Numerical Examination of Thermal Bridging Effects at the Edges of Vacuum-Insulation-Panels (VIP) in various Constructions

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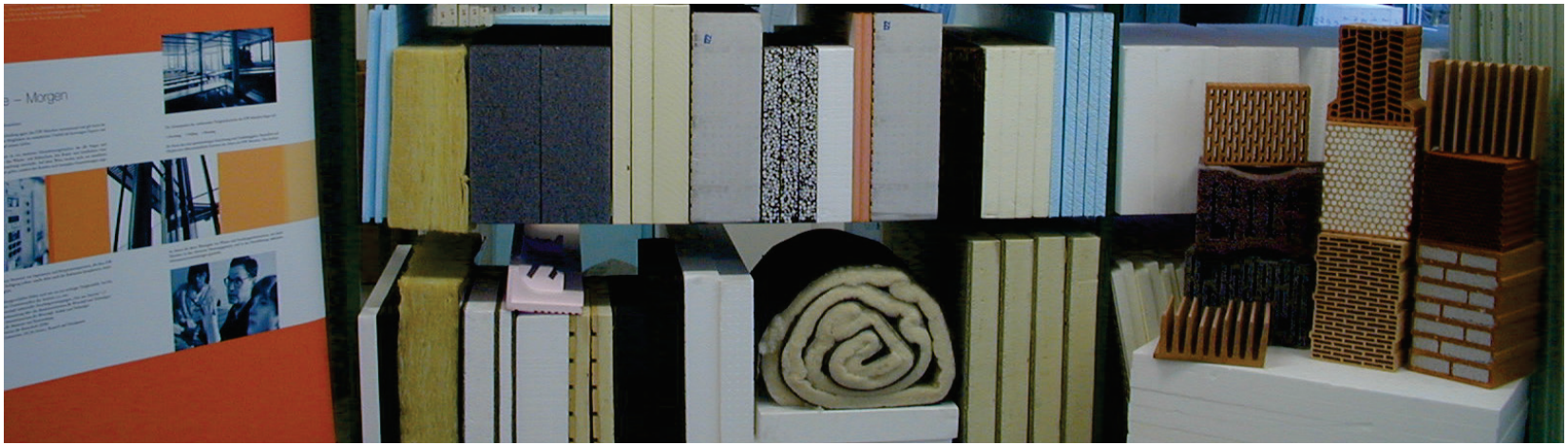

Introduction: FIW München


Forschungsinstitut für
Wärmeschutz e.V. München
FIW
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FIW München

- Organized in 4 divisions
  - Insulation for Buildings
  - Technical Insulation
  - Building Physics and Components
  - Certification
- Certification, Consulting, Assessment, Information and Training
- Reseach on thermal- and moisture protection of materials, components and buildings
- Testing, surveillance, measurement and simulation of hygrothermal properties
- Expert monitoring for development and market entry of new products

120 members of association

www.fiw-muenchen.de

- Manufacturers of insulating materials
- Manufacturers of building materials
- Manufacturers of building components and systems
- Insulating Organizations, Reseach- and testing institutes
- Building experts

Thermal Bridging Effects on VIP

Sensitivity of the System

Investigated influencing Factors

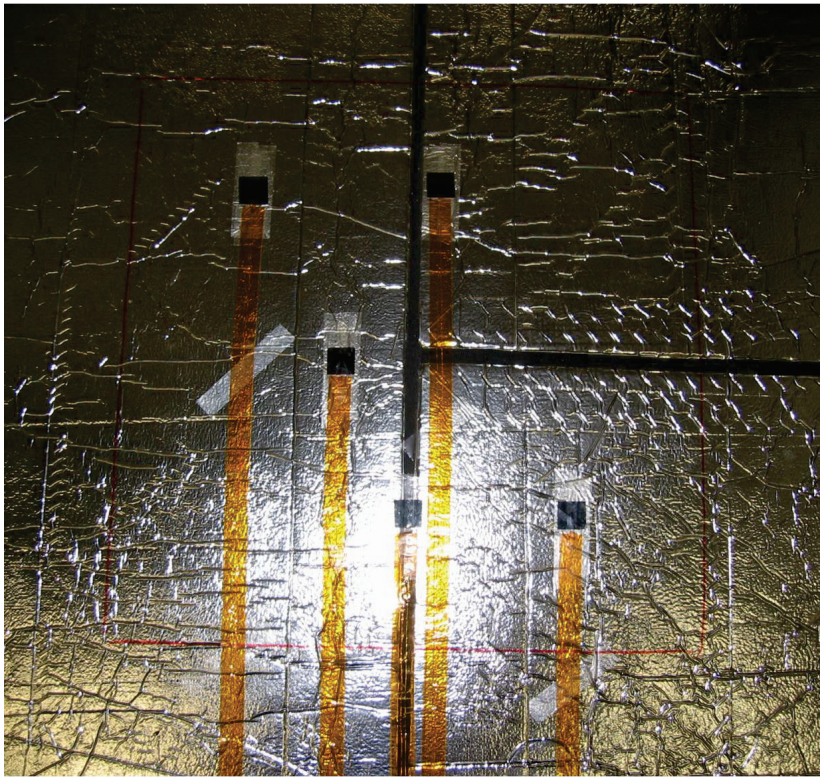
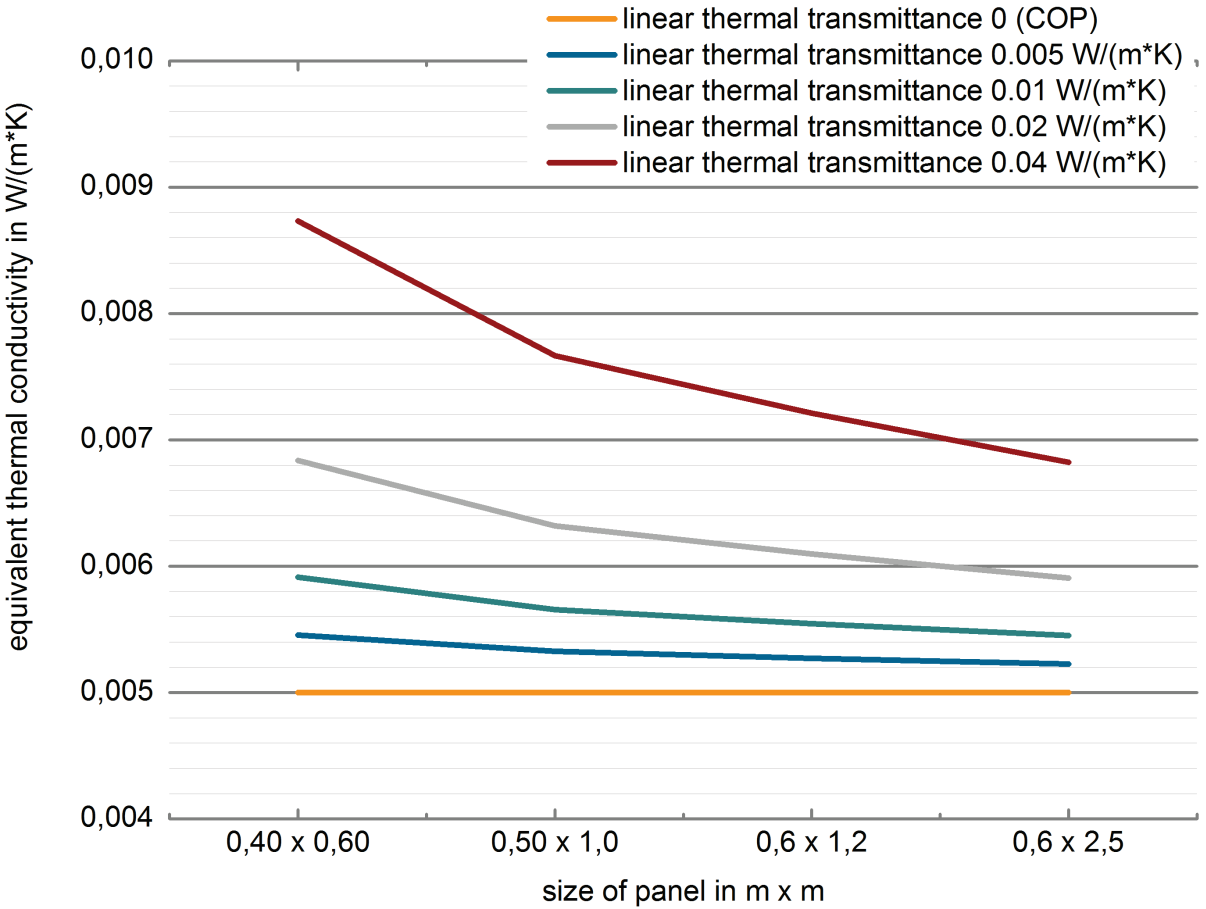


Photo: FIW Munich

- Edge design
- Material and thickness of barrier layer
- Gap width between two panels and gap filler material
- Cover layer material
- Mounting and fixing
- 2-layered constructions

Linear thermal transmittance vs. panel size

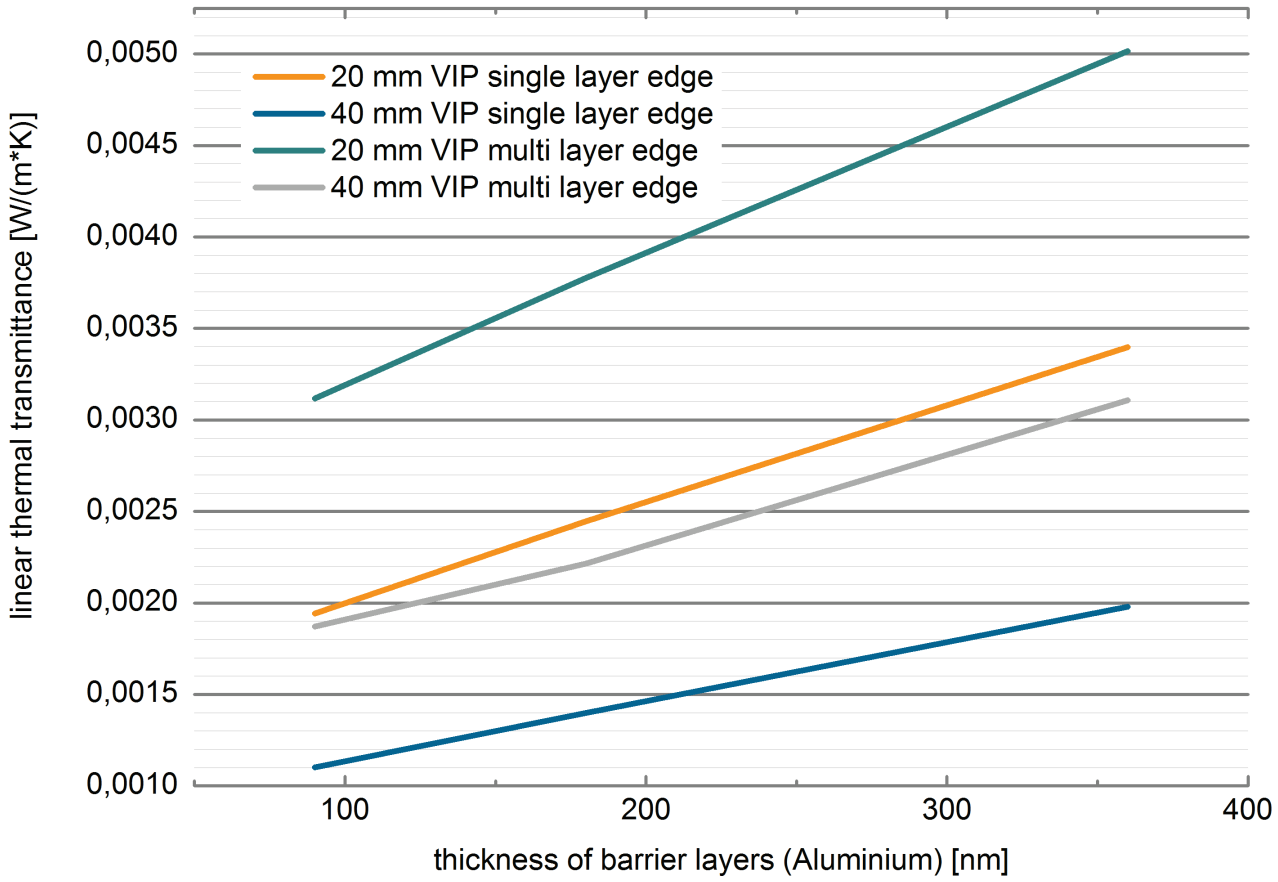


Edge Design

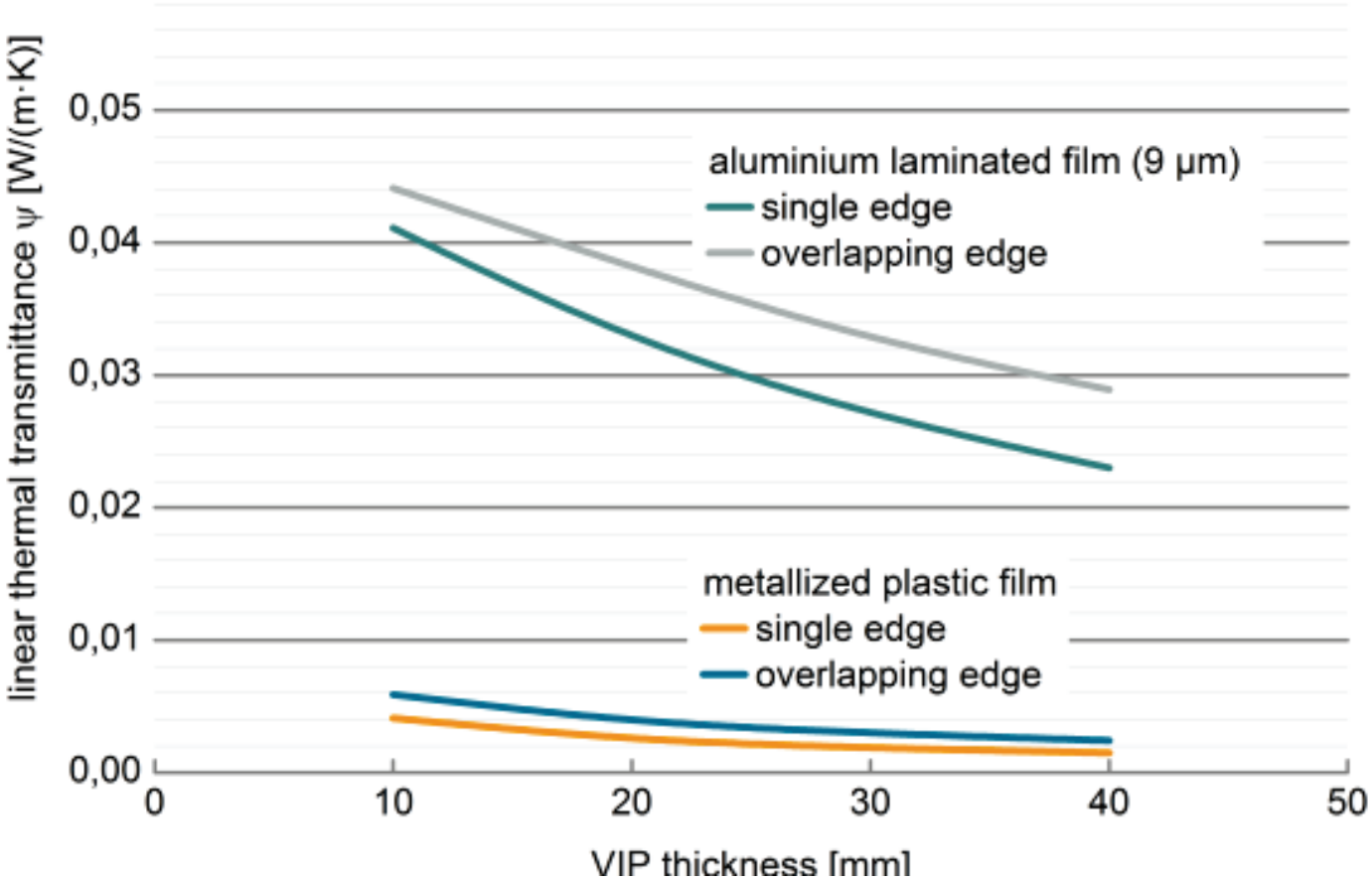
Top: single layer edges (also named concentric rim or single layer connection)

Bottom: multilayered edges with foil-welding areas (also named overlapping edge design or multi layered connection)

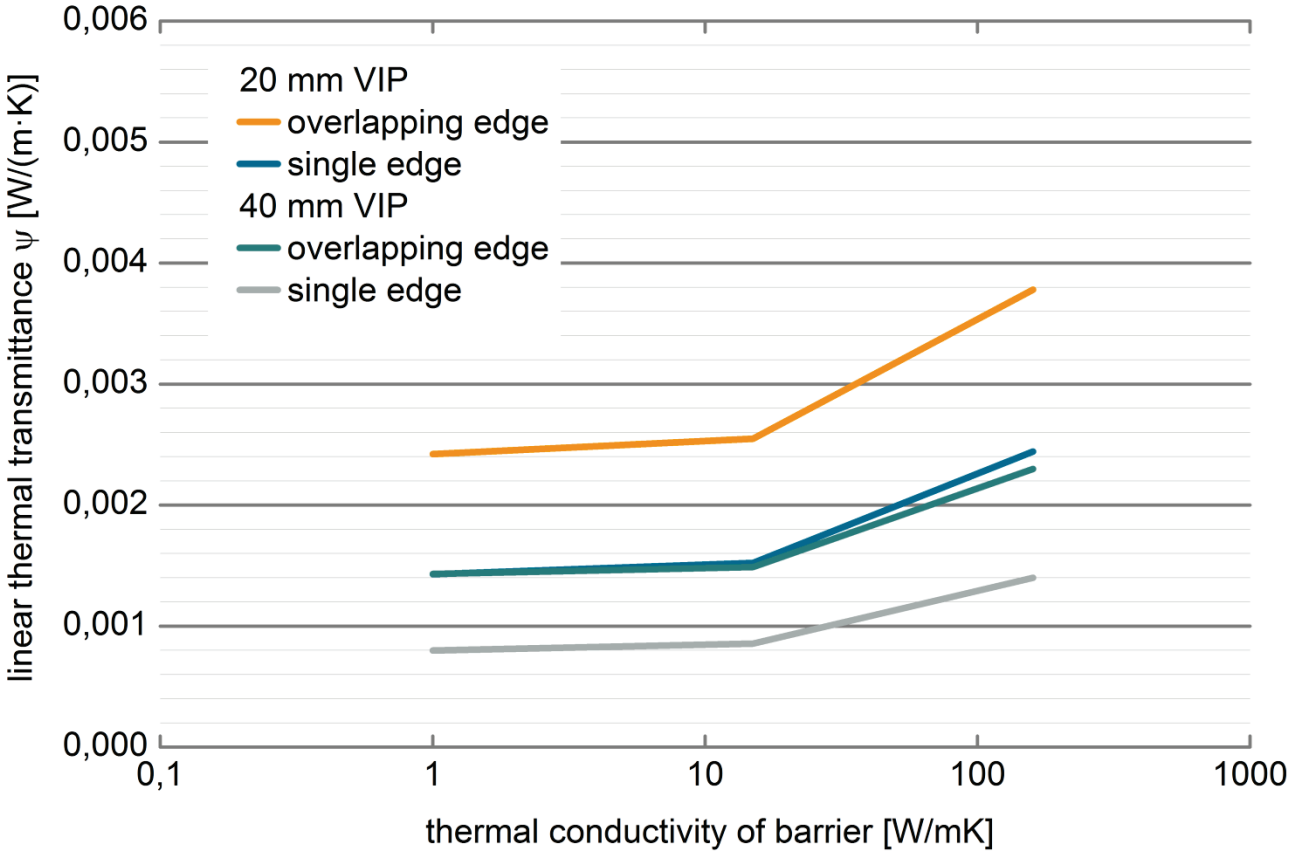
Edge design and thickness of barrier layer



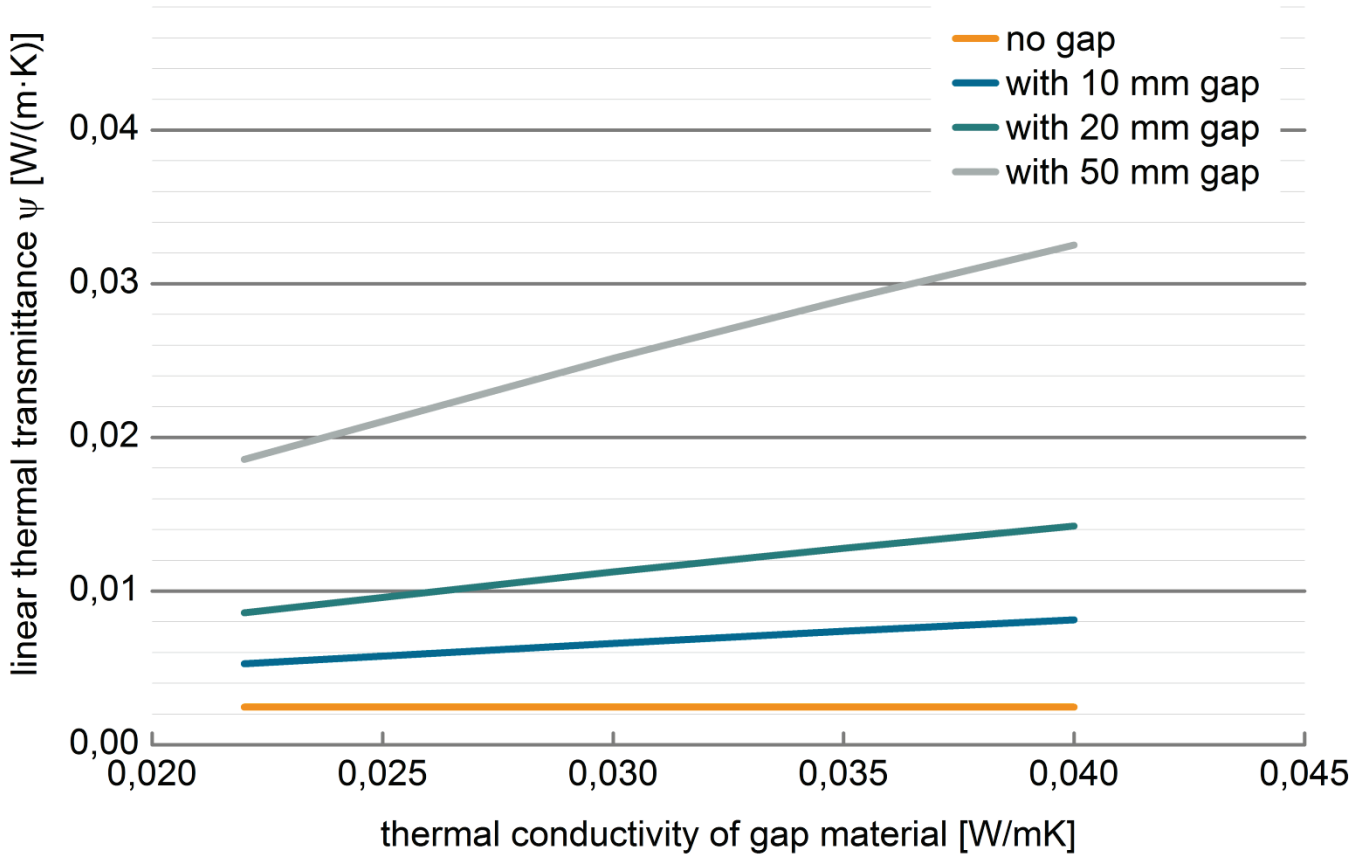
Edge design and thickness of barrier layer



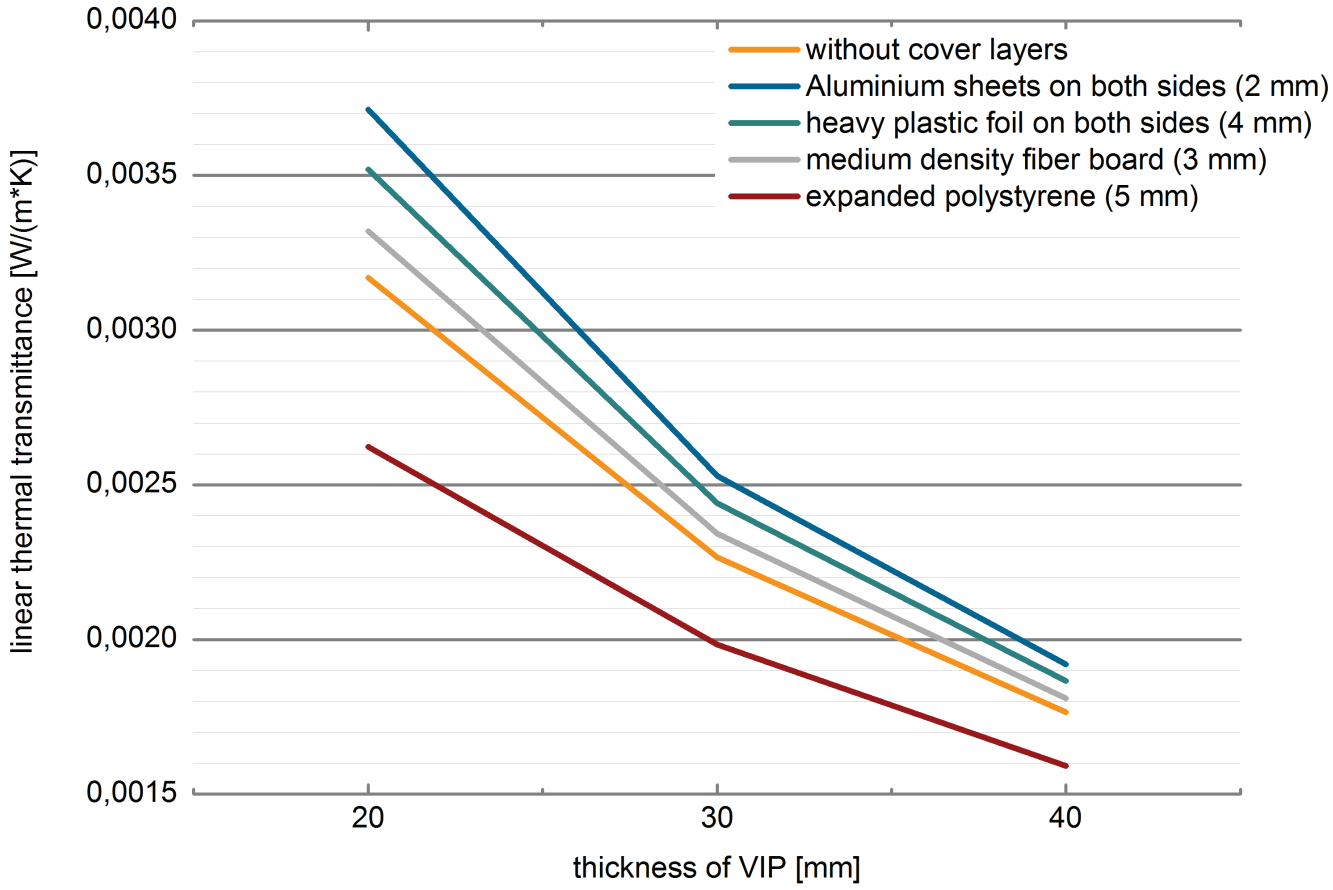
Thermal Conductivity of Barrier Material



Gap Width and Gap Filler Material



Cover Layer Material



3-dimensional effects

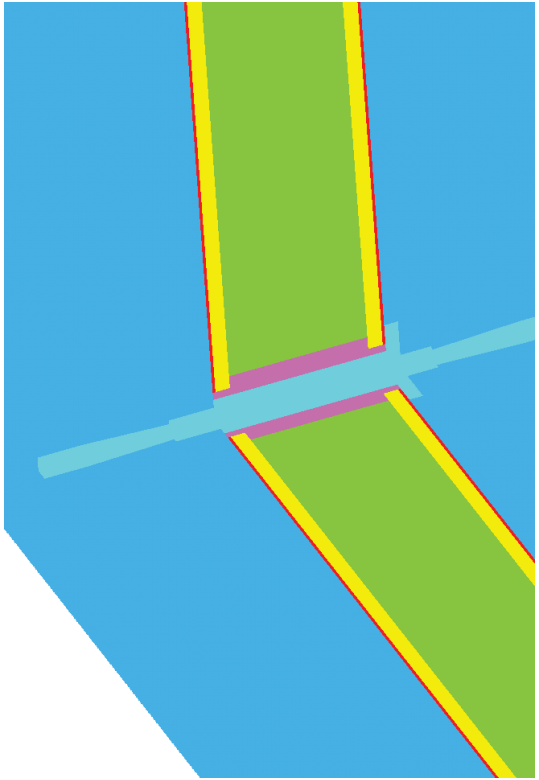
$$U_{Element} = \frac{Q_{Element}}{A_{Element} \cdot \Delta\vartheta}$$

$$Q_{Element} = \Delta\vartheta \cdot (U_0 \cdot A_{Element} + \sum \psi_i \cdot l_i + \sum \chi_i \cdot n_i)$$

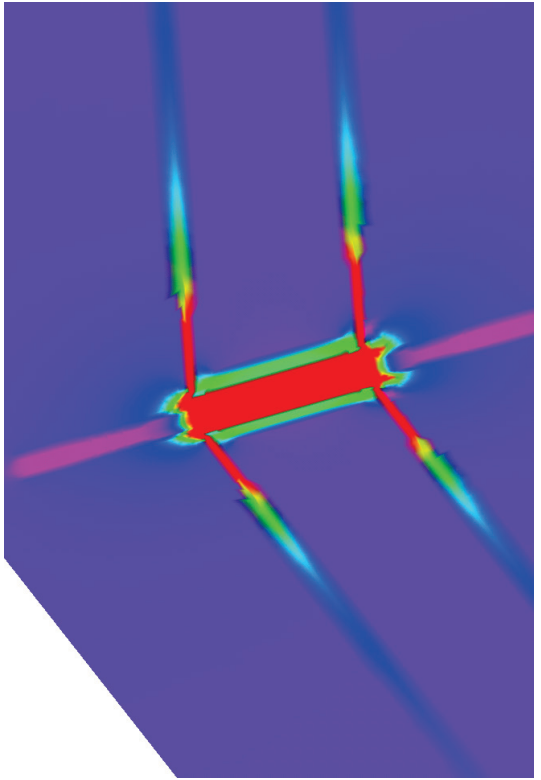
- 3-dim effects need to be taken into account in constructions
- Effect easily exceeds the 3 % criterium in ISO 6946 (up to +100 % in U-value)
- Use thermal breaks…
- Stainless steel or plastic anchors…
- Cover anchors by second layer of insulation…

Mounting and Fixing – prefab. components

Glass fiber reinforced anchors

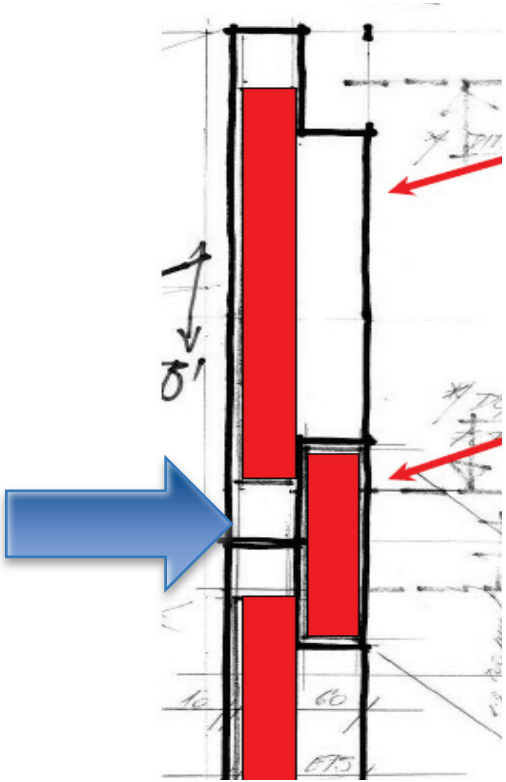


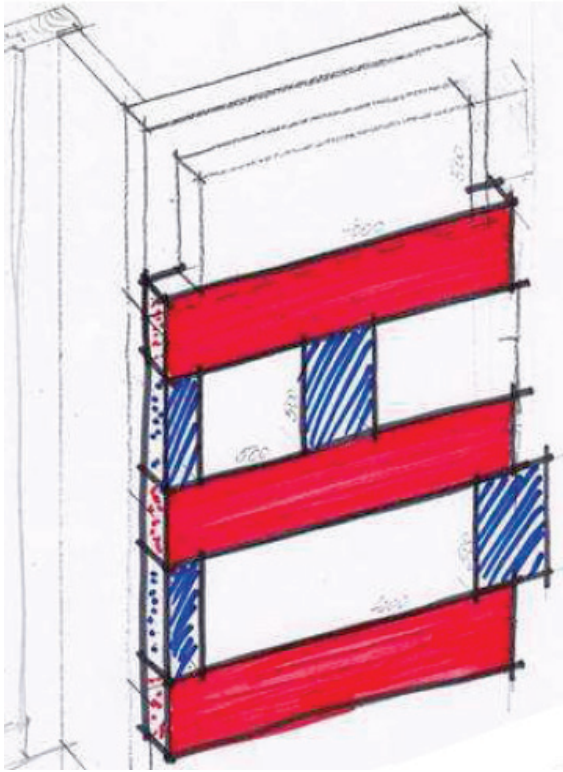
3-dim Model for simulation

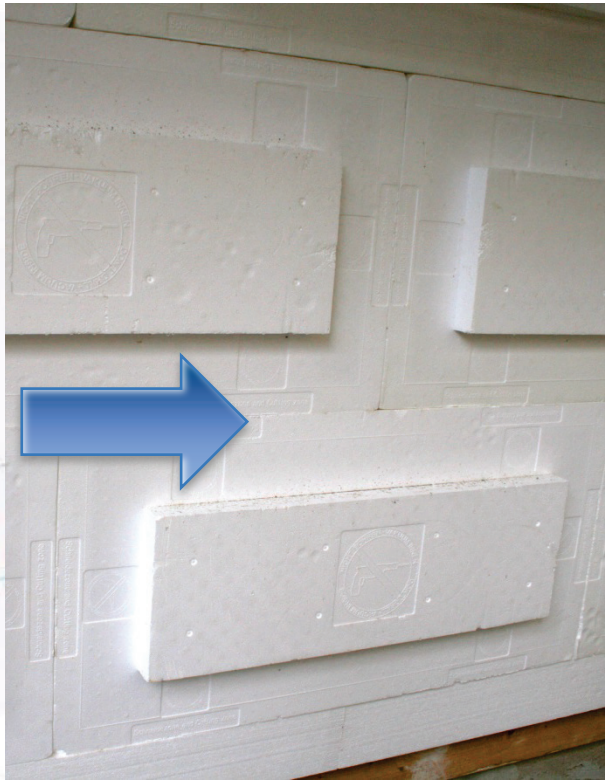


Total heat flux

Constructions with second layer







Drawing: St. Gobain weber maxit

Photo: FIW Munich

Summary: good VIPs and VIP-constructions

- Use unfavorable edge design only on shorter rims
- Use foils with thin barrier layers (but low permeation)
- Check for alternative barrier materials (SiOx; stainless steel)
- Use metallized multilayer foils (no Aluminium ultra-barrier foils)
- Avoid gaps between panels
- If gaps are unavoidable make sure to keep them as small as possible and fill them with insulating material
- Use cover layers made of insulating material
- Use multilayer constructions
- use plastic or stainless steel anchors