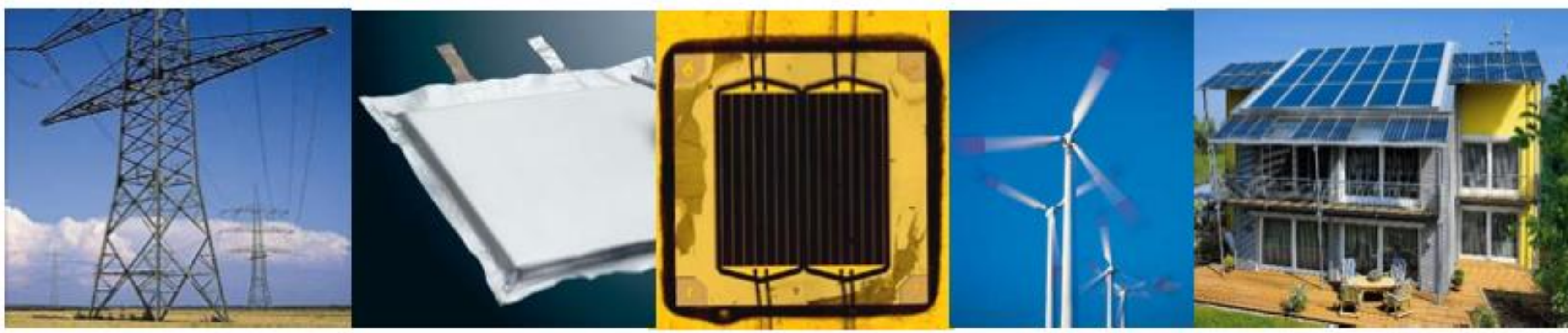
Thermal Bridges in Steel Framing Components

Developments in Mitigation of Thermal Bridges Generated by Light Gage Steel Framing



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Agenda

- why using steel framing?
- ways of reducing thermal bridging – an overview
- numerical analysis of different wall assemblies
- conclusion - outlook

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Metal Framing – Problems and Solutions

advantages:

- dimensionally stable
- immune to termites/insects
- good recyclability

disadvantages:

- steel is a very good heat conductor
- thermal bridges

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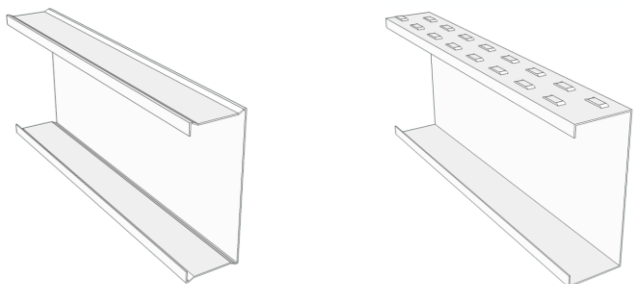
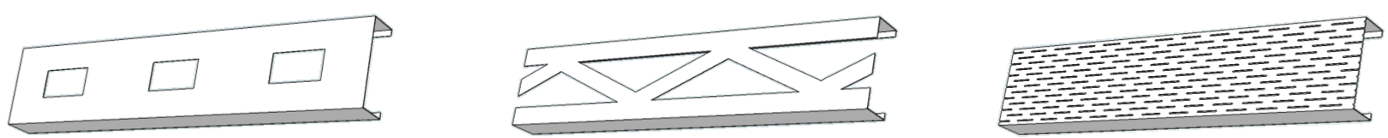
Metal Framing – Problems and Solutions

known technologies to reduce thermal bridging:

- reducing the contact area between metal stud and wall material
  reduction of contact area up to 95%
  increase in overall U-value 9 to 15%



- reduction of the stud web area
  increase in overall U-value up to 36%



- place low conducting material on the flanges - where heat flow is most critical
- replacing the steel web with a less conductive material

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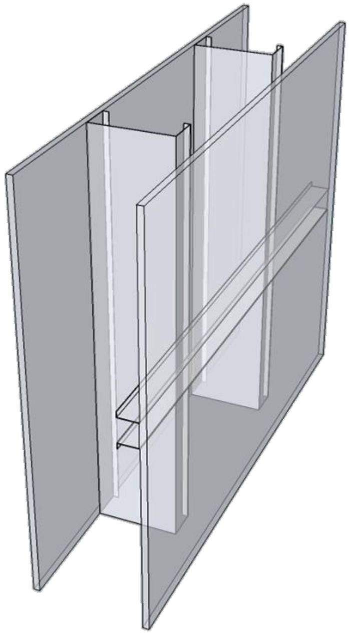
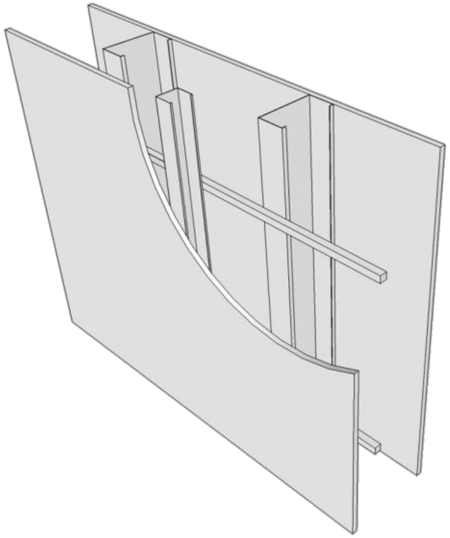
Metal Framing – Problems and Solutions

known technologies to reduce thermal bridging:

- enhanced constructions: spacers and/or double-stud-walls
  performance of wood-stud walls achievable
  but: construction more complex, thus more expensive





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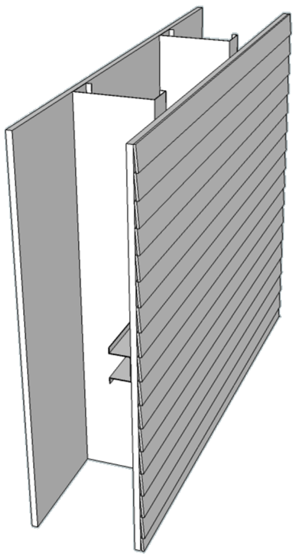
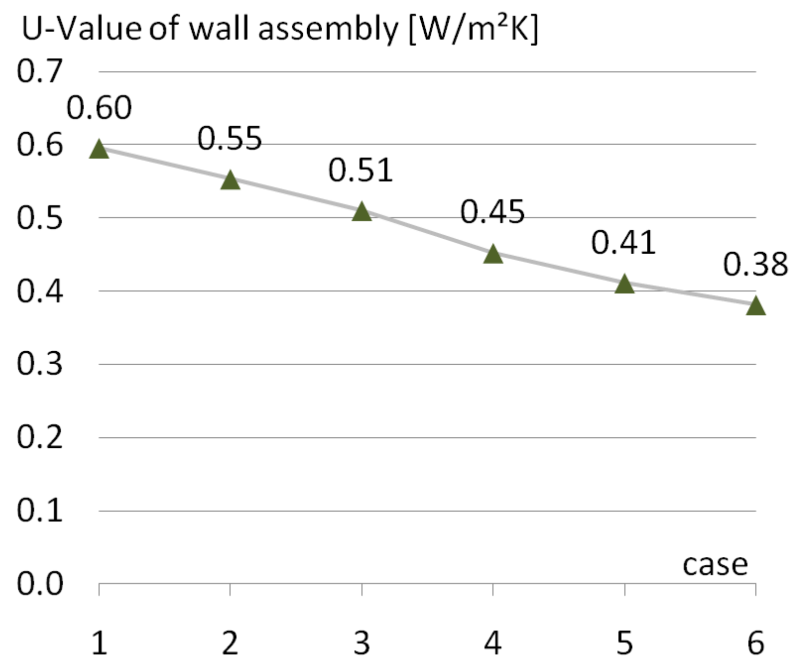
numerical analysis of different wall assemblies

example A) metal spacer, variation of conductivity of insulation material in the cavities



	λ fill [W/mK]	U Wall [W/m²K]
1	0.048	0.60
2	0.042	0.55
3	0.036	0.51
4	0.029	0.45
5	0.024	0.41
6	0.021	0.38



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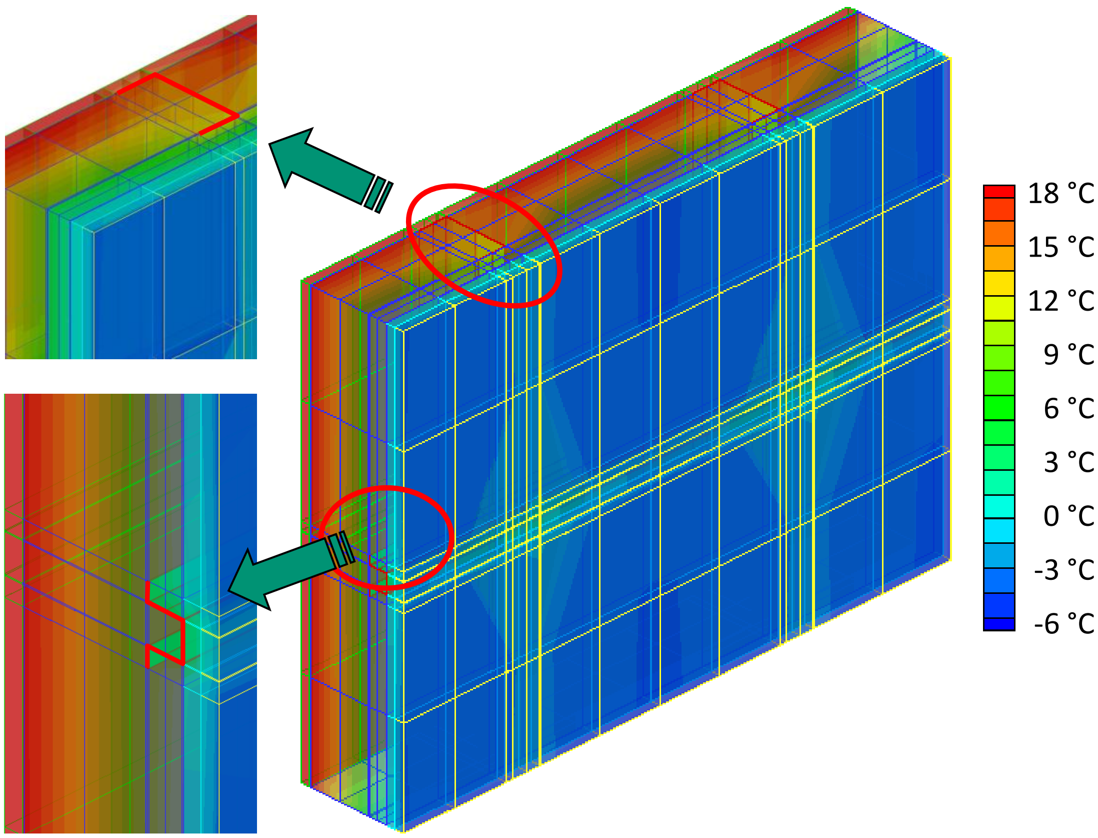
numerical analysis of different wall assemblies

example A) metal spacer, variation of conductivity of insulation material in the cavities



Temperature map plot

boundary conditions:

T_{inside}= 21.1°C (70°F)

$T_{outside}$= -6.7°C (20°F)

Although the direct path for heat flow is interrupted, the "framing effect" can be seen on the surfaces.

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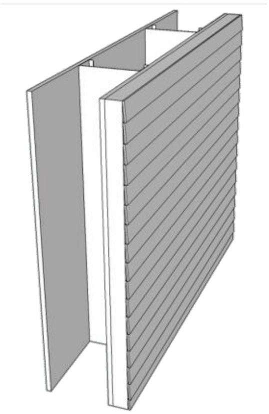
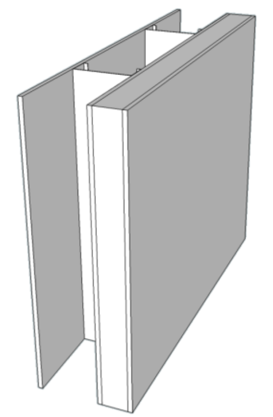
numerical analysis of different wall assemblies

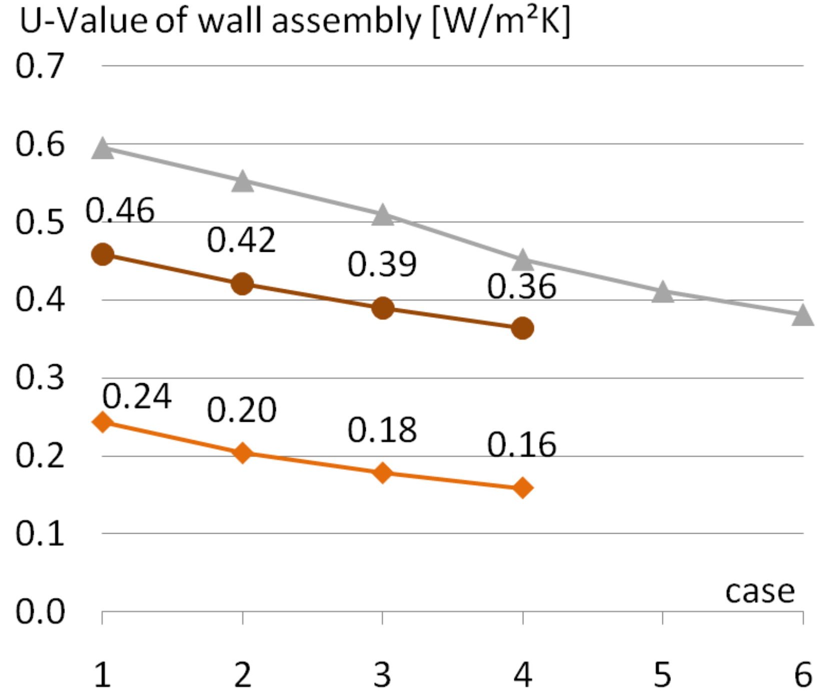
example B) and C) exterior insulation with foam (2.5 and 10.2 cm), variation of λ_{foam}



	λ sheeting [W/mK]	U Wall [W/m²K]
1	0.036	0.46
2	0.029	0.42
3	0.024	0.39
4	0.021	0.36



	λ sheeting [W/mK]	U Wall [W/m²K]
1	0.036	0.24
2	0.029	0.20
3	0.024	0.18
4	0.021	0.16



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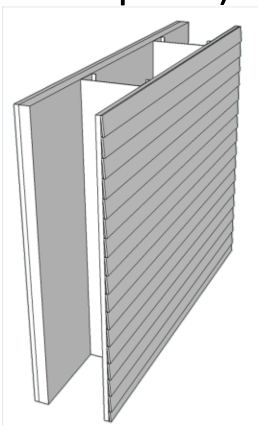
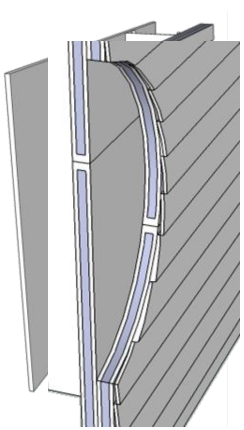
numerical analysis of different wall assemblies

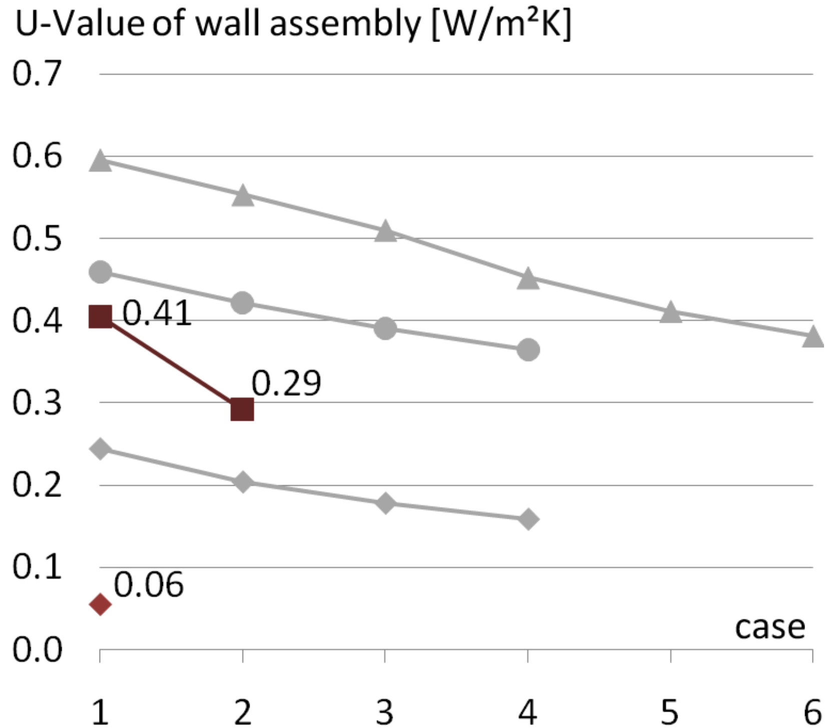
example D) and E) using "high tech" materials aerogel and VIP



	λ sheeting [W/mK]	U Wall [W/m²K]
1	0.014 (1.27 cm)	0.41
2	0.014 (2.54 cm)	0.29



	λ sheeting [W/mK]	U Wall [W/m²K]
1	0.003	0.06



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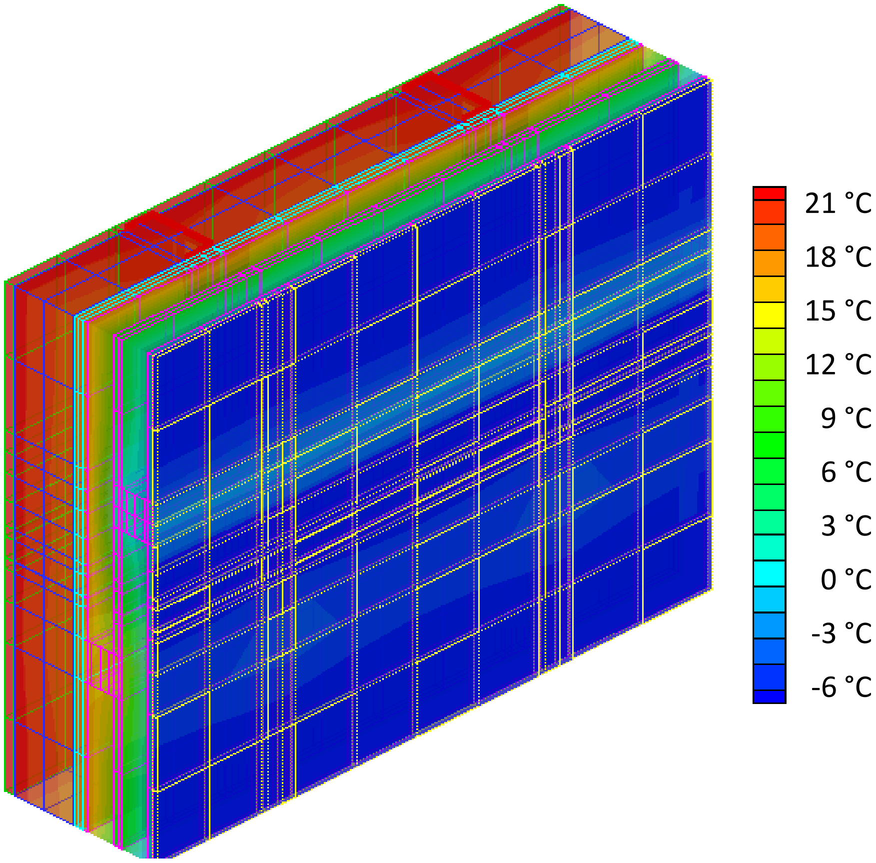
numerical analysis of different wall assemblies

example E) two layers foam covered VIP



By using materials with very high thermal resistivity the influence of the metal studs is nearly insignificant.

This is an interesting option, if the amount of space is limited, for example for retrofits.

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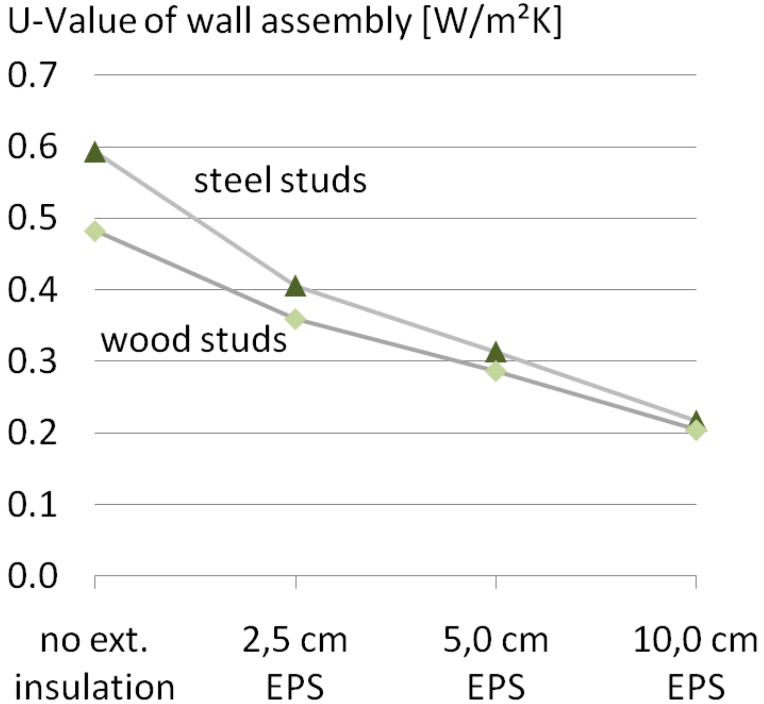
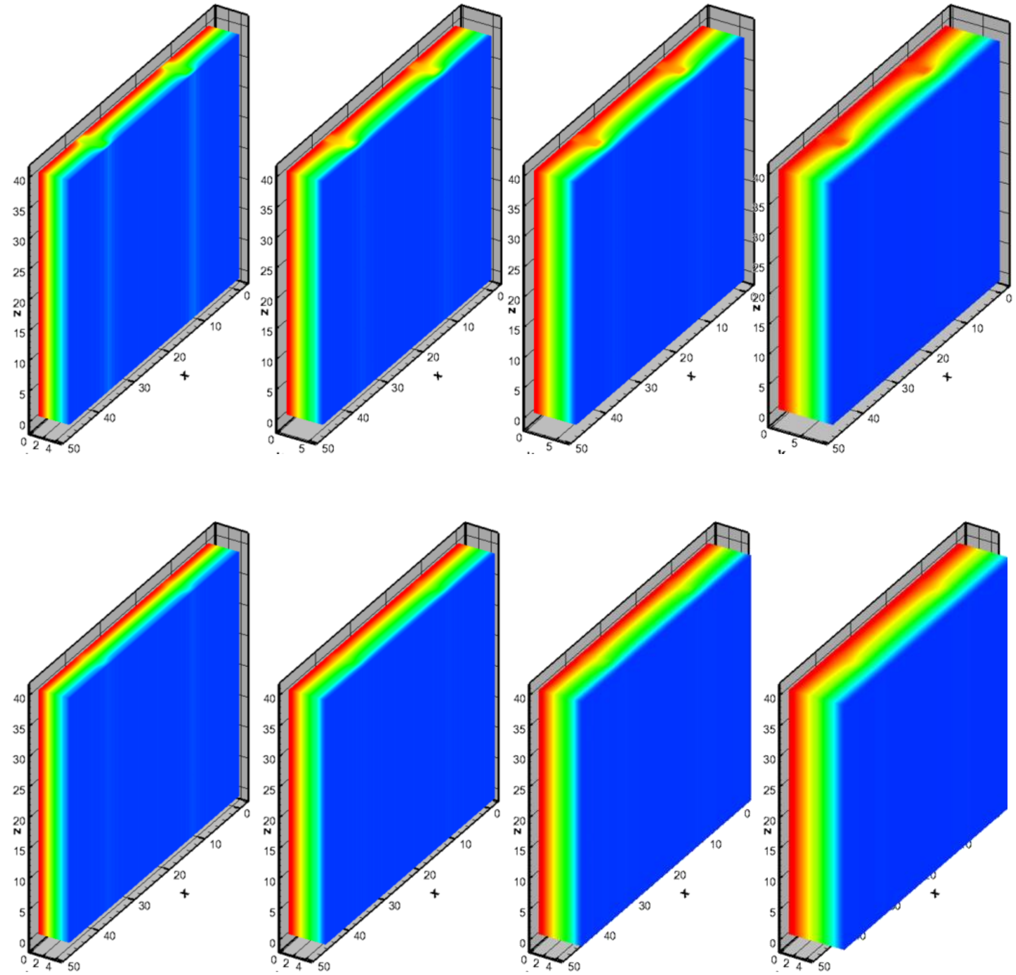
Conclusions and Outlook

wood vs. metal studs using EIFS





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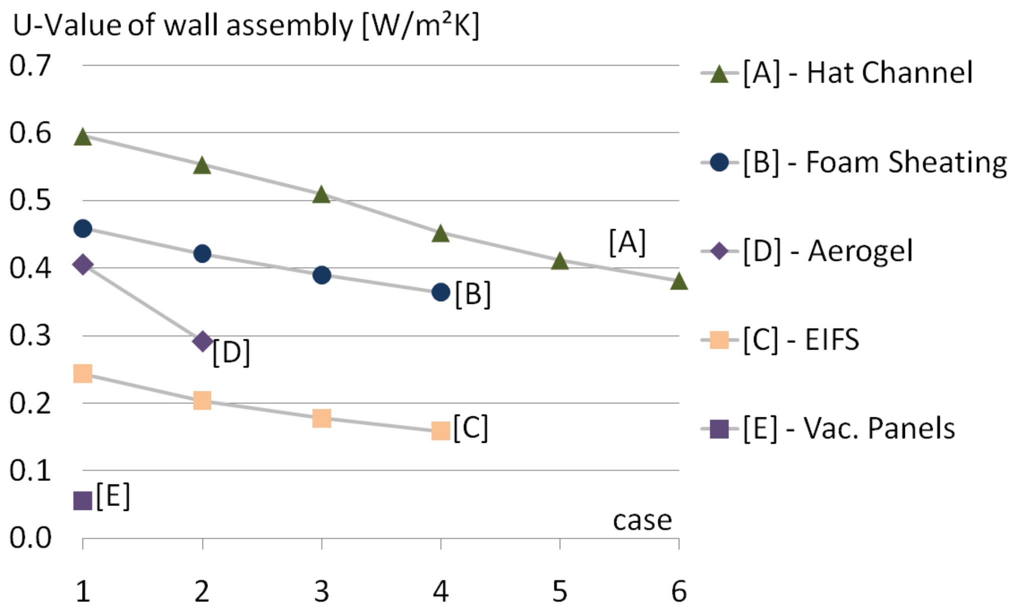
Conclusions and Outlook

metal studs can sharply reduce a wall's effective U-value, due to thermal bridging

with increasing amount of thermal insulation on the outside, these effects decrease and low U values can be achieved



high-end materials, as aerogel and VIP, can be seen as an outlook: as soon as they are available on economically acceptable scale, they are solutions if the amount of space is limited or installation of exterior insulation is prohibited

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thank you!

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