vs. Assembly Performance Indicators

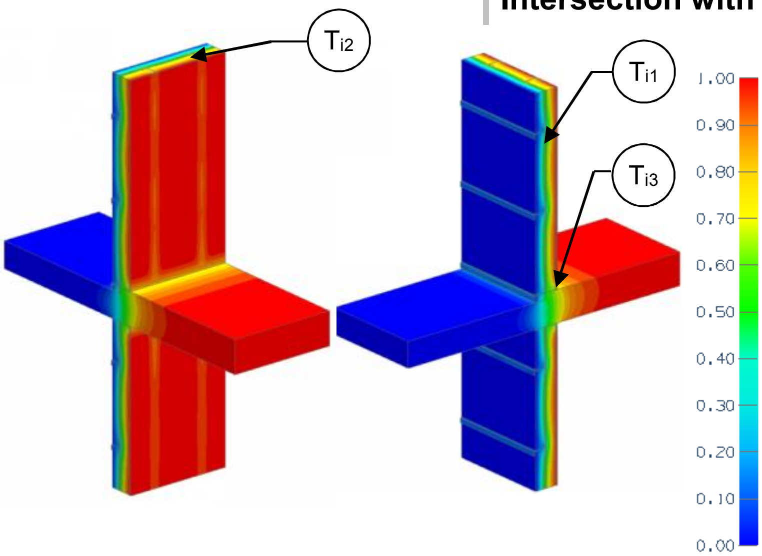
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft ·hr·°F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) | R-8.6 (1.51) | 0.116 (0.66) | 0.612 (1.059) |

### Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.35 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.73 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.64 | Min T on slab exposed to interior air, at gypsum between studs |

# Detail A06-CC

**Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Uninsulated Concrete Slab Intersection with Insulated Curb**




View from Interior　　View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

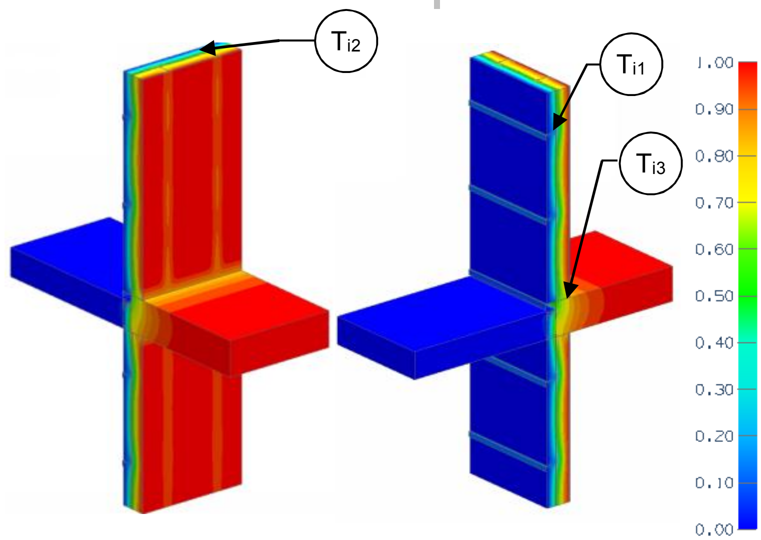
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) | R-9.3 (1.63) | 0.108 (0.61) | 0.528 (0.914) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.35 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.73 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.70 | Min T on slab exposed to interior air, at gypsum between studs |

# Detail A07-SA

**Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Uninsulated Curb**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | “clear wall” U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

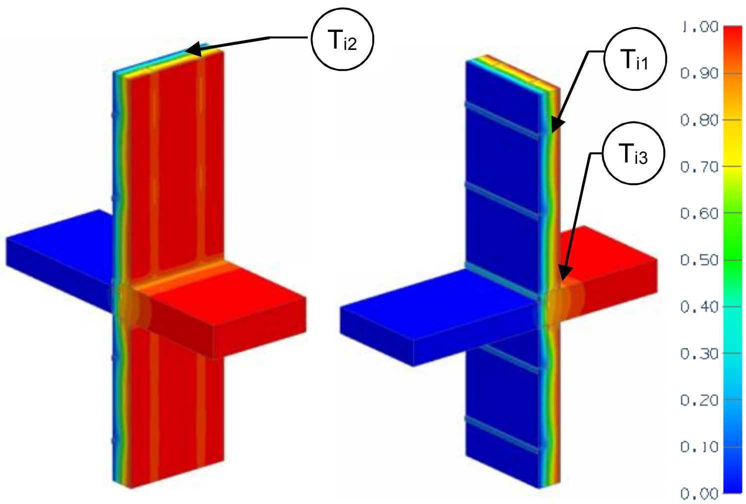
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·ºF / Btu (m² K / W) | $R_o$ ft²·hr·ºF / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·ºF (W/m² K) | R ft²·hr·ºF / Btu 53(m² K / W) | U Btu/ft² ·hr ·ºF (W/m² K) | ψ Btu/ft hr ºF (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) | R-11.6 (2.04) | 0.087 (0.49) | 0.319 (0.551) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.35 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.73 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.77 | Min T on slab exposed to interior air, at gypsum between studs |

# Detail A08-SA

**Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Isokorb CM20 Thermally Broken Slab Projection with Insulated Curb**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value, without slab |
| Transmittance / Resistance | U R | U- and R-values for overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

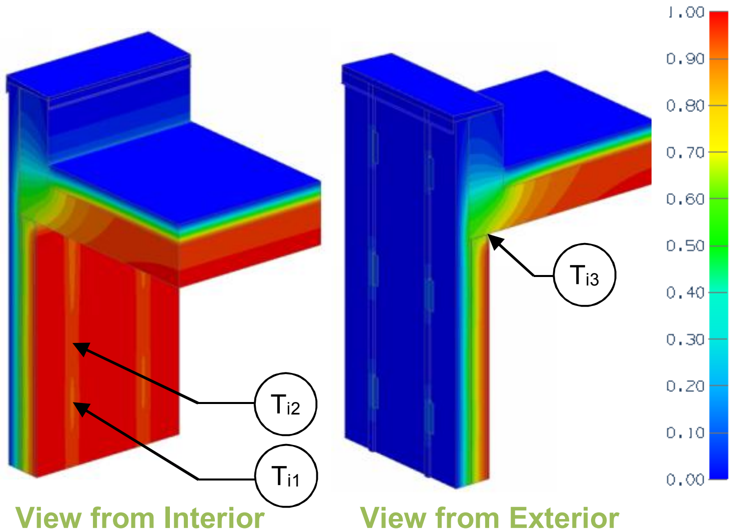
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) | R-13.6 (2.40) | 0.073 (0.42) | 0.189 (0.327) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.35 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.73 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.85 | Min T on slab exposed to interior air, at gypsum between studs |

# Detail B01-CC

**Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Intermittent Vertical Z Girts (16" o.c.) Supporting Metal Cladding –Concrete Roof Deck at Continuous Concrete Parapet**




## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1Dr}$, $R_{1Dw}$ | Two base assemblies : r = insulated roof w = steel stud wall assembly w/ intermittent vertical z Girts |
| Transmittance / Resistance without Anomaly | $U_{or}$ $R_{or}$, $U_{ow}$ $R_{ow}$ | "clear field" U- and R-values. Separate values presented for the two base assemblies |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of parapet |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Wall Exterior Insulation 1D R-Value (RSI) | $R_{1Dw}$ ft²·hr·°F / Btu (m² K / W) | $R_{ow}$ ft²·hr·°F / Btu (m² K / W) | $U_{ow}$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.9 (3.33) | 0.053 (0.30) |

**Base Assembly - Roof**

| Roof Exterior Insulation 1D R-Value (RSI) | $R_{1Dw}$ ft²·hr·°F / Btu (m² K / W) | $R_{ow}$ ft²·hr·°F / Btu (m² K / W) | $U_{ow}$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-20 (3.52) | R-21.9 (3.86) | R-21.9 (3.86) | 0.046 (0.26) |

**Parapet Linear Transmittance**

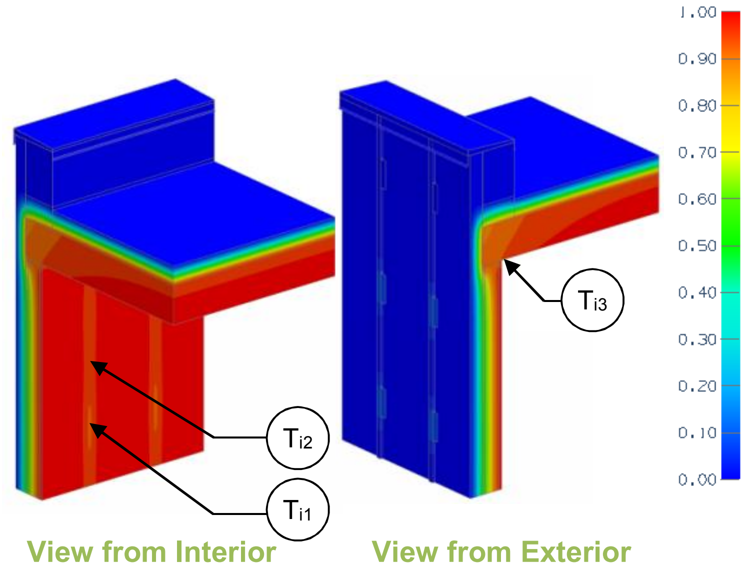
| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-9.6 (1.69) | 0.104 (0.59) | 0.396 (0.686) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.52 | Min T on sheathing away from roof slab, at clip |
| $T_{i2}$ | 0.72 | Max T on sheathing away from roof slab, between clips at stud |
| $T_{i3}$ | 0.69 | Min T on roof slab exposed to interior air, at gypsum between studs |

# Detail B02-SA

**Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Intermittent Vertical Z Girts (16" o.c.) Supporting Metal Cladding –Concrete Roof Deck at Isokorb AXT1 Thermally Broken Concrete Parapet**




## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1Dr}$, $R_{1Dw}$ | Two base assemblies : r = insulated roof w = steel stud wall assembly w/ intermittent vertical z Girts |
| Transmittance / Resistance without Anomaly | $U_{or}$ $R_{or}$, $U_{ow}$ $R_{ow}$ | "clear field" U- and R-values. Separate values presented for the two base assemblies |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of parapet |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Wall Exterior Insulation 1D R-Value (RSI) | $R_{1Dw}$ ft²·hr·°F / Btu (m² K / W) | $R_{ow}$ ft²·hr·°F / Btu (m² K / W) | $U_{ow}$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.9 (3.33) | 0.053 (0.30) |

**Base Assembly - Roof**

| Roof Exterior Insulation 1D R-Value (RSI) | $R_{1Dw}$ ft²·hr·°F / Btu (m² K / W) | $R_{ow}$ ft²·hr·°F / Btu (m² K / W) | $U_{ow}$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-20 (3.52) | R-21.9 (3.86) | R-21.9 (3.86) | 0.046 (0.26) |

**Parapet Linear Transmittance**

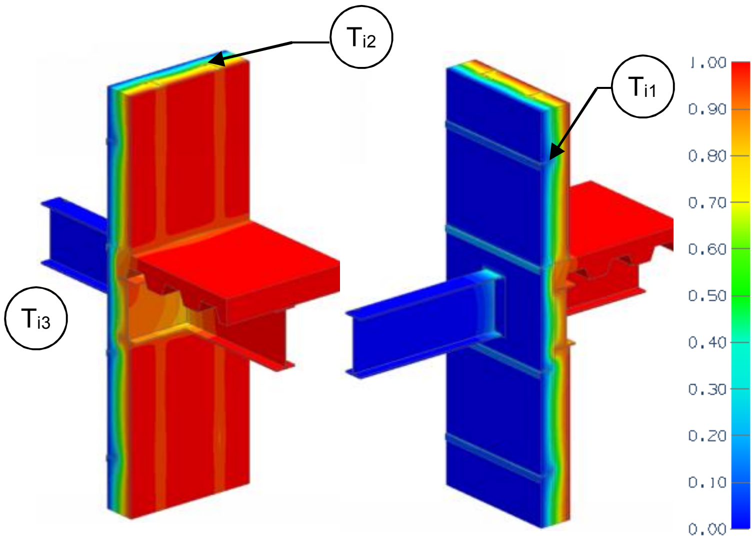
| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-17.4 (3.06) | 0.058 (0.33) | 0.058 (0.100) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.52 | Min T on sheathing away from roof slab, at clip |
| $T_{i2}$ | 0.72 | Max T on sheathing away from roof slab, between clips at stud |
| $T_{i3}$ | 0.90 | Min T on roof slab exposed to interior air, at gypsum between studs |

# Detail C01-CC

**Exterior and Interior Insulated 3 5/8” x 1 5/8” Steel Stud (16” o.c.) Wall Assembly with Horizontal Z-girts (24” o.c.) Supporting Metal Cladding – Structural Steel Floor Intersection with Uninterrupted Beam**




View from Interior　　View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | “clear wall” U- and R-value without slab or beam |
| Transmittance / Resistance | $U_s$ $R_s$ | U and R-values for steel stud wall with slab |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | $\psi_s$ | Incremental increase in transmittance per linear length of floor slab |
| Point Transmittance | $\chi$ | Incremental increase in transmittance for beam penetration |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Wall Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) |

**Beam Point Transmittance**

| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | $\chi$ Btu/hr °F (W/K) |
|---|---|---|
| R-6.9 (1.21) | 0.146 (0.83) | 1.73 (0.92) |

**Slab Linear Transmittance**

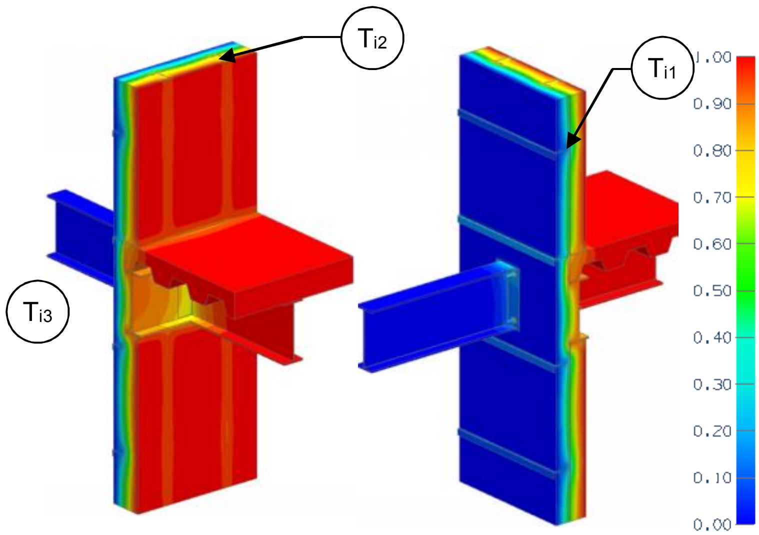
| $R_s$ ft²·hr·°F / Btu (m² K / W) | $U_s$ Btu/ft² ·hr ·°F (W/m² K) | $\psi_s$ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-15.6 (2.75) | 0.064 (0.36) | 0.083 (0.143) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.35 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.73 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.52 | Min T on beam exposed to interior air, top flange at I-beam intersection |

# Detail C02-TI

## Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Structural Steel Floor Intersection with Isolator Pad




View from Interior View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value without slab or beam |
| Transmittance / Resistance | $U_s$ $R_s$ | U and R-values for steel stud wall with slab |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | $\psi_s$ | Incremental increase in transmittance per linear length of floor slab |
| Point Transmittance | $\chi$ | Incremental increase in transmittance for beam penetration |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

### Base Assembly – Wall

| Wall Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) |

### Slab Linear Transmittance

| $R_s$ ft²·hr·°F / Btu (m² K / W) | $U_s$ Btu/ft² ·hr ·°F (W/m² K) | $\psi_s$ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-15.6 (2.75) | 0.064 (0.36) | 0.083 (0.143) |

### Beam Point Transmittance

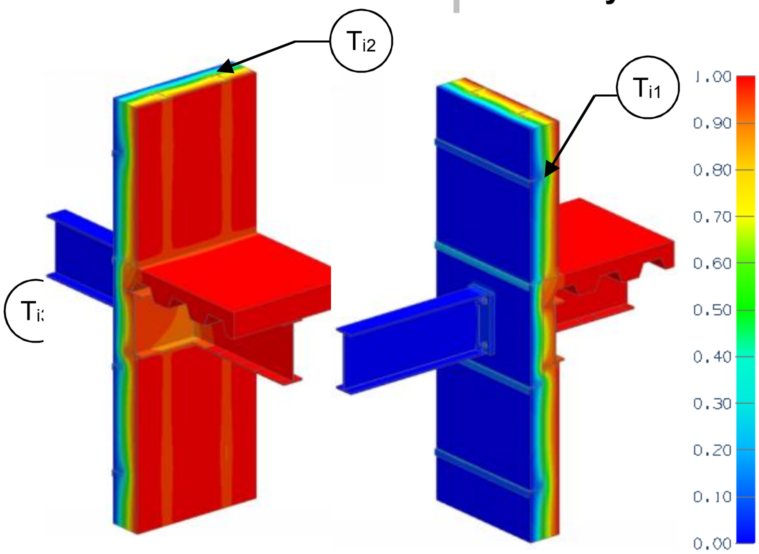
| Thermal Isolator Pad | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | $\chi$ Btu/hr °F (W/K) |
|---|---|---|---|
| 5 mm pad, stainless steel bolts | R-6.0 (1.06) | 0.167 (0.95) | 2.17 (1.15) |
| 5 mm pad, steel bolts | R-5.9 (1.04) | 0.170 (0.97) | 2.24 (1.19) |
| 5 mm pad, stainless steel bolts, w/ R10 outboard of plates | R-6.4 (1.13) | 0.156 (0.89) | 1.80 (1.03) |
| 10 mm pad, stainless steel bolts | R-6.7 (1.17) | 0.150 (0.85) | 1.82 (0.97) |
| 10 mm pad, steel bolts | R-6.5 (1.15) | 0.153 (0.87) | 1.89 (1.00) |
| 19 mm pad, steel bolts | R-6.9 (1.22) | 0.145 (0.82) | 1.71 (0.91) |
| 25 mm pad, steel bolts | R-7.1 (1.25) | 0.140 (0.80) | 1.61 (0.86) |

## Temperature Indices

| | 5 mm pad, stainless bolts | 5 mm pad, steel bolts | 5 mm pad, stainless bolts, w/ R10 | 10 mm pad, stainless bolts | 10 mm pad, steel bolts | |
|---|---|---|---|---|---|---|
| $T_{i1}$ | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.33 | 0.32 | 0.39 | 0.42 | 0.41 | Min T on beam exposed to interior air, top flange at I-beam intersection |

# Detail C03-SA

**Exterior and Interior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Horizontal Z-girts (24" o.c.) Supporting Metal Cladding – Structural Steel Floor Intersection with Isokorb S22 Thermally Broken Beam**




View from Interior View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-14.3 (2.52 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value without slab or beam |
| Transmittance / Resistance | $U_s$ $R_s$ | U and R-values for steel stud wall with slab |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | $\psi_s$ | Incremental increase in transmittance per linear length of floor slab |
| Point Transmittance | $\chi$ | Incremental increase in transmittance for beam penetration |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Wall Exterior Insulation 1D R-Value (RSI) | $R_{w1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-29.3 (5.16) | R-18.5 (3.25) | 0.054 (0.31) |

**Beam Point Transmittance**

| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | $\chi$ Btu/hr °F (W/K) |
|---|---|---|
| R-9.4 (1.65) | 0.107 (0.61) | 0.91 (0.48) |

**Slab Linear Transmittance**

| $R_s$ ft²·hr·°F / Btu (m² K / W) | $U_s$ Btu/ft² ·hr ·°F (W/m² K) | $\psi_s$ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-15.6 (2.75) | 0.064 (0.36) | 0.083 (0.143) |

## Temperature Indices

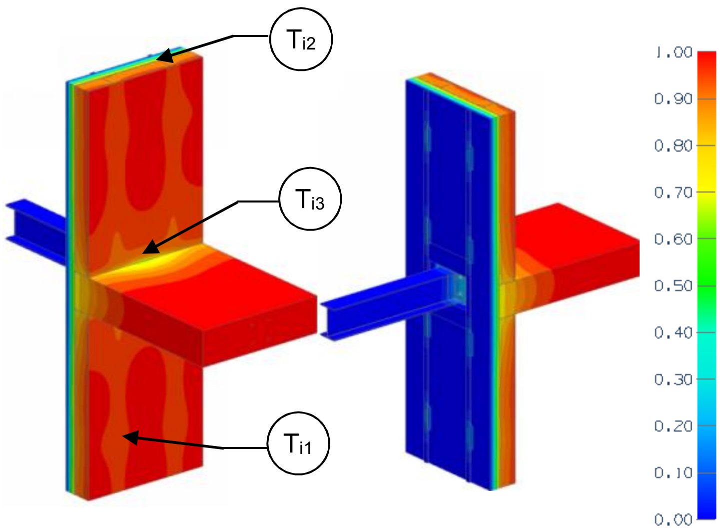
| | | |
|---|---|---|
| $T_{i1}$ | 0.32 | Min T on sheathing away from slab, between studs at girts |
| $T_{i2}$ | 0.89 | Max T on sheathing away from slab, between girts at studs |
| $T_{i3}$ | 0.79 | Min T on beam exposed to interior air, top flange at I-beam intersection |



Schöck Innovative Building Solutions

# Detail D01-CC

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Intermittent Vertical Z-girts (16" o.c.) Supporting Metal Cladding – Concrete Floor to Steel Beam Connection**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value without slab or beam |
| Transmittance / Resistance | $U_s$ $R_s$ | U and R-values for steel stud wall with slab |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | $\psi_s$ | Incremental increase in transmittance per linear length of floor slab |
| Point Transmittance | $\chi$ | Incremental increase in transmittance for beam penetration |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-13.8 (2.44) | 0.072 (0.41) |

**Beam Point Transmittance**

| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | $\chi$ Btu/hr °F (W/K) |
|---|---|---|
| R-7.3 (1.28) | 0.137 (0.78) | 1.24 (0.66) |

**Slab Linear Transmittance**

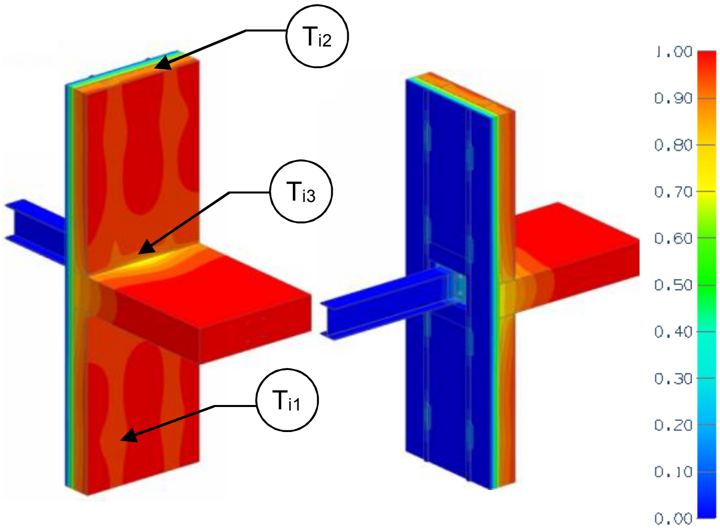
| $R_s$ ft²·hr·°F / Btu (m² K / W) | $U_s$ Btu/ft² ·hr ·°F (W/m² K) | $\psi_s$ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-12.7 (2.24) | 0.079 (0.45) | 0.052 (0.090) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.44 | Min T on sheathing, at slab, in line with beam |
| $T_{i2}$ | 0.88 | Max T on sheathing, at studs, between clips |
| $T_{i3}$ | 0.40 | Min T on slab exposed to interior air, at sheathing, in line with beam |

# Detail D02-TI

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Intermittent Vertical Z-girts (16" o.c.) Supporting Metal Cladding – Concrete Floor to Steel Beam with a Thermal Isolator Pad Connection**




View from Interior　　View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value without slab or beam |
| Transmittance / Resistance | $U_s$ $R_s$ | U and R-values for steel stud wall with slab |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | $\psi_s$ | Incremental increase in transmittance per linear length of floor slab |
| Point Transmittance | $\chi$ | Incremental increase in transmittance for beam penetration |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-13.8 (2.44) | 0.072 (0.41) |

**Beam Point Transmittance**

| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | $\chi$ Btu/hr °F (W/K) |
|---|---|---|
| R-8.2 (1.45) | 0.121 (0.69) | 0.91 (0.48) |

**Slab Linear Transmittance**

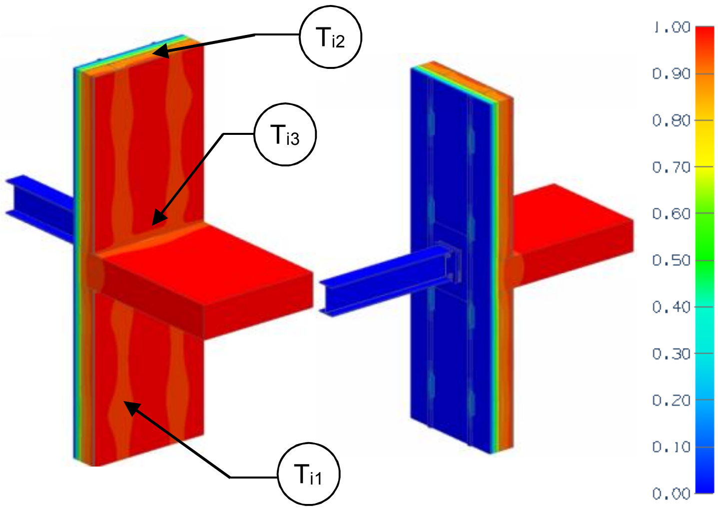
| $R_s$ ft²·hr·°F / Btu (m² K / W) | $U_s$ Btu/ft² ·hr ·°F (W/m² K) | $\psi_s$ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-12.7 (2.24) | 0.079 (0.45) | 0.052 (0.090) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.44 | Min T on sheathing, at slab, in line with beam |
| $T_{i2}$ | 0.88 | Max T on sheathing, at studs, between clips |
| $T_{i3}$ | 0.54 | Min T on slab exposed to interior air, at sheathing, in line with beam |

# Detail D03-SA

**Exterior Insulated 3 5/8" x 1 5/8" Steel Stud (16" o.c.) Wall Assembly with Intermittent Vertical Z-girts (16" o.c.) Supporting Metal Cladding – Concrete Floor to Steel Beam with Isokorb KS14 Connection**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-3.2 (0.56 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | "clear wall" U- and R-value without slab or beam |
| Transmittance / Resistance | $U_s$ $R_s$ | U and R-values for steel stud wall with slab |
| Transmittance / Resistance | U R | U and R-values for the overall assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature 1 = interior temperature |
| Linear Transmittance | $\psi_s$ | Incremental increase in transmittance per linear length of floor slab |
| Point Transmittance | $\chi$ | Incremental increase in transmittance for beam penetration |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

**Base Assembly – Wall**

| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) |
|---|---|---|---|
| R-15 (2.64) | R-18.2 (3.20) | R-13.8 (2.44) | 0.072 (0.41) |

**Beam Point Transmittance**

| R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | $\chi$ Btu/hr °F (W/K) |
|---|---|---|
| R-12.2 (2.14) | 0.082 (0.47) | 0.07 (0.04) |

**Slab Linear Transmittance**

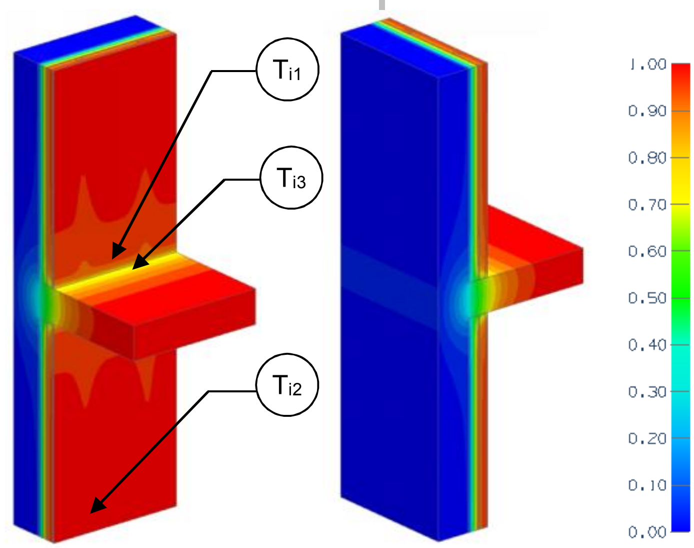
| $R_s$ ft²·hr·°F / Btu (m² K / W) | $U_s$ Btu/ft² ·hr ·°F (W/m² K) | $\psi_s$ Btu/ft hr °F (W/m K) |
|---|---|---|
| R-12.7 (2.24) | 0.079 (0.45) | 0.052 (0.090) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.44 | Min T on sheathing, at slab, in line with beam |
| $T_{i2}$ | 0.88 | Max T on sheathing, at studs, between clips |
| $T_{i3}$ | 0.84 | Min T on slab exposed to interior air, at sheathing, in line with beam |

# Detail E01-CC

**Interior Insulated Concrete Mass Wall with 1 5/8” Steel Studs (16” o.c.) Supporting Interior Finish – Continuous Concrete Floor Slab Intersection**




View from Interior    View from Exterior

## Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-2.9 (0.51 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | “clear wall” U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U and R-values for the assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

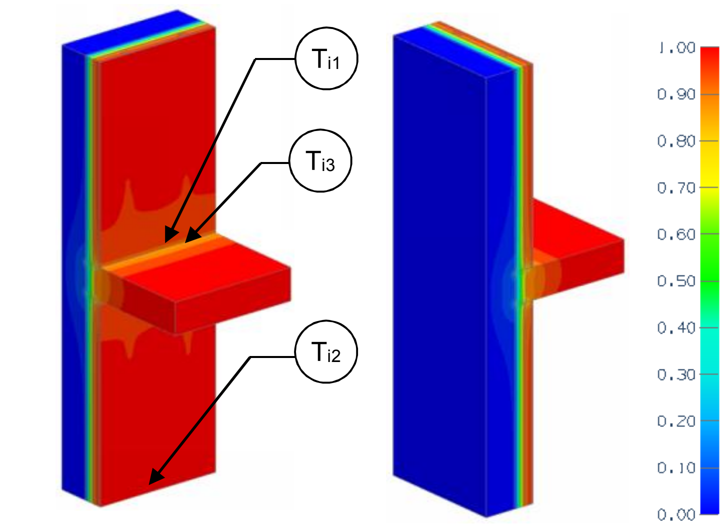
| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-10.0 (1.76) | R-12.9 (2.26) | R-12.2 (2.15) | 0.082 (0.47) | R-7.5 (1.32) | 0.134 (0.76) | 0.447 (0.773) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.84 | Min T on insulation away from slab, between studs |
| $T_{i2}$ | 0.87 | Max T on insulation away from slab, at studs |
| $T_{i3}$ | 0.57 | Min T on slab exposed to interior air, at insulation between studs |

# Detail E02-SA

## Interior Insulated Concrete Mass Wall with 1 5/8” Steel Studs (16” o.c.) Supporting Interior Finish – Isokorb Rutherma DF Thermally Broken Concrete Floor Slab Intersection




View from Interior

View from Exterior

### Thermal Performance Indicators

| | | |
|---|---|---|
| Assembly 1D (Nominal) R-Value | $R_{1D}$ | R-2.9 (0.51 RSI) + exterior insulation |
| Transmittance / Resistance without Anomaly | $U_o$, $R_o$ | “clear wall” U- and R-value, without slab |
| Transmittance / Resistance | U<br>R | U and R-values for the assembly |
| Surface Temperature Index[1] | $T_i$ | 0 = exterior temperature<br>1 = interior temperature |
| Linear Transmittance | ψ | Incremental increase in transmittance per linear length of slab |

[1]Surface temperatures are a result of steady-state conductive heat flow with constant heat transfer coefficients. Limitations are identified in ASHRAE 1365-RP.

## Nominal (1D) vs. Assembly Performance Indicators

| Exterior Insulation 1D R-Value (RSI) | $R_{1D}$ ft²·hr·°F / Btu (m² K / W) | $R_o$ ft²·hr·°F / Btu (m² K / W) | $U_o$ Btu/ft² ·hr ·°F (W/m² K) | R ft²·hr·°F / Btu (m² K / W) | U Btu/ft² ·hr ·°F (W/m² K) | ψ Btu/ft hr °F (W/m K) |
|---|---|---|---|---|---|---|
| R-10.0 (1.76) | R-12.9 (2.26) | R-12.2 (2.15) | 0.082 (0.47) | R-9.7 (1.72) | 0.103 (0.58) | 0.179 (0.310) |

## Temperature Indices

| | | |
|---|---|---|
| $T_{i1}$ | 0.84 | Min T on insulation away from slab, between studs |
| $T_{i2}$ | 0.87 | Max T on insulation away from slab, at studs |
| $T_{i3}$ | 0.70 | Min T on slab exposed to interior air, at insulation between studs |

# APPENDIX C: Thermal Resistance Tables

**Table C1:** Thermal resistance of of R-15 exterior insulated steel stud assemblies with cantilevered concrete slab

| Scenario | | Description | Clear Wall R-value ft² ·hr ·°F/Btu (m²K/W) | Overall R-value ft² ·hr ·°F/Btu (m²K/W) | Ψ Btu/ft ·hr ·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | A01-CC | Without insulation at curb | R-11.3 (1.99) | R-6.8 (1.19) | 0.584 (1.011) | - |
| | A02-CC | With insulation at curb | R-11.3 (1.99) | R-7.3 (1.28) | 0.485 (0.840) | 17% |
| Manufactured Thermal Break (Isokorb CM20) | A03-SA | Without insulation at curb | R-11.3 (1.99) | R-8.7 (1.53) | 0.261 (0.452) | 55% |
| | A04-SA | With insulation at curb | R-11.3 (1.99) | R-10 (1.76) | 0.117 (0.203) | 80% |

**Table C2:** Thermal resistance of R-15/R-12 split insulated steel stud assemblies with cantilevered concrete slab

| Scenario | | Description | Clear Wall R-value ft² ·hr ·°F/Btu (m²K/W) | Overall R-value ft² ·hr ·°F/Btu (m²K/W) | Ψ Btu/ft ·hr ·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | A05-CC | Without insulation at curb | R-18.5 (3.25) | R-8.6 (1.51) | 0.612 (1.059) | - |
| | A06-CC | With insulation at curb | R-18.5 (3.25) | R-9.3 (1.63) | 0.528 (0.914) | 14% |
| Manufactured Thermal Break (Isokorb CM20) | A07-SA | Without insulation at curb | R-18.5 (3.25) | R-11.6 (2.04) | 0.319 (0.528) | 48% |
| | A08-SA | With insulation at curb | R-18.5 (3.25) | R-13.6 (2.4) | 0.189 (0.327) | 69% |

**Table C3:** Thermal resistance of R-15/R-12 split insulated steel stud assembly at a concrete parapet and roof deck with R-20 insulation

| Scenario | | Description | Clear Wall R-value ft²·hr·°F/Btu (m²K/W) | Clear Roof R-value ft²·hr·°F/Btu (m²K/W) | Overall R-value ft²·hr·°F/Btu (m²K/W) | Ψ Btu/ft·hr·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|---|
| Conventional Construction | B01-CC | Continuous concrete parapet bypassing interior wall and roof insulation | R-18.9 (3.33) | R-21.9 (3.86) | R-9.6 (1.69) | 0.396 (0.686) | - |
| Manufactured Thermal Break (Isokorb AXT1) | B02- SA | Concrete parapet and roof separated by AXT1 Thermal Break | R-18.9 (3.33) | R-21.9 (3.86) | R-17.4 (3.06) | 0.058 (0.100) | 85% |

**Table C4:** Thermal resistance of structural steel beam penetration through R-15/R-12 split insulated steel stud assembly

| Scenario | | Description | Clear Wall R-value ft²·hr·°F/Btu (m²K/W) | Overall R-value ft²·hr·°F/Btu (m²K/W) | Χ Btu/hr·°F (W/K) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | C01-CC | Uninterrupted steel through beam | R-18.5 (3.25) | R-6.9 (1.21) | 1.73 (0.92) | - |
| Thermal Isolator Pad | C02-TI | 5 mm isolator pad, stainless steel bolts | R-18.5 (3.25) | R-6 (1.06) | 2.17 (1.15) | -26% |
| | | 5 mm isolator pad, steel bolts | R-18.5 (3.25) | R-5.9 (1.04) | 2.24 (1.19) | -30% |
| | | 5 mm pad, stainless steel bolts, R-10 outboard of flanges | R-18.5 (3.25) | R-6.4 (1.13) | 1.94 (1.03) | -12% |
| | | 10 mm isolator pad, stainless steel bolts | R-18.5 (3.25) | R-6.7 (1.17) | 1.82 (0.97) | -5% |
| | | 10 mm isolator pad, steel bolts | R-18.5 (3.25) | R-6.5 (1.15) | 1.89 (1.00) | -9% |
| | | 19 mm isolator pad, steel bolts | R-18.5 (3.25) | R-6.9 (1.22) | 1.71 (0.91) | 1% |
| | | 25 mm isolator pad, steel bolts | R-18.5 (3.25) | R-7.1 (1.25) | 1.61 (0.86) | 7% |
| Manufactured Thermal Break (Isokorb S22) | C03-SA | Steel beam separated by Isokorb S22 thermal break | R-18.5 (3.25) | R-9.4 (1.65) | 0.91 (0.48) | 48% |

**Table C5:** Thermal resistance of concrete floor slab to structural steel balcony with a R-15/R-12 split insulated steel stud wall assembly

| Scenario | | Description | Clear Wall R-value ft² ·hr ·°F/Btu (m²K/W) | Overall R-value ft² ·hr ·°F/Btu (m²K/W) | X Btu/hr ·°F (W/K) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | D01-CC | Steel beam bypassing exterior insulation | R-13.8 (2.44) | R-7.3 (1.28) | 1.24 (0.66) | - |
| Thermal Isolator Pad | D02-TI | 10mm Isolator pad between steel beam and concrete | R-13.8 (2.44) | R-8.2 (1.45) | 0.91 (0.48) | 27% |
| Manufactured Thermal Break (Isokorb KS14) | D03-SA | Isokorb KS14 thermal break between steel beam and concrete | R-13.8 (2.44) | R-12.2 (2.14) | 0.07 (0.04) | 94% |

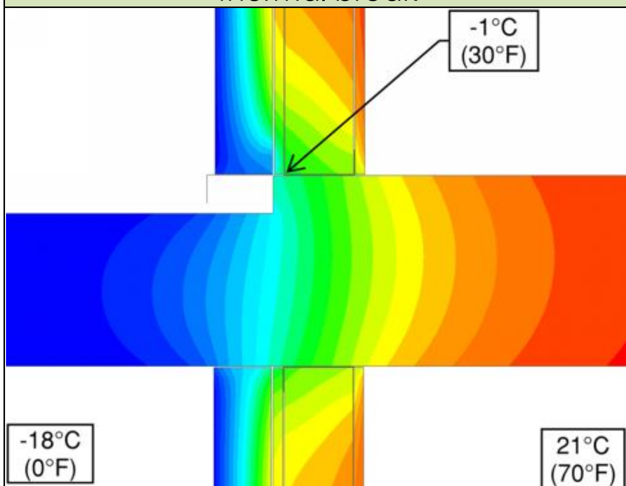
**Table C6:** Thermal resistance of R-10 Interior insulated poured-in place concrete wall at floor slab interface

| Scenario | | Description | Clear Wall R-value ft² ·hr ·°F/Btu (m²K/W) | Overall R-value ft² ·hr ·°F/Btu (m²K/W) | Ψ Btu/ft ·hr ·°F (W/mK) | % Reduction in Heat Loss |
|---|---|---|---|---|---|---|
| Conventional Construction | E01-CC | Continuous concrete floor to wall connection, bypassing interior insulation | R-12.2 (2.15) | R-7.5 (1.32) | 0.447 (0.773) | - |
| Manufactured Thermal Break (Isokorb Rutherma DF) | E02-SA | Concrete wall and floor separated by Rutherma DF Thermal Break | R-12.2 (2.15) | R-9.7 (1.72) | 0.179 (0.310) | 60% |

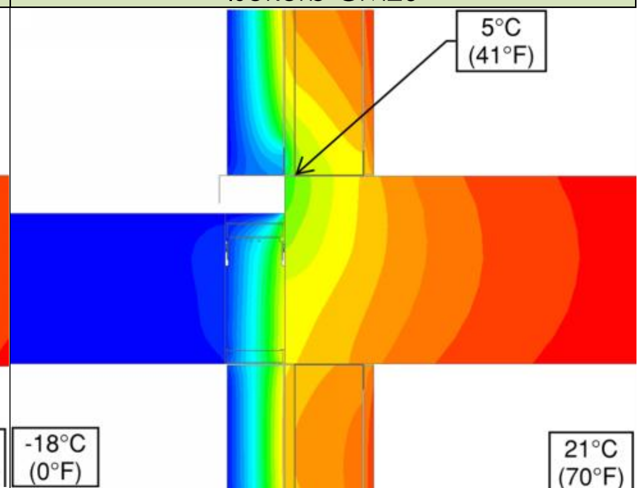
# APPENDIX D: Design Condition Thermal Profiles

**Table D1:** Thermal profiles for cantilevered concrete with exterior insulated steel stud assembly

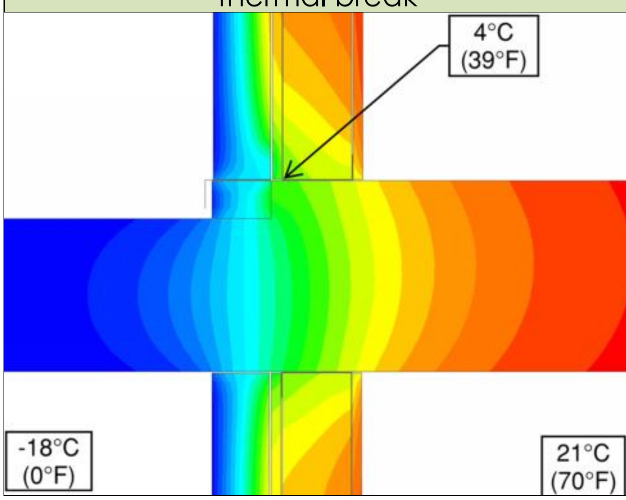
A01-CC: Without curb insulation, without thermal break




A03-SA: Without curb insulation, with Isokorb CM20




A02-CC: With curb insulation, without thermal break




A04-SA: With curb insulation, with Isokorb CM20

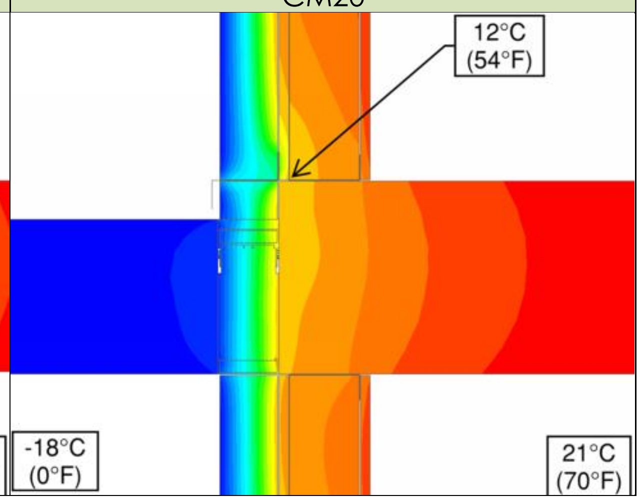


**Table D2:** Thermal profiles for cantilevered concrete with split insulated steel stud assembly

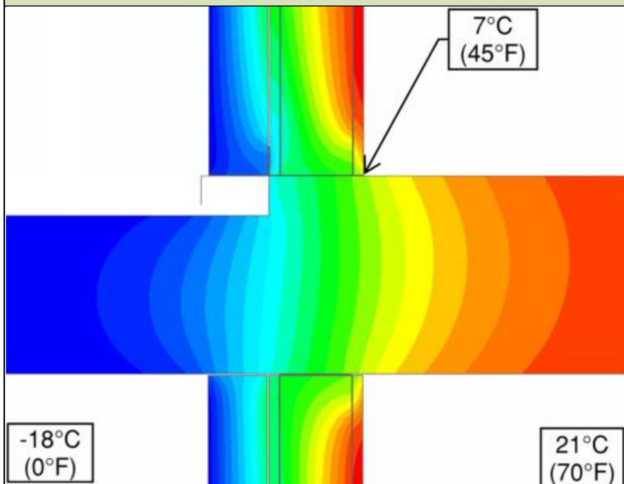
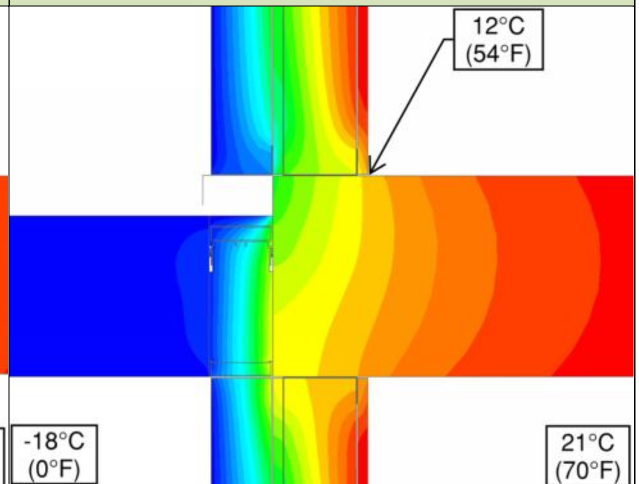
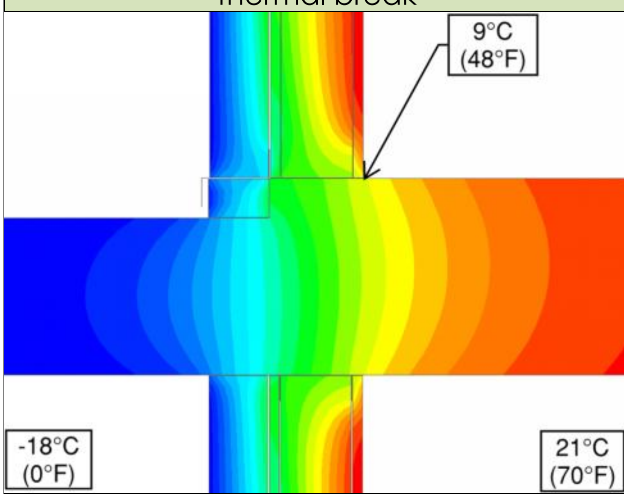
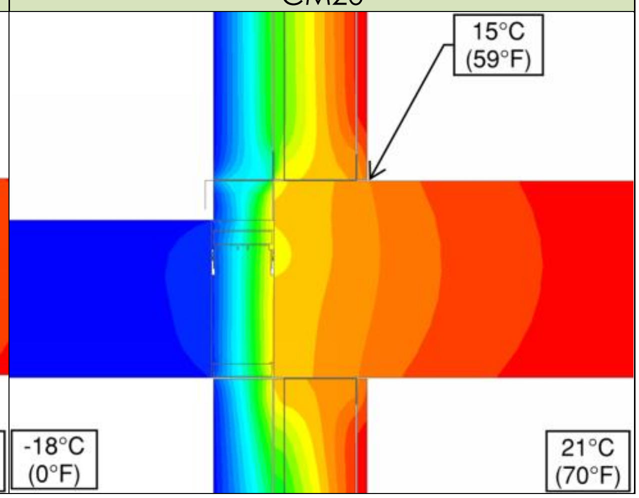
| A05-CC: Without curb insulation, without thermal break | A07-SA: Without curb insulation, with Isokorb CM20 |
|---|---|
|  |  |
| **A06-CC: With curb insulation, without thermal break** | **A08-SA: With curb insulation, with Isokorb CM20** |
|  |  |

**Table D3:** Temperature profiles for concrete parapets

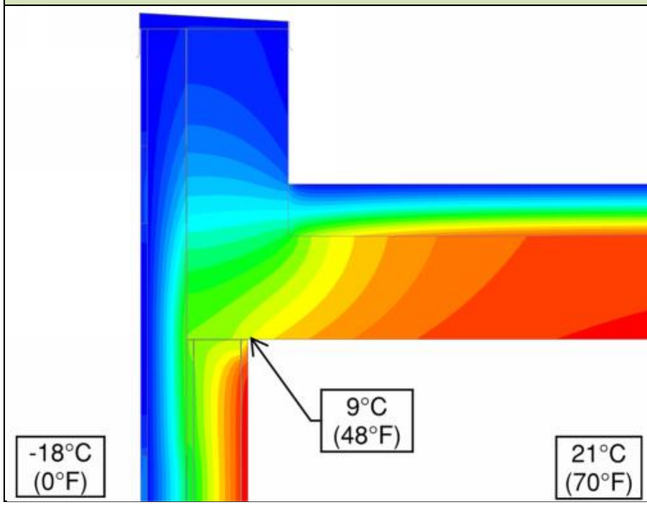
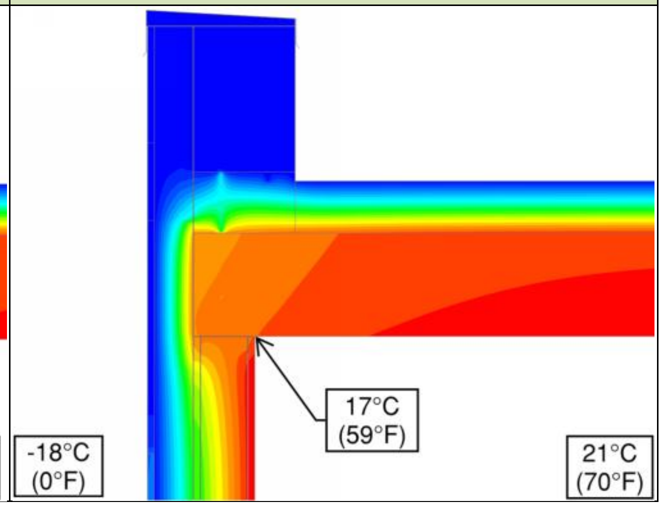
| B01-CC: Continuous concrete bypassing insulation | B02-SA: Isokorb AXT1 |
|---|---|
|  |  |

**Table D4:** Temperature profiles for steel to steel connections

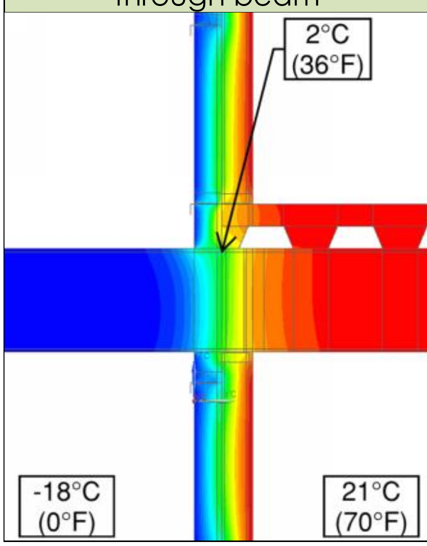
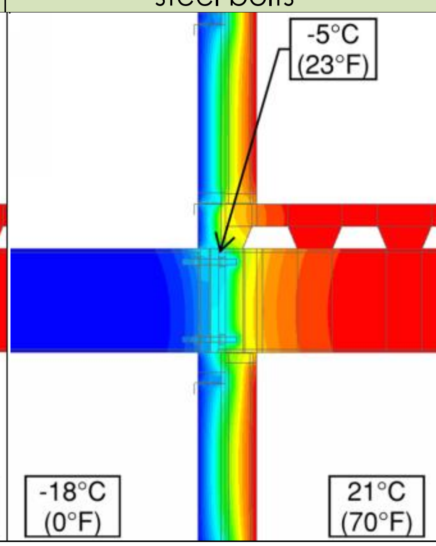
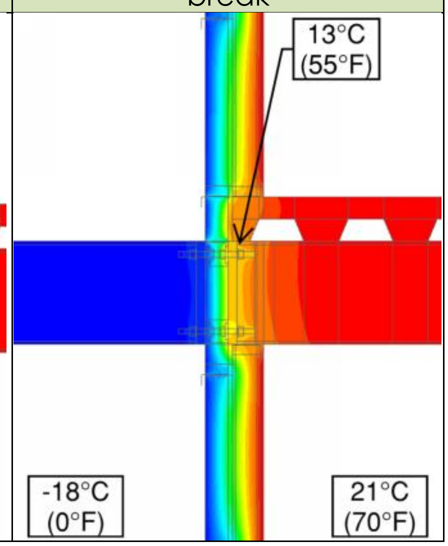
| C01-CC: Continuous steel through beam | C02-TI: 5mm isolator pad, steel bolts | C03-SA: Isokorb S22 thermal break |
|---|---|---|
|  |  |  |

**Table D5:** Temperature profiles for concrete floor slabs to steel connections

<table>
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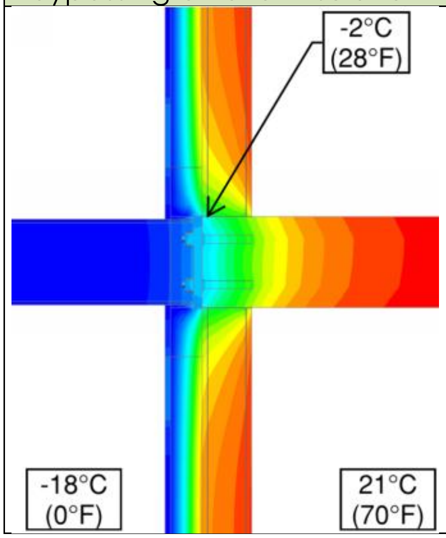
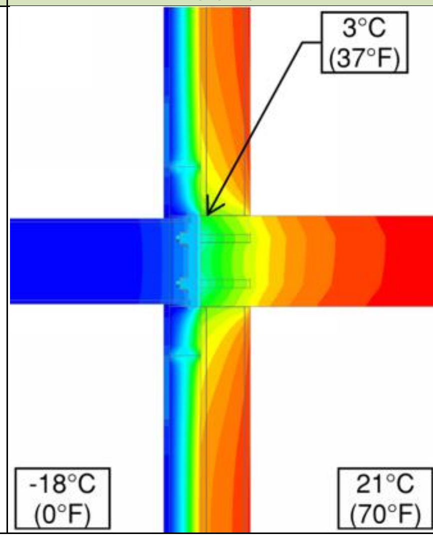
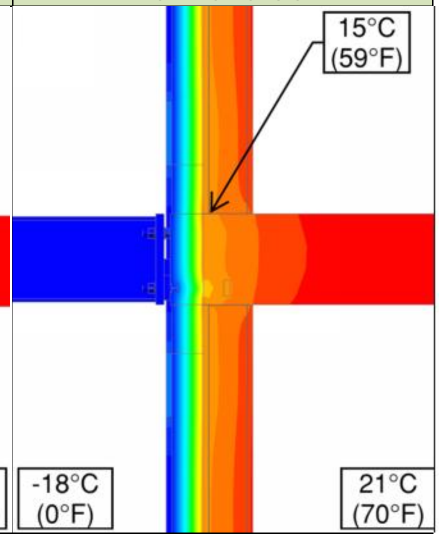
<tr><td>
</td><td>
</td><td>
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**Table D6:** Temperature profiles for interior insulated poured-in-place concrete

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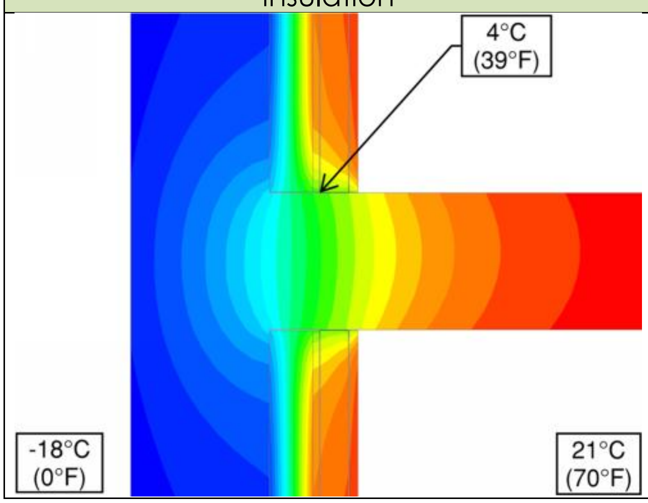
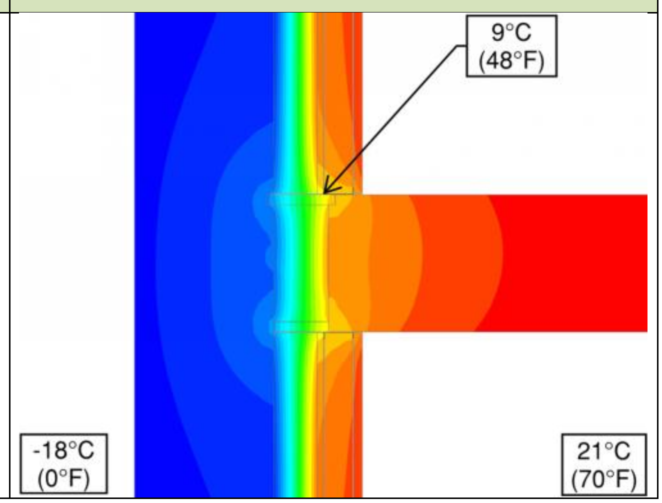
<tr><td>
</td><td>
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