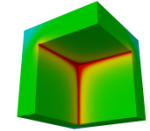


AnTherm

the software system for
Analysis of Thermal
behaviour of building constructions
with thermal bridges

<http://antherm.eu/>

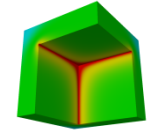


Avoiding thermal bridges supported by the three dimensional analysis of heat flux and vapour transport in building components.

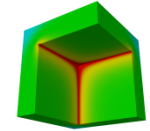
Calculation and visualization of thermal heat bridges by tracing the heat- and vapour stream.

Examples and capabilities available for such calculations by using the three dimensional simulation software AnTherm.

T.Kornicki, Vienna

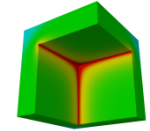


- The building envelope as thermal- and vapour diffusion bridge
- The development history of stable and practical tool commonly evolving in parallel to European standards
- Three dimensional visualization – the added value to building physics
- Modelling examples
 - Thermal renovation of a balcony – searching for the optimal solution
 - Slab over carport – three dimensional effects and localizing thermal bridges
 - Not insulated garage slab – core condensation and damage due to freezing caused by extensive vapour diffusion
 - Basement deep in ground – dynamic transient problem, harmonic coupling coefficients and the phase lag
- Discussion and conclusion



Tomasz Kornicki

- Physicist and computer scientist
- “IT Services” in Vienna
- Scientific and Management Consultancy since more than 25 years
- Software Tools for Building Physics
- Reliable partner for high performance simulation, supercomputing and (not only scientific) visualisation
- Lecturer at TU-Vienna, Danube-Univ. ,...
- International Building Performance Simulation Association

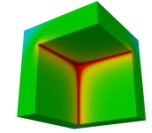


AnTherm

- AnTherm = the hymn (anthem)

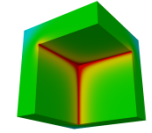
In memoriam of **Dr. Walter Heindl** (†1994), author of the concept of **Base Solutions** and the **Thermal Coupling Coefficients (Leitwerte)**

- The kernel of these theoretical concepts have been directly adopted into the „**Thermal Bridge Standards**“ **EN ISO 10211**, thus stringent **conformity to the standard** is easily and automatically provided by **AnTherm!**



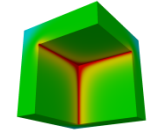
Visualisation

- **“Making visible”** of heat flow processes within the interior of a building component thanks to **employing progressive visualisation technologies**, finally now deployed into the **building physics** in its **precious quality**.
- The **thermal bridge** can be **analysed and developed** like the game.
- **„Pictures speak louder than words...“**
- Results are **meaningful** to “non physicists” and can be **easily understood** by non professionals!



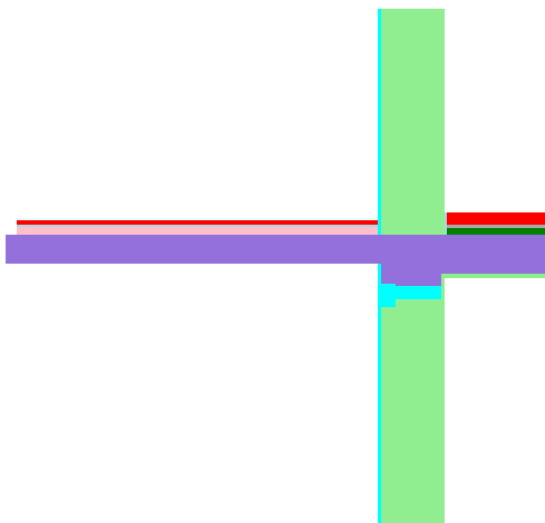
Short presentation

Thermal Bridge Simulation
and
Visualisation in 2D, 3D and 4D
with
AnTherm

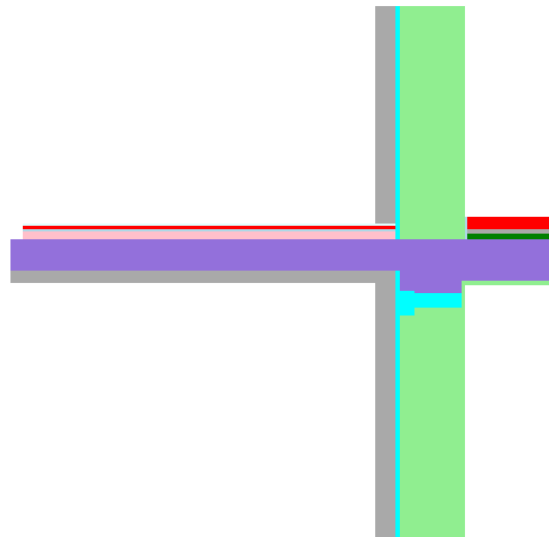


Renovating the balcony

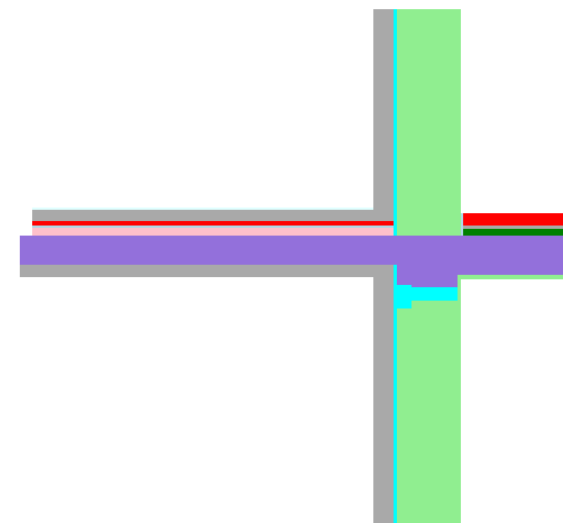
Simulation in 2D
with
AnTherm



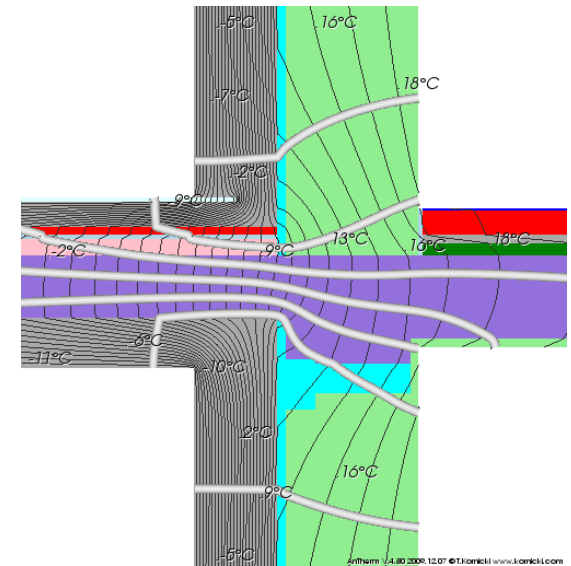
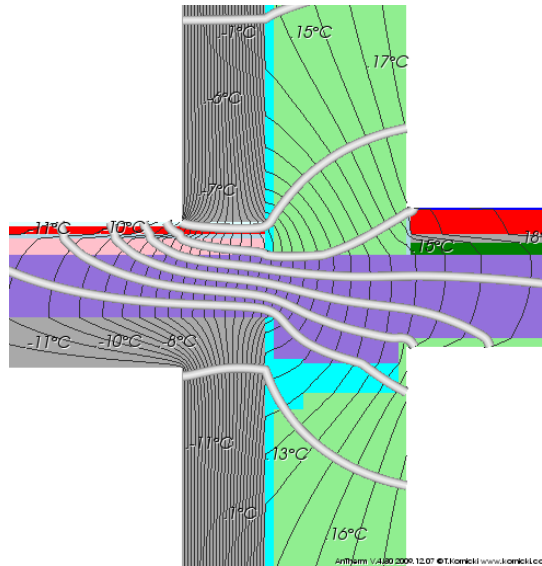
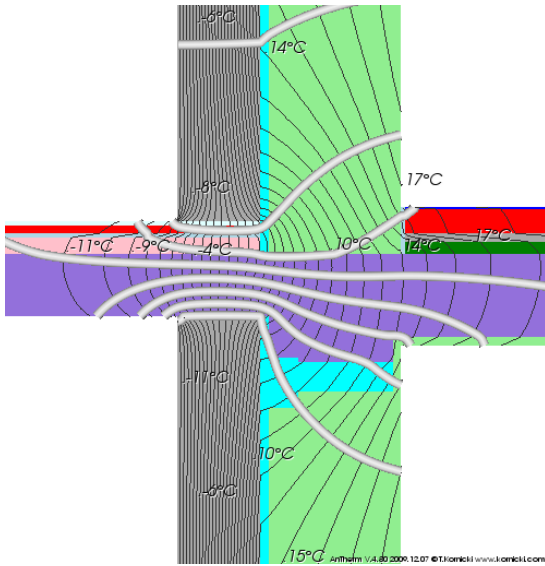
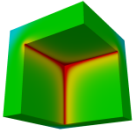
AnTherm V4.80.2009.12.07 ©T.Kornicki www.kornicki.com



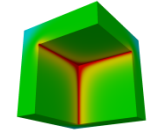
AnTherm V4.80.2009.12.07 ©T.Kornicki www.kornicki.com



AnTherm V4.80.2009.12.07 ©T.Kornicki www.kornicki.com



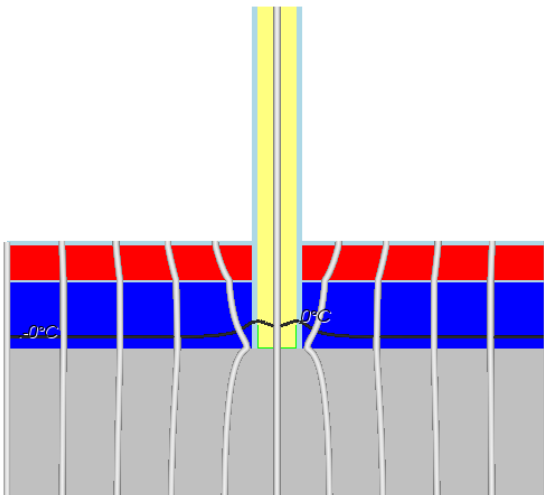
		U [W/m ² K]	L2D [W/mK]	Vergl. zu V1	ψ [W/mK]	T* [°C]	fRsi
V1	Without insulation	1,2466	3,6822		0,4409	8,91	0,65
V2	Wall insulation 10cm	0,3028	1,4400	39%	0,6526	13,53	0,80
V3	+ Balcony bottom insul. 6cm	0,3028	1,3293	36%	0,5419	14,31	0,82
V4	+ Balcony total insulation	0,3028	1,0998	30%	0,3124	15,87	0,87
V2'	Wall insulation 20cm	0,1724	1,0611	29%	0,6130	14,71	0,83
V3'	+ Balcony bottom insul. 12cm	0,1724	0,9697	26%	0,5215	15,33	0,85
V4'	+ Balcony total insul. (12cm/6cm)	0,1724	0,7640	21%	0,3159	16,73	0,90



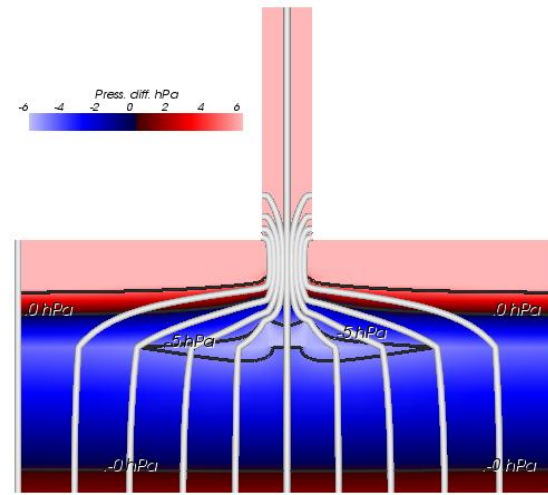
Garage slab without insulation

Condensation and freezing

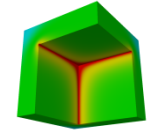
Simulation in 2D
with
AnTherm



AnTherm V4.80 2009.12.07 © T.Kornicki www.kornicki.com



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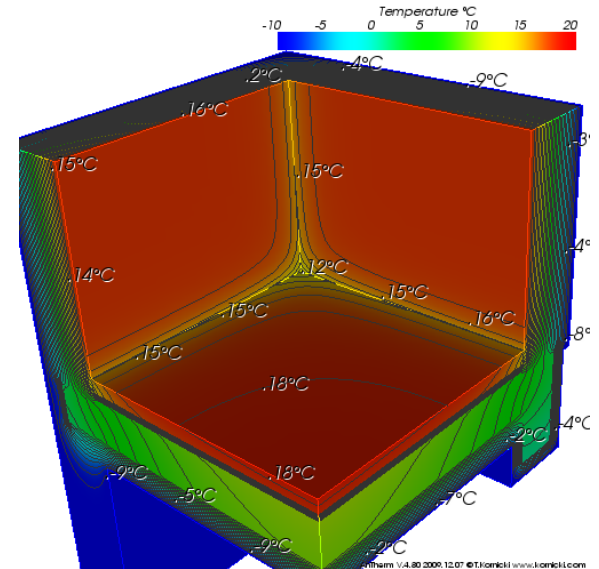
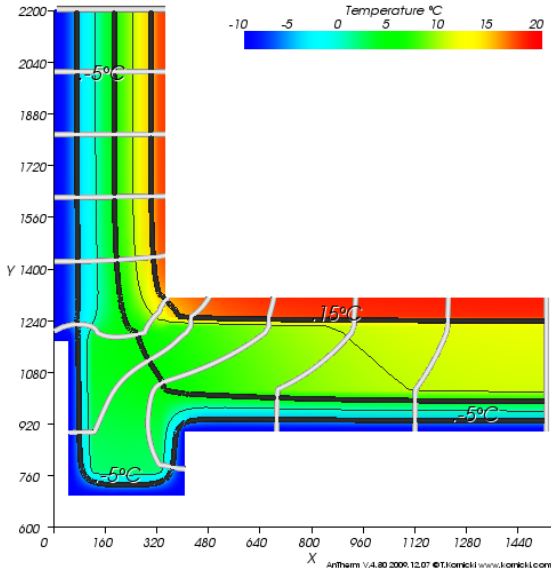
Slab over carport

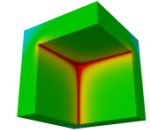
Localising thermal bridges

Simulation in 2D and 3D

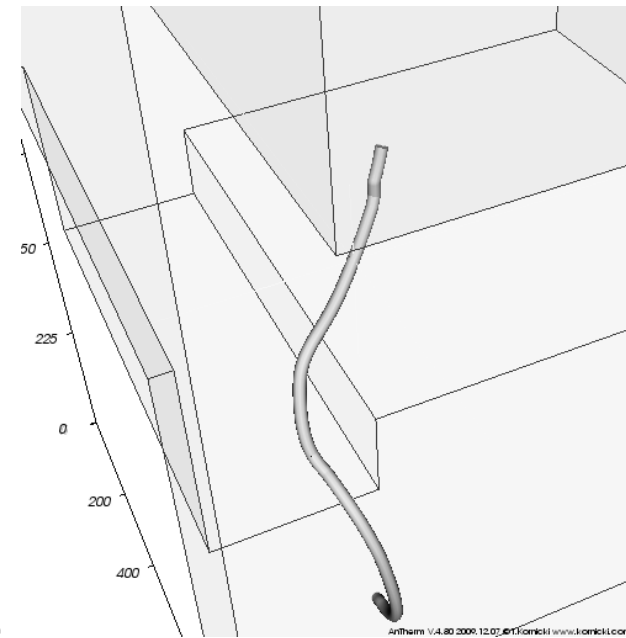
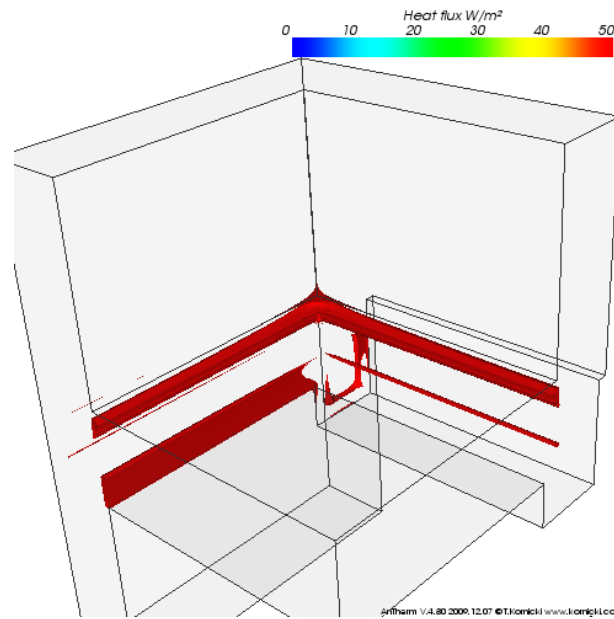
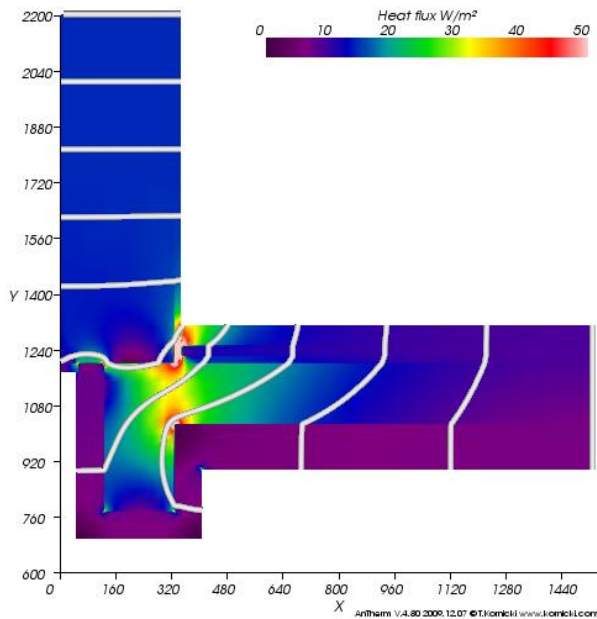
with

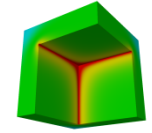
AnTherm





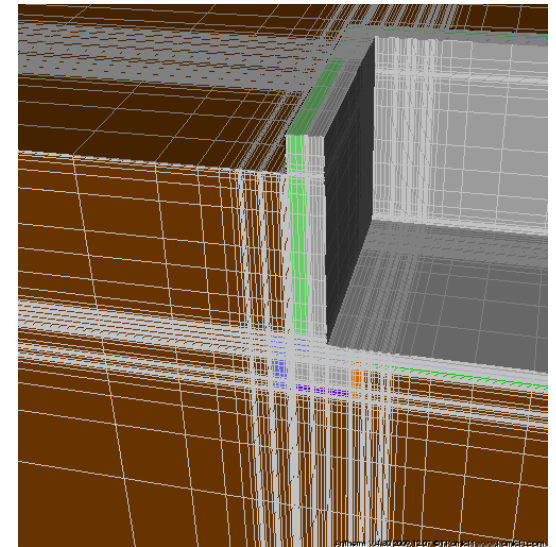
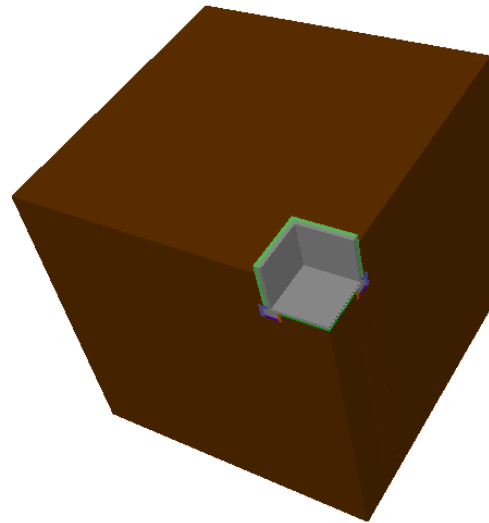
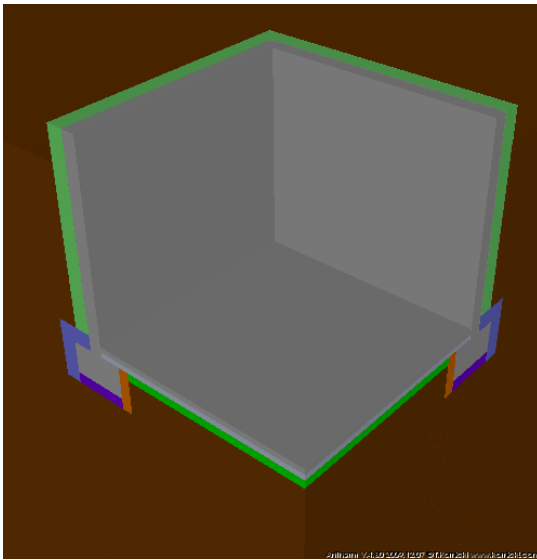
- 2D calculated result :
 $T^* = 15,22^{\circ}\text{C}$, $fR_{si} = 0.84$
- but
- 3D calculation leads to :
 $T^* = 11.08^{\circ}\text{C}$, $fR_{si} = 0,70 !$

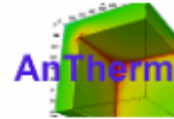
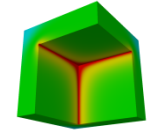




Groundwork

Simulation in 3D mit **AnTherm**





File: D:\Entw\01 Forum Passivhaus Poznan\Pyszczek\STOPA FUNDAMENTOWA-01_tko.antherm

Number of evaluated cells: 538272 (Nodes > 4306176)

Boundary conditions and resulting Surface Temperatures / Condensing Humidity

	Air temperature [°C]	min.temperature [°C]	max.temperature [°C]	Condensing.H. [%]
INDOOR	16,00	11,35	15,56	73,90 %
OUTDOOR	-20,00	-20,00	-19,51	100,00 %

Boundary conditions

f_{Rsi}^*
0,87 Extremes and surface condensation

Weighting factors for coldest surface point of each room

	INDOOR	OUTDOOR
g(INDOOR)	0,870846	0,000098
g(OUTDOOR)	0,129154	0,999902

Weighting factors (g-values)

Coordinates (x,y,z) for coldest surface point of each room

	x	y	z	Temp.[°C]
INDOOR	-125,0000	-125,0000	800,0000	11,35
OUTDOOR	20000,0000	20000,0000	3700,0000	-20,00

f_{Rsi}^*
0,87 Critical locations

Thermal Coupling Coefficients [W / K]

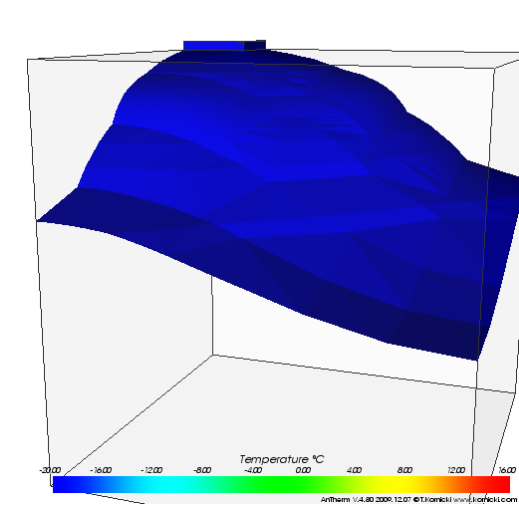
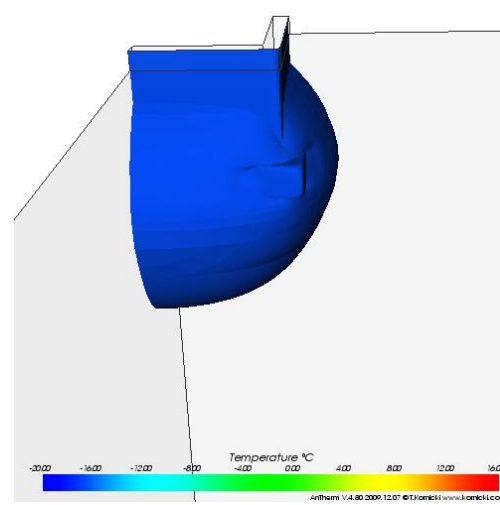
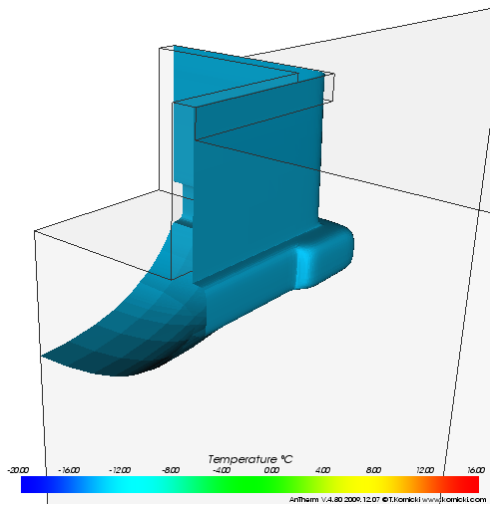
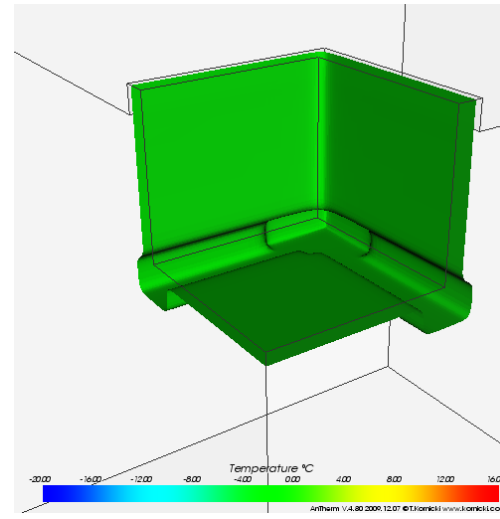
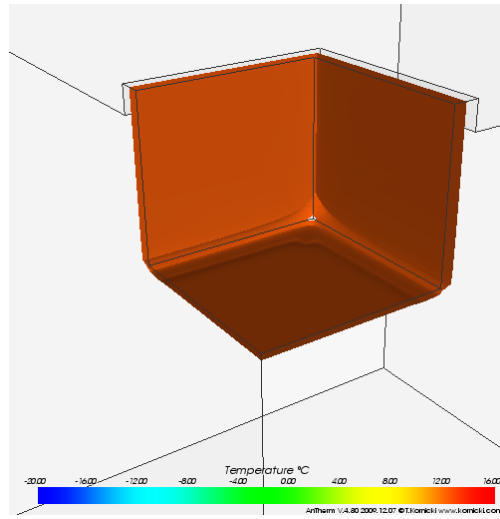
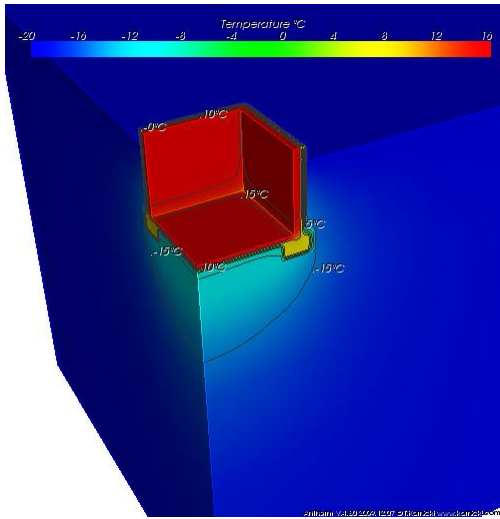
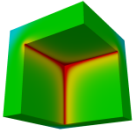
Room\Room	INDOOR	OUTDOOR
INDOOR		6,741698
OUTDOOR	6,741750	

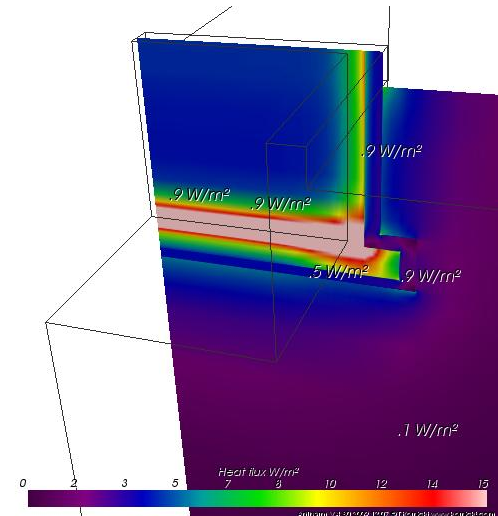
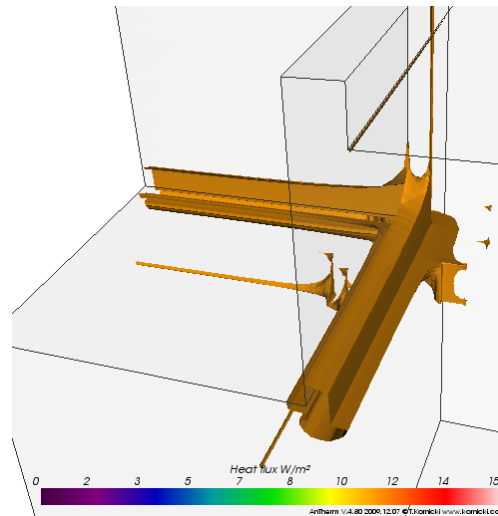
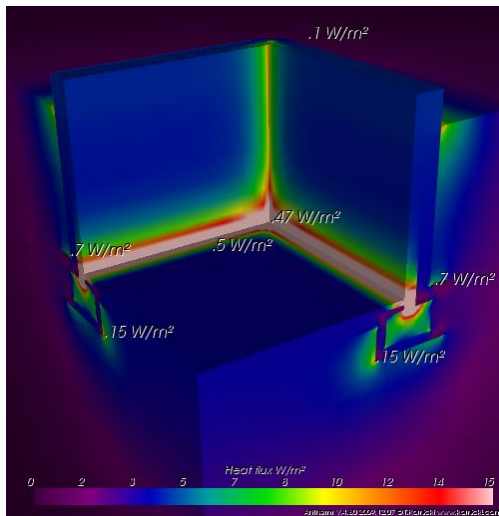
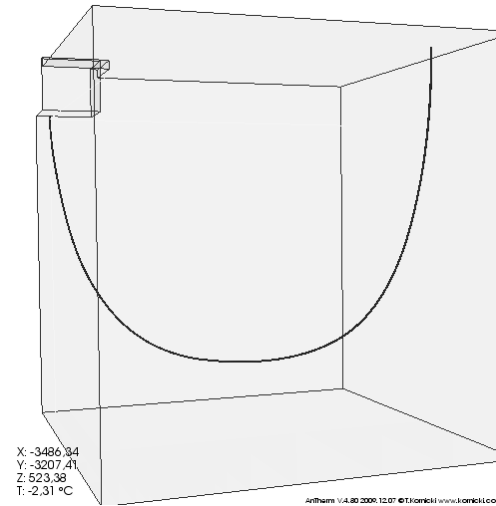
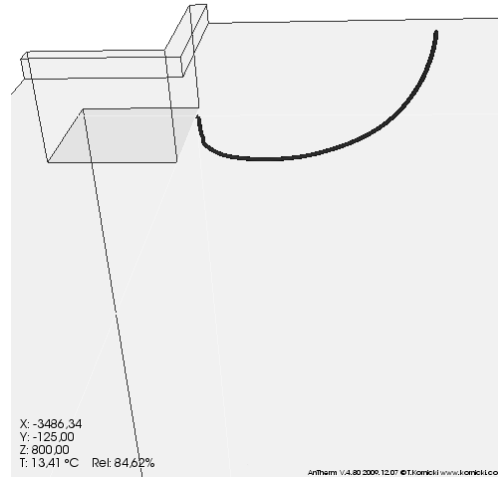
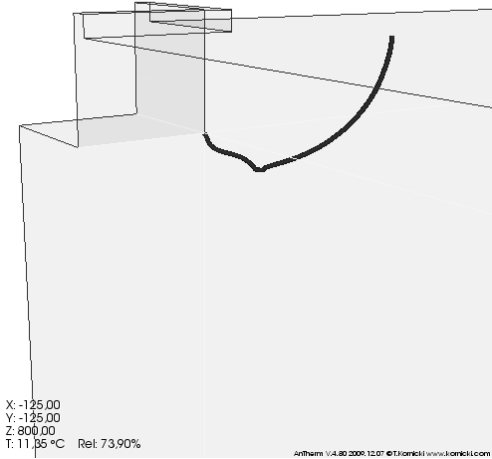
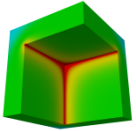
Coupling Coefficients (Thermal Heat Loss Factors)

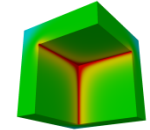
Precision information

	Close-up error [W / K]	Coeff. sum [W / K]	Relative close-up error
INDOOR	5,29186e-005	6,741750	7,84938e-006
OUTDOOR	-5,29186e-005	6,741698	-7,84944e-006

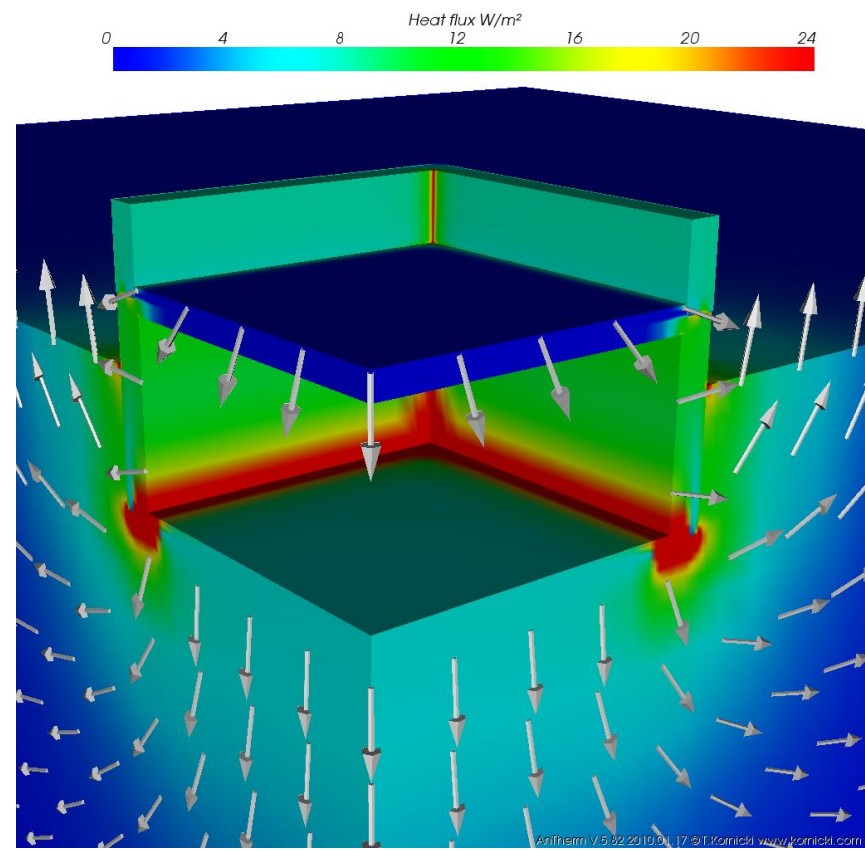
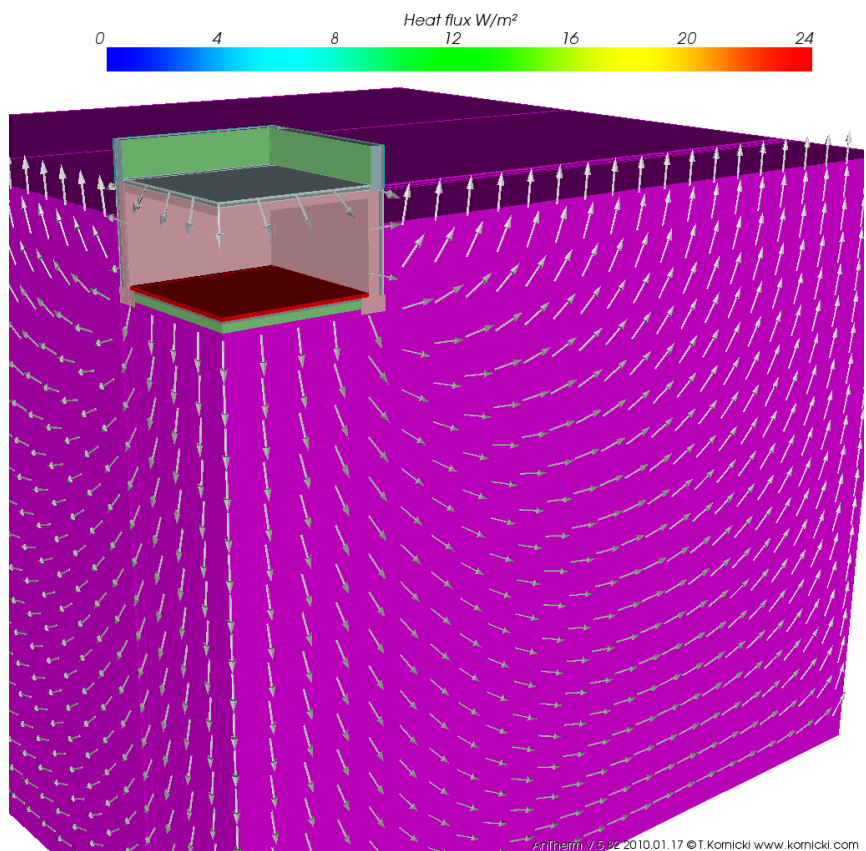
Precision information (error estimates)

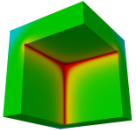






Foundation deep in ground dynamic transient problem Harmonic simulation in 3D





Harmonic thermal coefficients and the dependant Phase Lag of heat losses following the temperature changes

- calculated **directly**
- independent of boundary conditions (no need to know them)
- shown as complex number and as the amplitude and phase lag

Thermal Coupling Coefficients [W / K]

Space\Space	Room 0	Room 1	Room 2
Room 0		2,116365	15,705269
Room 1	2,116364		10,089766
Room 2	15,705270	10,089766	

Steady state coefficient heat loss factor

Harmonic Thermal Conductance for the period of 31536000 s Year

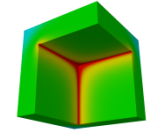
Space\Space	Room 0		Room 1		Room 2	
	Re	Im	Re	Im	Re	Im
Room 0	-372,1741	-343,2399	2,1133	-0,0619	7,2899	-2,9619
Room 1	2,1130	-0,0616	-12,2096	-0,4732	10,0850	-0,2125
Room 2	7,2866	-2,9647	10,0853	-0,2123	-28,3451	-6,3106

harmonic coefficient heat loss factor

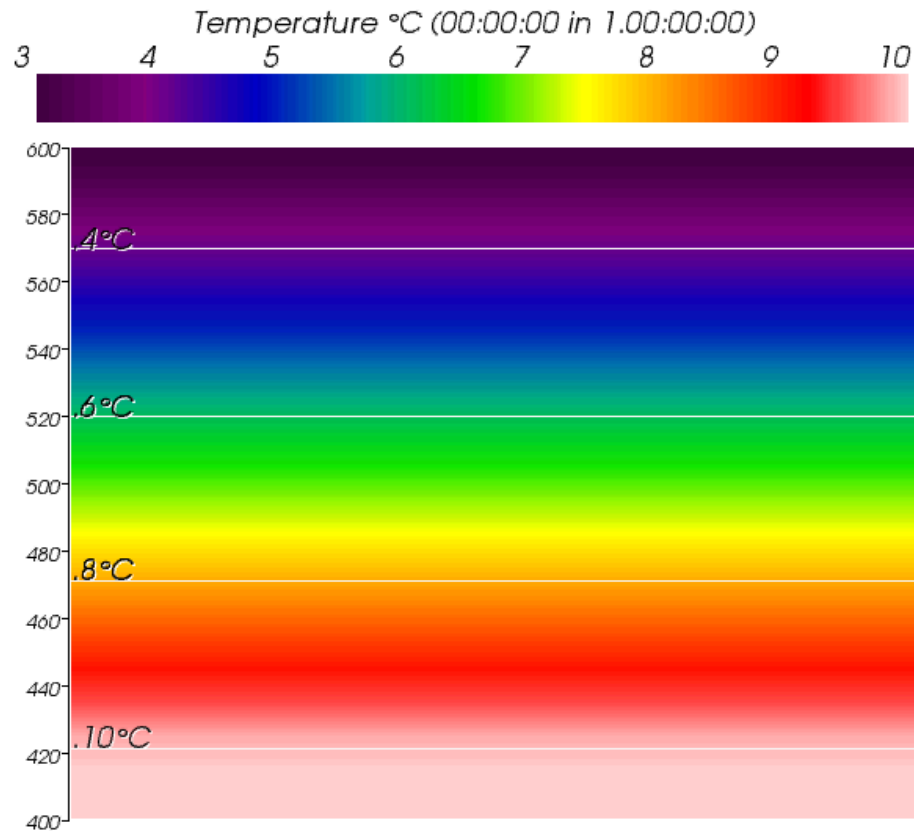
Space\Space	Room 0		Room 1		Room 2	
	Amplitude [W/K]	Phase [months]	Amplitude [W/K]	Phase [months]	Amplitude [W/K]	Phase [months]
Room 0	506,2876	-4,5772	2,1143	-0,0559	7,8686	-0,7371
Room 1	2,1139	-0,0557	12,2187	-5,9260	10,0872	-0,0402
Room 2	7,8666	-0,7380	10,0876	-0,0402	29,0391	-5,5816

Amplitude

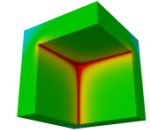
Phase-Lag



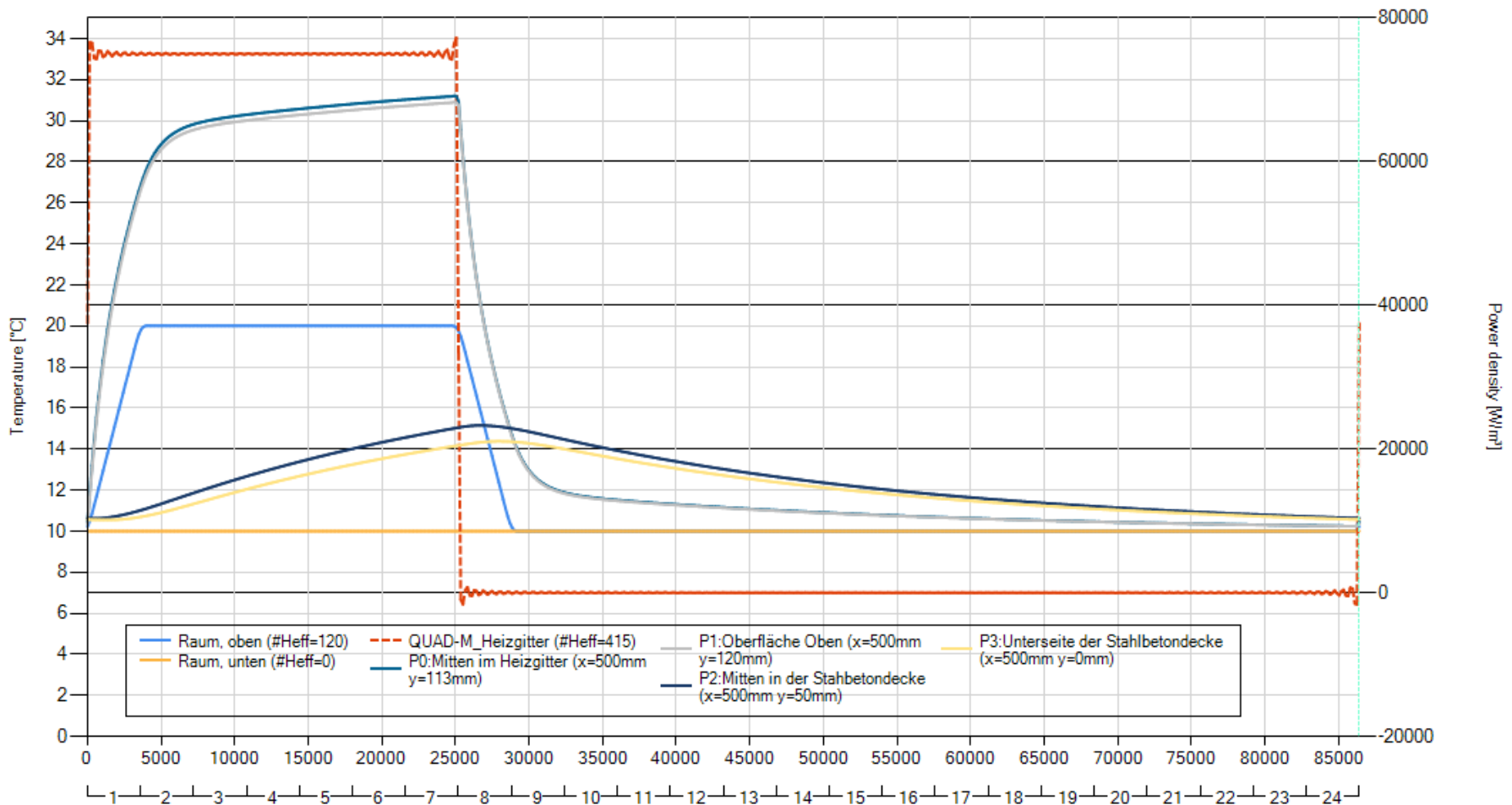
Transient – time dependant

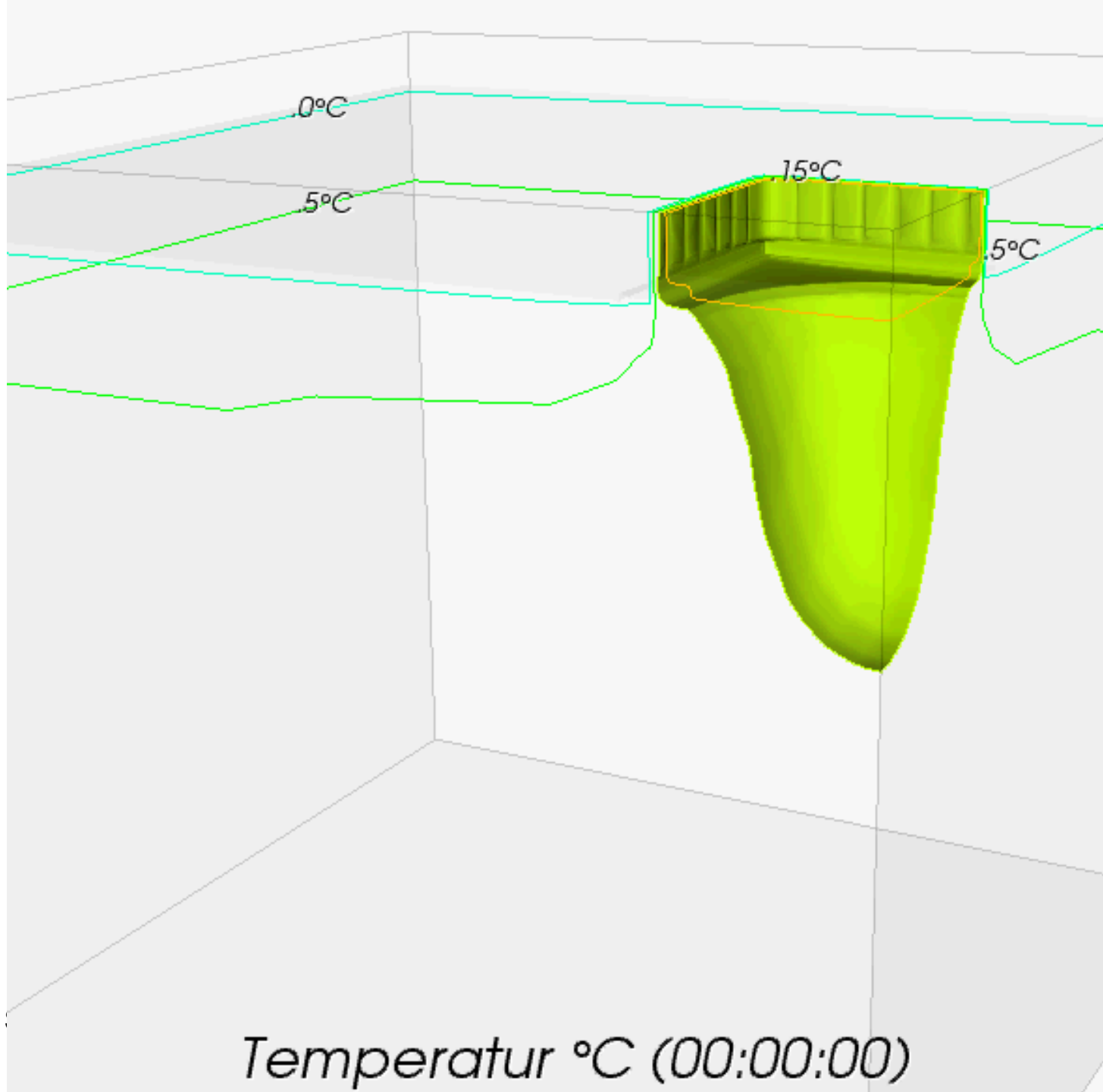
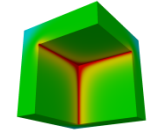


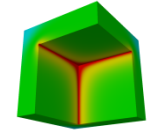
Anthem V.6.102 2011.10.10 T.Kornicki www.kornicki.com



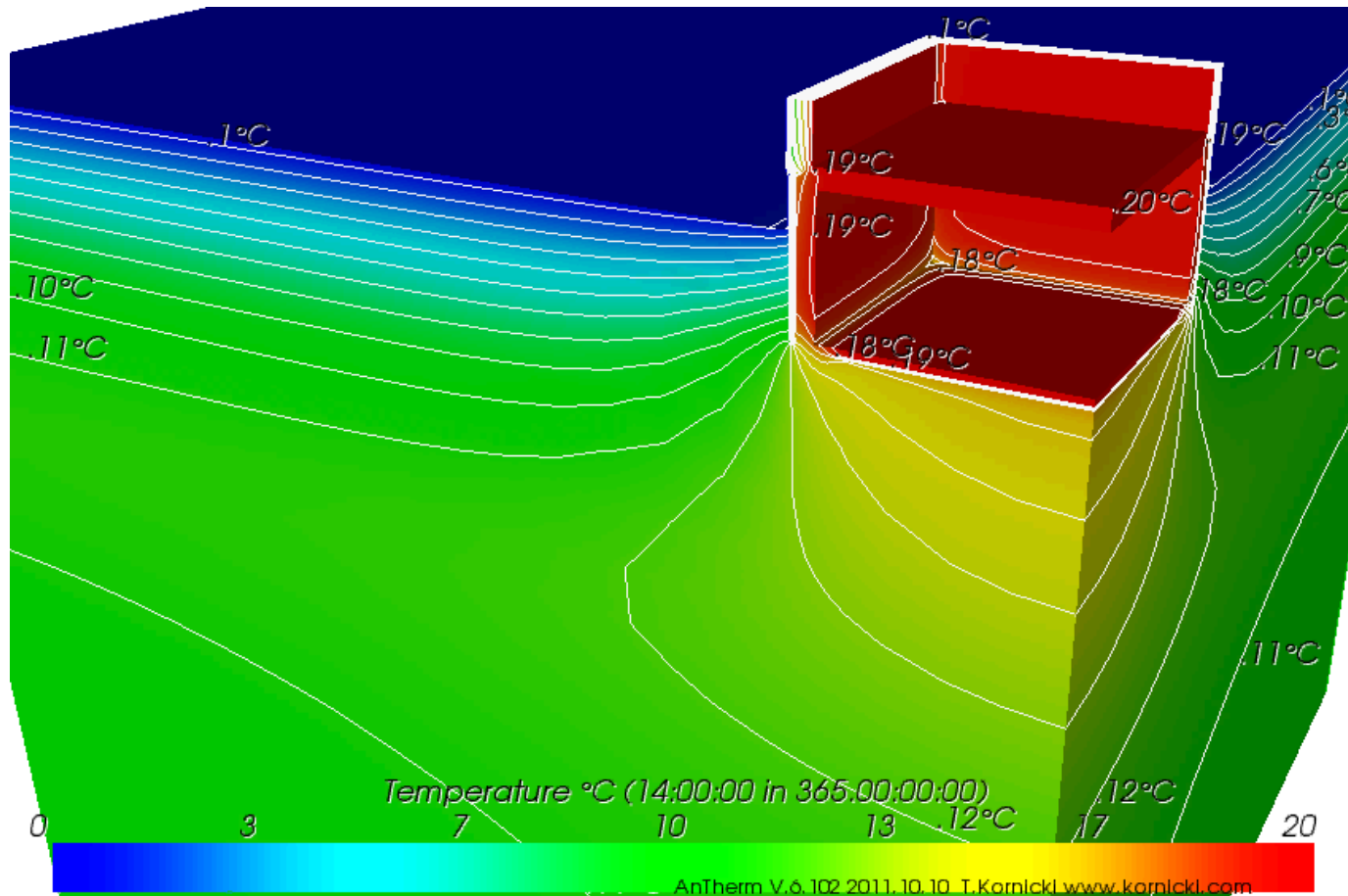
Transient – time dependant

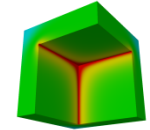




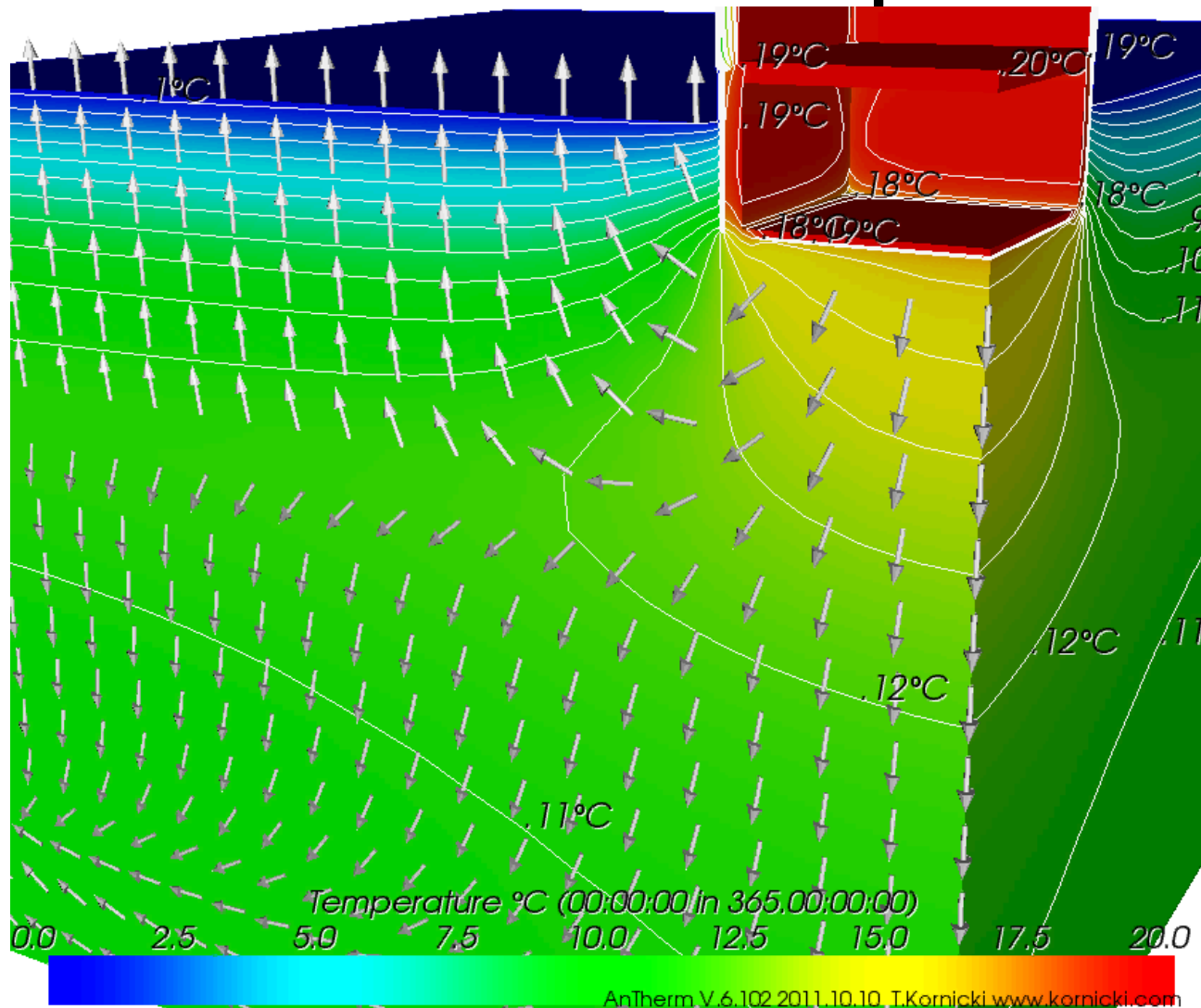


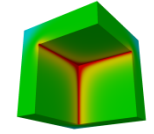
Transient – time dependant





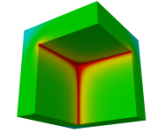
Transient – time dependant





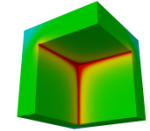
...

• ...



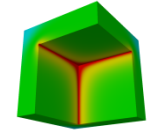
Stable on Target

- **Experience of more than 30 years** in development of software for building physics already
- Basic understanding of building physics alone is absolutely sufficient to use and control the application
- Deep **automation** of the numerical models in use, **no „scientific sophistication“**
- Results are **immediately evaluated**
- Highest **quality of results** can be transferred directly into reports



Phenomenally simple

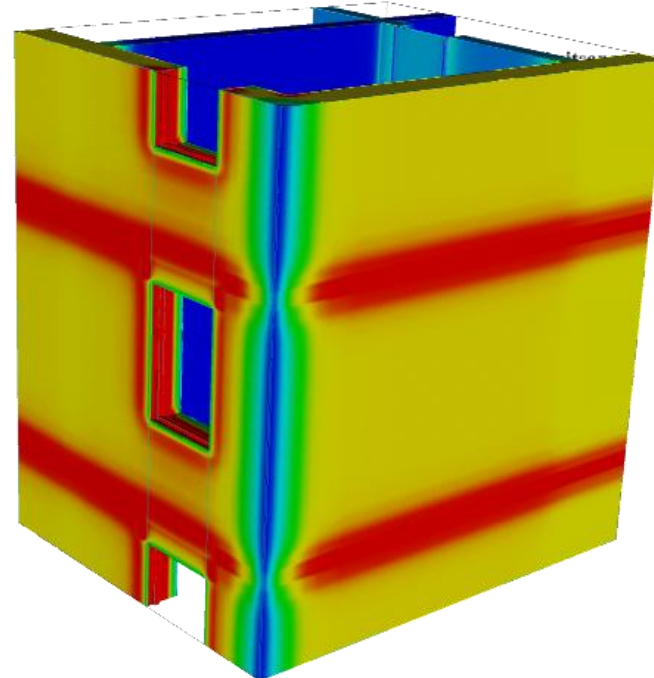
- AnTherm stands for **very innovative** application for the **building physics**
- It provides an **integration** new visualisation capabilities **into the everyday life** of a engineer, while that technology is rooted in supercomputing and scientific visualization of large amounts of physical data
- What was far beyond the access of building physics professionals, due to its complexity and unacceptable learning effort, is made in AnTherm **phenomenally simple**
- The front end of the program is intentionally kept as simple as possible – casual user must be able **to control the application immediately without special learning efforts**



Higher Value, More Use

Results obtained easily from AnTherm, specially visualizations (pictures describing highly complex physical phenomena obtained in a straight forward manner and self describing, even for non professionals) significantly improve the value of building physics analysis processes and by that the commercial success of users of such massive and supportive tool

Simply more value!
Simply more use!

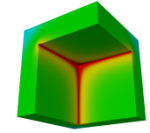


Anzahl der bilanzierten Zellen: 69129

Raum\Raum	Thermische Leitwerte [W / K]	
	Room 0	Room 1
Room 0		1,917153
Room 1	1,917154	

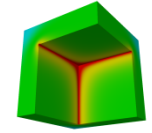
Wärmeq.\Raum	Verteilungsschlüssel [1]	
	Room 0	Room 1
PS 0	0,111552	0,888448

Leitwert Summe [W / K]	Leitwertbezogener Schliessfehler
1,917150	4,54671e-007
1,917150	-4,54671e-007



... even more value

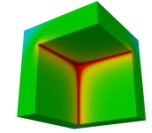
- Easy to learn and to control
- Saves time
- Exact and precise calculation
- Standard conformant (EN ISO 10211, 10077, 13786, ...)
- **In one tool:**
 - 2D and 3D
 - Heat transport
 - Ψ (psi) – value calculation
 - Mould- and condensation controls
 - Vapour diffusion
 - Transient harmonic
- Mobility with dongle license
- Free demo version



AnTherm

- Innovative user application
- Rooted on many years of experience
- and proven technologies you admire so

- Observing the continuing competition we are steadily aimed to make the application be the best, fastest, most exquisite and unflawed, ideal tool



Trial instead of elaboration

- Fee demo version:

<http://www.antherm.eu/>

- Registration required (contact data)

- Example videos on YouTube:

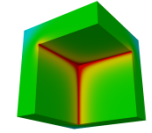
<http://www.youtube.com/tkornicki>

- Imagery created with AnTherm on PicasaWeb:

<http://www.picasaweb.com/antherm>

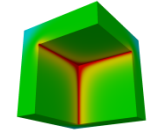
- User Guide, Theory, Learning materials, Tutorials:

<http://help.antherm.eu/>



Conclusio

Good replaced with Better



AnTherm

the software system for
Analysis of Thermal behaviour
in building constructions with thermal bridges

Contact-Ordering: <http://www.antherm.eu/>

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Phone: +43-1-6157099