

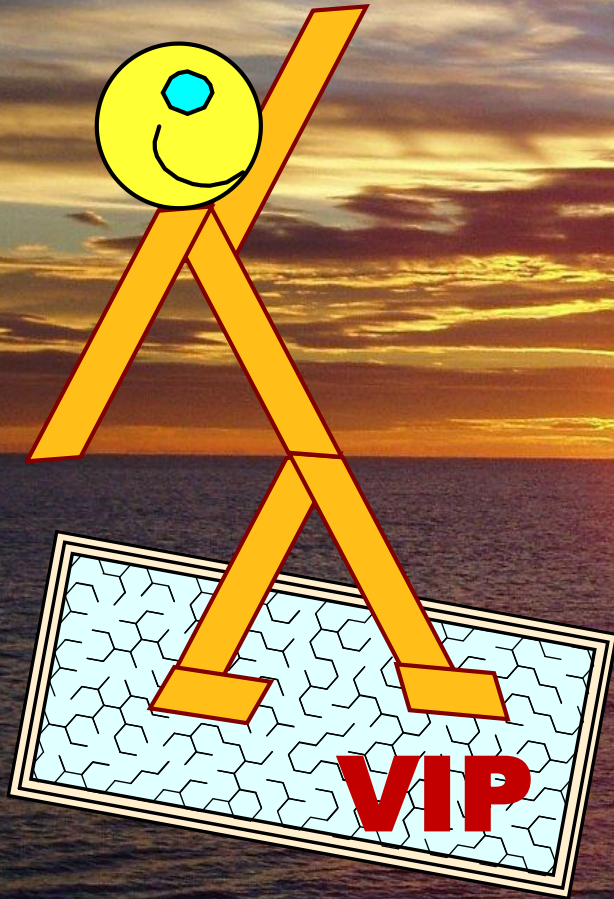
COMPARISON OF LABORATORY INVESTIGATIONS AND NUMERICAL SIMULATIONS OF VACUUM INSULATION PANELS IN VARIOUS WALL STRUCTURE ARRANGEMENTS

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**As a VIP I'm still in the game...!
... surfin' in the IVIS...**



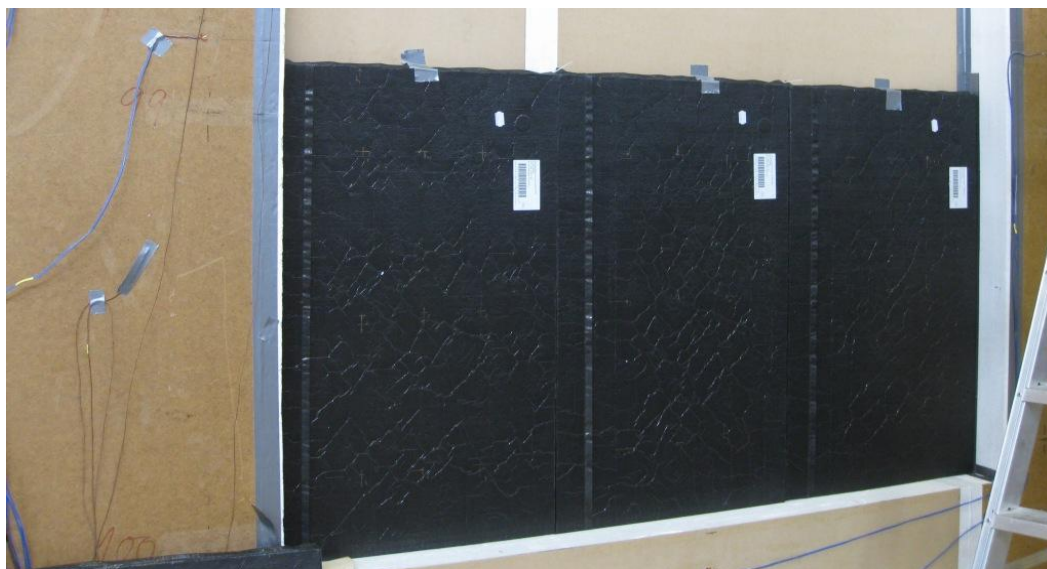
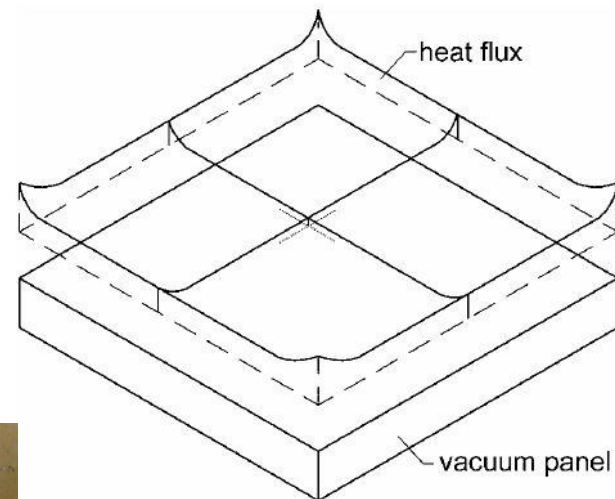
The ROBUST project

- Project funded through the research program *Robust Envelope Construction Details for Buildings of the 21st Century* (ROBUST).
- First of several large scale laboratory investigations on VIPs

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VIP thermal performance comparisons

- Comparison of numerical simulations and hot box measurements:
 - Edge loss thermal bridge values
 - U-values



Large scale laboratory investigations

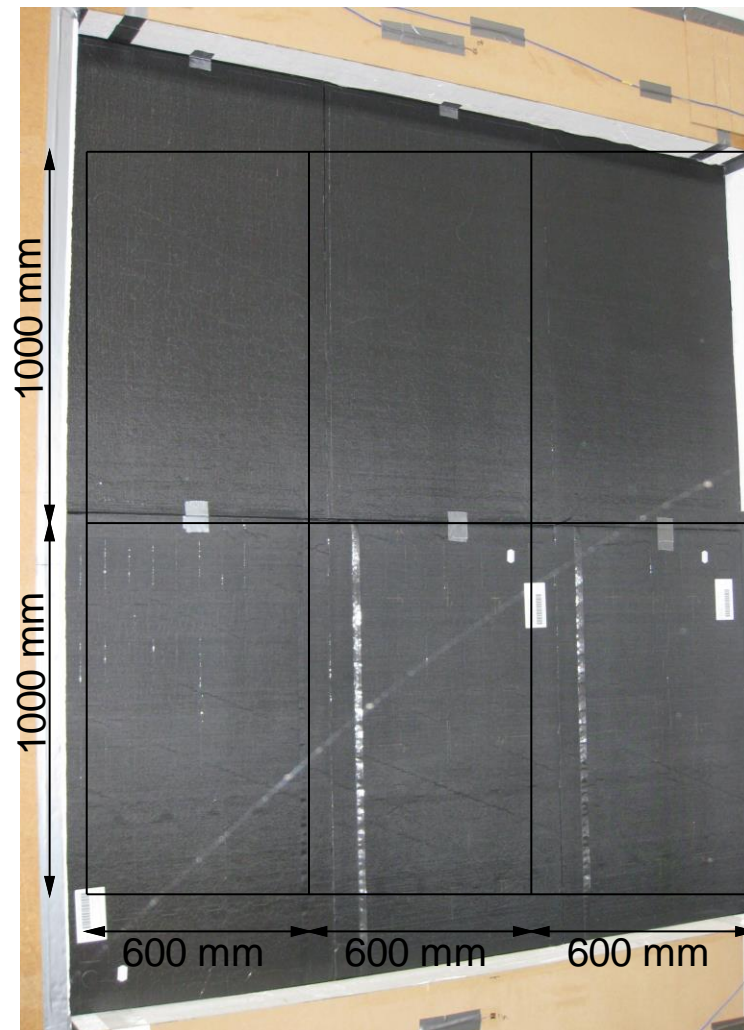
- Guarded hot box
 - 2.5 x 2.5m total measuring area
- Numerical simulations using 2D-finite element program, THERM



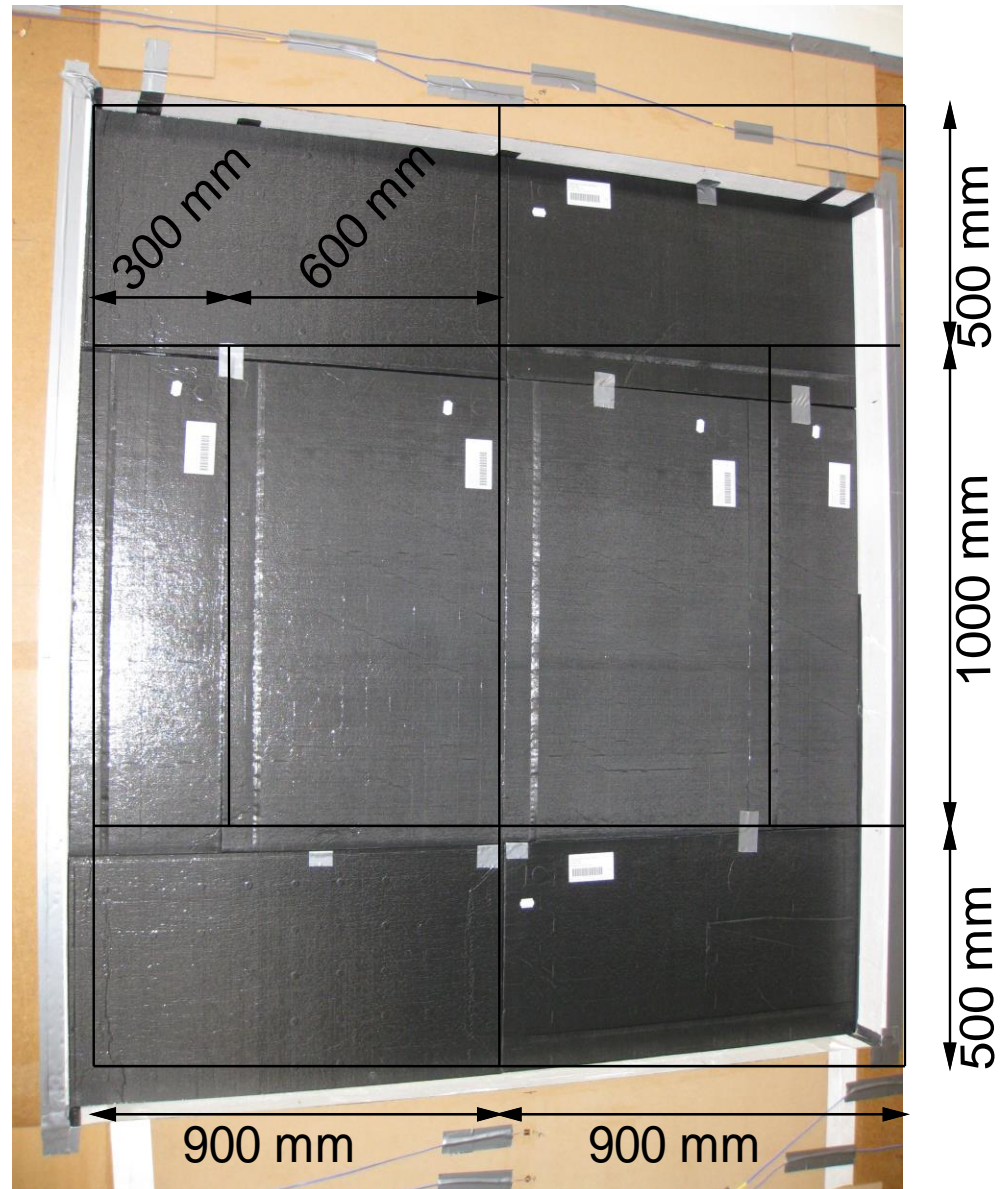
Hot box measurements

VIP configuration

- VIP test field
 - 1.8 m x 2.0 m
- VIPs covered with MDF boards during testing
- Test configurations;
 - Single layer of 40 mm VIPs,
 - Single layer of 40 mm VIPs with taped panel joints
 - Single layer of 20 mm VIPs
 - Double layer of 20 mm VIPs
 - Double layer of 20 mm VIPs with staggered joints



- Double layer of 20 mm VIPs with staggered joints

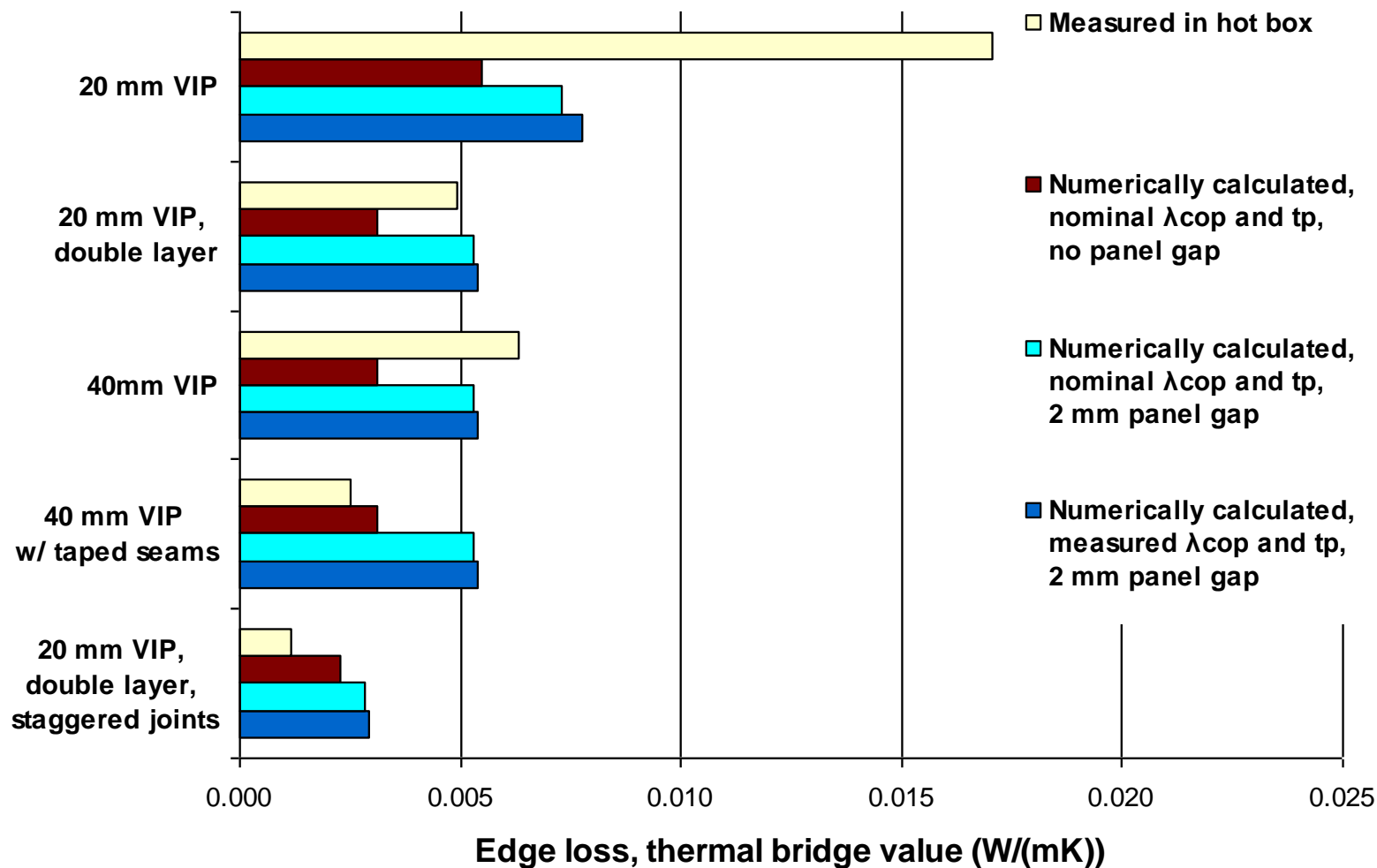


VIP physical properties

- Core conductivity
 - 20 mm VIPs measured to $\lambda_{\text{cop}} = 0.0042 \text{ W/(mK)}$
 - 40 mm VIPs measured to $\lambda_{\text{cop}} = 0.0044 \text{ W/(mK)}$
- Varying thickness
 - Measured values 5 % lower than declared values
- Varying height and width
 - Leads to panel gaps



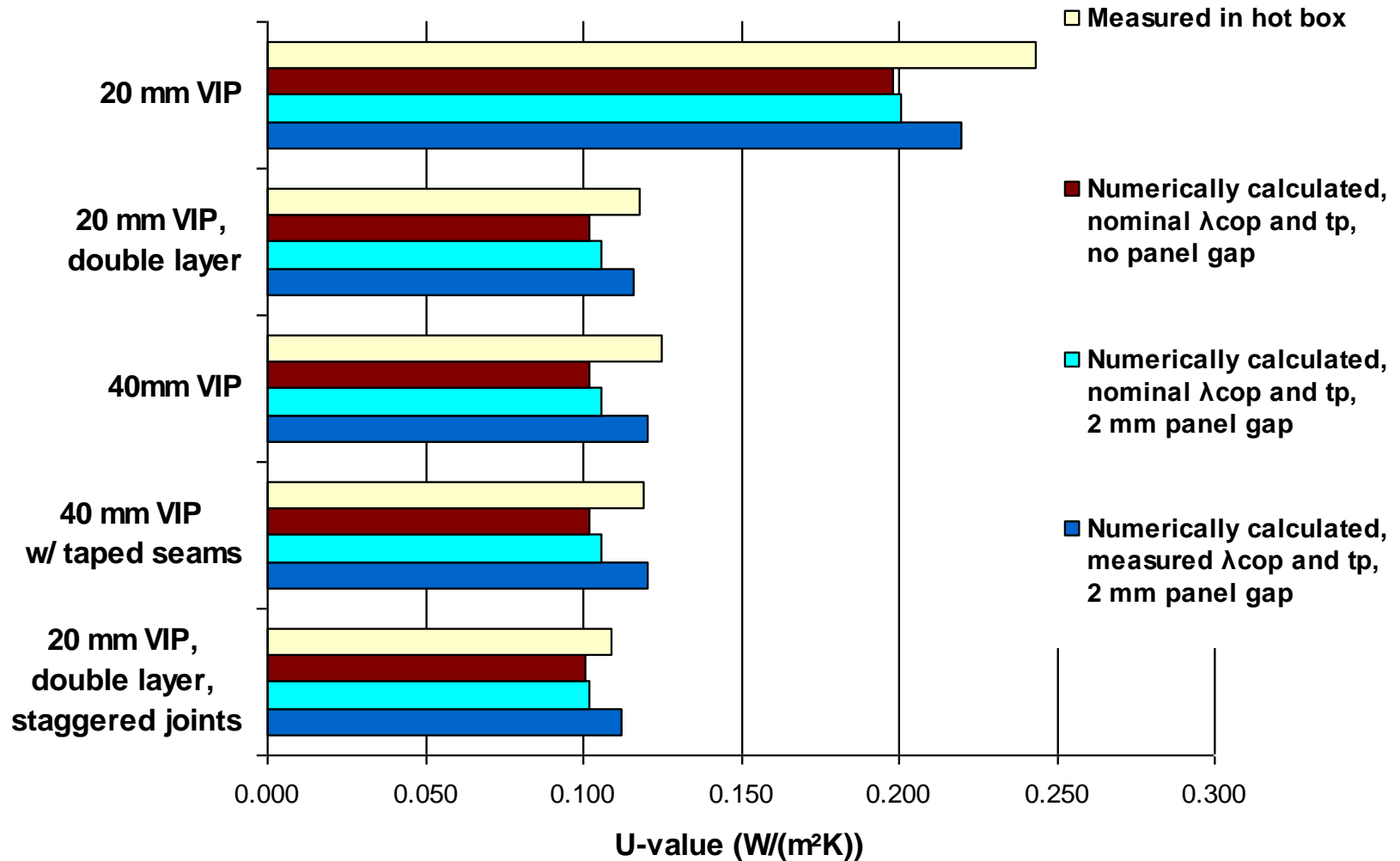
Comparison of VIP linear thermal bridge values using hot box measurements and numerical simulations



Comparison of U-values

Hot box VIP test configuration	Numerically simulated U-value test field U_{wall} (W/(m ² K))	Hot box measured U-value test field U_{wall} (W/(m ² K))
20 mm	0.219	0.234 ± 0.001
20 mm double layer	0.116	0.115 ± 0.001
40 mm single layer	0.121	0.122 ± 0.001
40 mm single layer w/tape	0.121	0.116 ± 0.001
20 mm double layer, staggered joints	0.112	0.109 ± 0.001

Comparison of VIP U-values using hot box measurements and numerical simulations



Conclusions

- Minor differences between staggered and non-staggered layout for 40 mm layers
- Numerical simulation methods suitable for calculating U-values
- Panel properties should be accounted for
 - Thickness of panels.
 - Core conductivity

Thank you for your attention

Questions?