Memo: Wall Assembly 3D Thermal Modeling for the LCC Downtown Campus

Dear Tim,

The parameters and results below summarize our work using AnTherm, a 3D finite element analysis package, to predict the thermal conductivity of one of the wall options for the Lane Community College Downtown Campus. This work used a trial version of the software; results were exported with the trial software watermark to reflect that fact.

**Model Parameters (outside to inside):**
- 20-gauge painted galvanized steel skin in square-S profiled vertical panels
- 4” rigid extruded polystyrene insulation between Z-girts (R-5 per inch)
- 14-gauge galvanized steel horizontal Z-girts, 4” web and 2” legs, 24” oc
- 3/16” diameter steel fasteners at intersections of studs and girts
- 5/8” Densglass Gold sheathing
- 16-gauge nominal 2x6 steel studs, 24” oc
- R-19 batt insulation between studs
- 1/2” gypsum wallboard

**Figure 1.** Screen shot of the wall assembly unit; calculations assumed that this unit repeated infinitely in the YZ plane.
Results
Output is presented as a “thermal coupling coefficient” between the outside and the inside space; the difference between the coefficients calculated from inside-to-outside and outside-to-inside reflect the ability of the numerical method to reach an accurate solution. Note that the residual error is extremely low in this case, indicating a valid result.

The thermal coupling coefficient of 0.110 Watts/Kelvin (W/K) realized over the modeled wall area corresponded to a thermal conductivity (U-value) equal to 0.052 Btu/h·sf·°F, or R-19.2.

The predicted value was particularly sensitive to the nature and thickness of the metal fasteners as well as the proportion of the metal skin panels in contact with the Z-girts; changing the profile of the metal skin from flat to a square S-shape, for example, with half of each panel held out from the wall and separated by 1” of air, caused the thermal resistance to increase from R-17.8 to R-19.2.

![Figure 2. Thermal contours of the wall when the inside is held at 20°C (68°F) and the outside is -10°C (14°F).](image)

**Figure 2.** Thermal contours of the wall when the inside is held at 20°C (68°F) and the outside is -10°C (14°F).

**Figure 3.** Thermal coupling coefficient and residual error output.

<table>
<thead>
<tr>
<th>Space</th>
<th>Inside</th>
<th>Outside</th>
<th>Close-up error [W / K]</th>
<th>Coeff. sum [W / K]</th>
<th>Relative close-up error</th>
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</thead>
<tbody>
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<td>Inside</td>
<td>0.110107</td>
<td></td>
<td>0.0223109e-004</td>
<td>0.110330</td>
<td>2.02220e-003</td>
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<td></td>
<td>0.0223109e-004</td>
<td>0.110107</td>
<td>-2.02630e-003</td>
</tr>
</tbody>
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Number of evaluated cells: 80611