

Use of metamodels for web-based calculation of thermal bridge parameters

WOST Workshop in Weimar – Thorsten Heidolf

June 24th 2022

Imagine. Model. Make.

Content

- Who is Leviat?
- What is a balcony connection?
- What are the building physics aspects?
- How have the metamodels helped us?

Who is Leviat?

Who is Leviat?

Leviat unites the **expertise, skills and resources** of CRH's construction accessories companies in a single, global organisation



- ▶ **3,000 people**
- ▶ **60 locations**
- ▶ **Manufacturing on 4 continents**
- ▶ **Sales in 30+ countries**

Our Trusted Product Brands

Leviat
A CRH COMPANY

Ancon[®]

Aschwanden

Connolly

HALFEN

HELIFIX

ISEDIO[®]

MOMENT

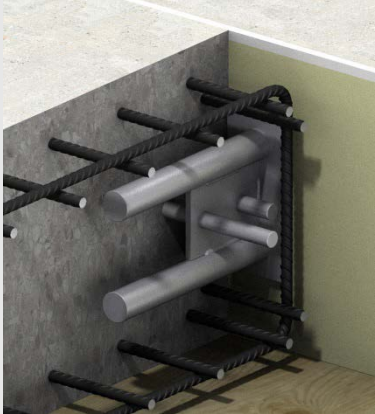
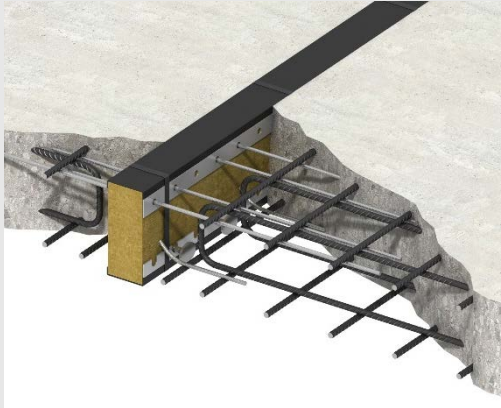
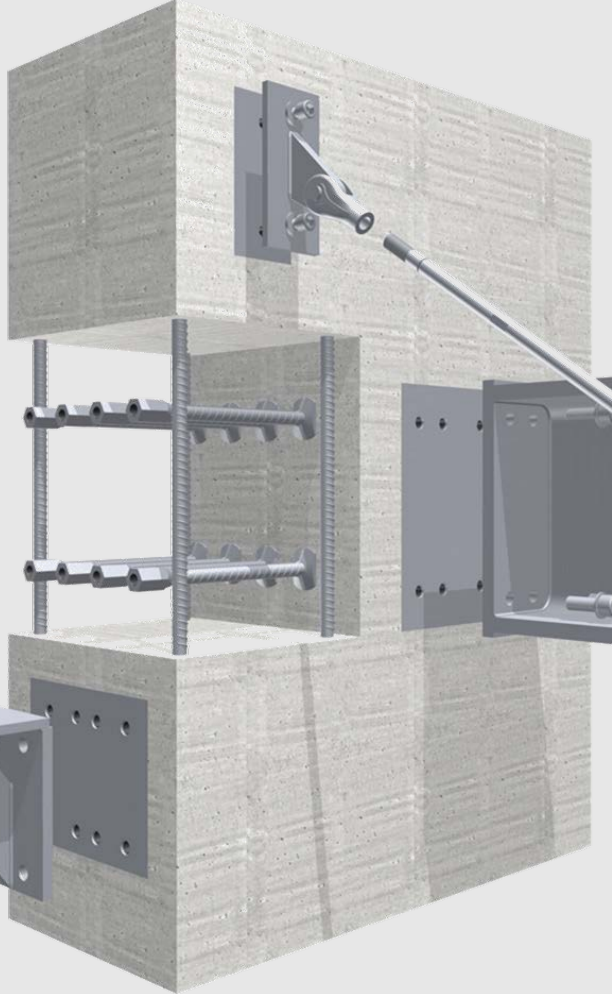
PLAKA

scaldex

MLB MeadowBurke

thermomass[®]

Connecting, Fixing, Anchoring & Lifting Technology



We help you build **better, safer, stronger & faster**

Sectors

We supply customers in **all construction sectors** from residential to infrastructure, and **industrial** applications



We help turn architectural visions into reality

What is a balcony connection?

What is a balcony connection?

Cooling fins



- Cooling fins - effective method to cool a warm body.

What is a balcony connection?

Cooling fins



- Cooling fins - effective method to cool a warm body.
- Unfortunately the concept works equally well on a building.

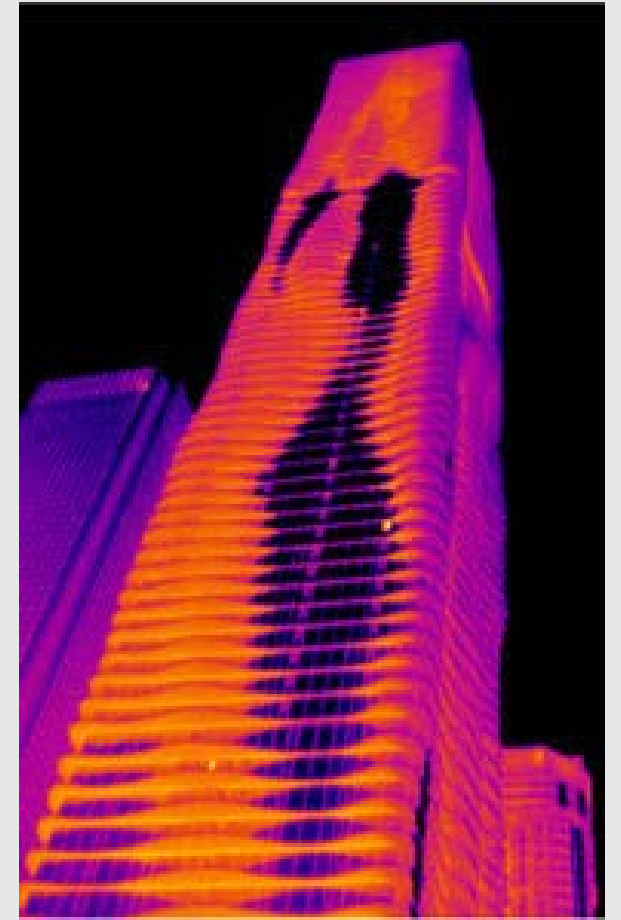


What is a balcony connection?

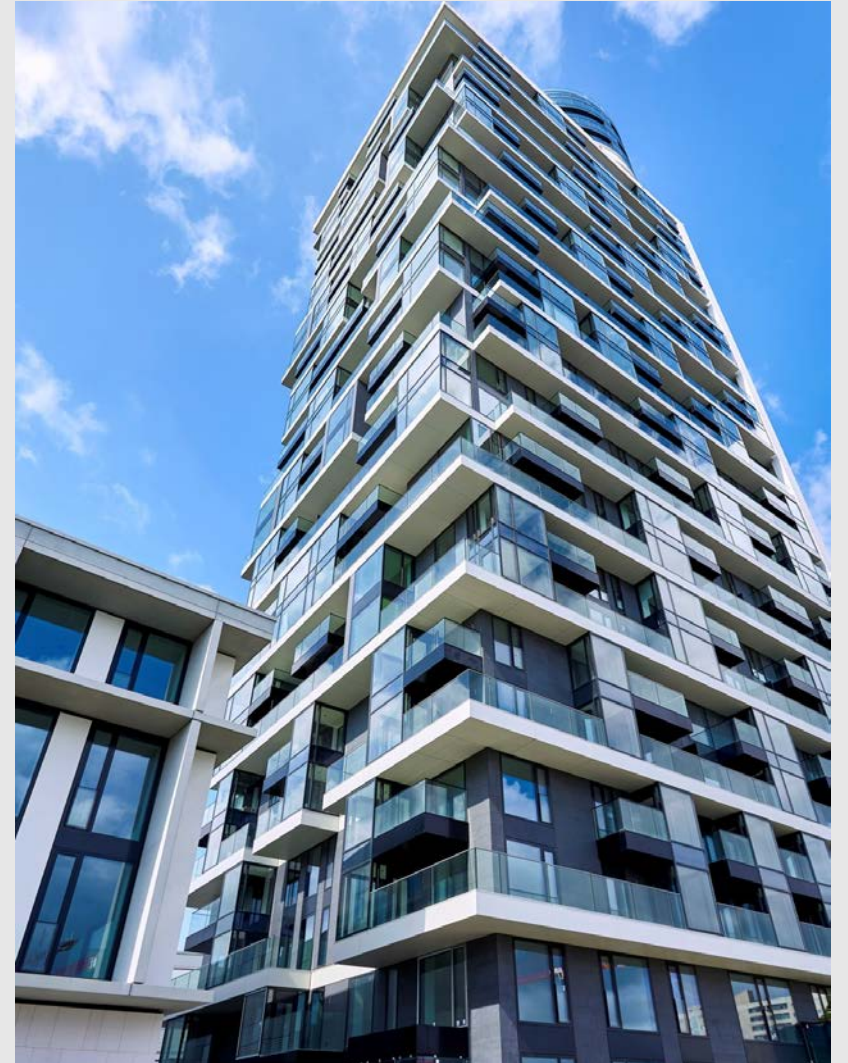
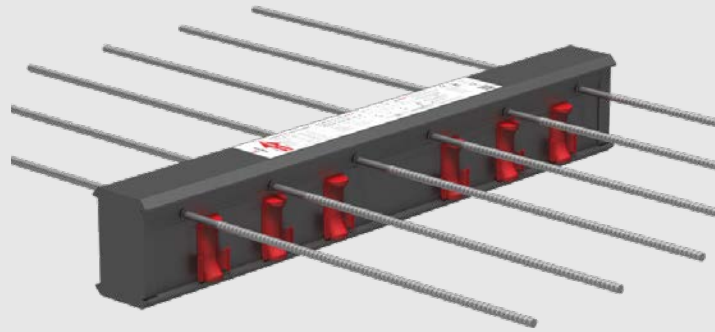
Cooling fins



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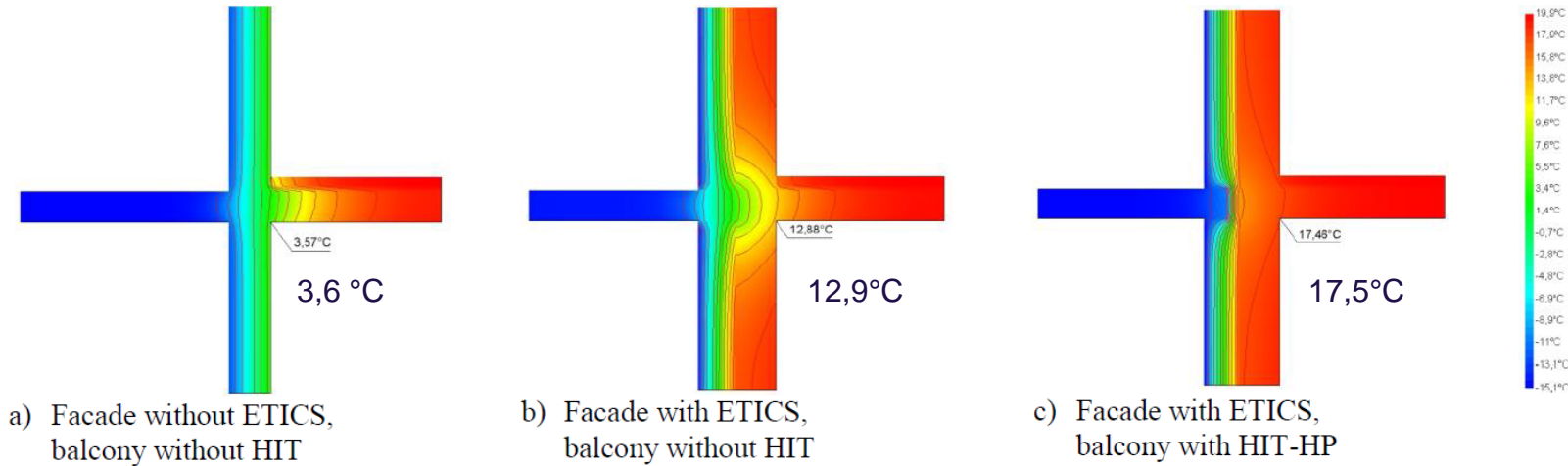
What is a balcony connection?



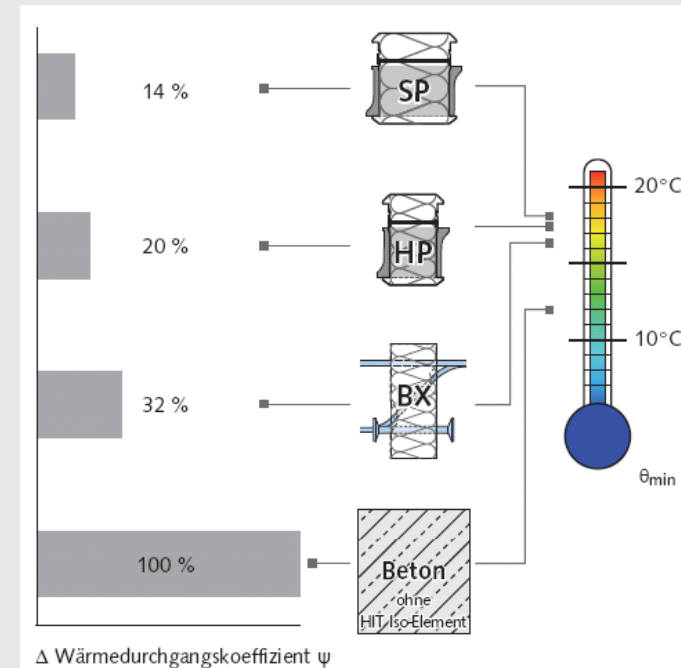
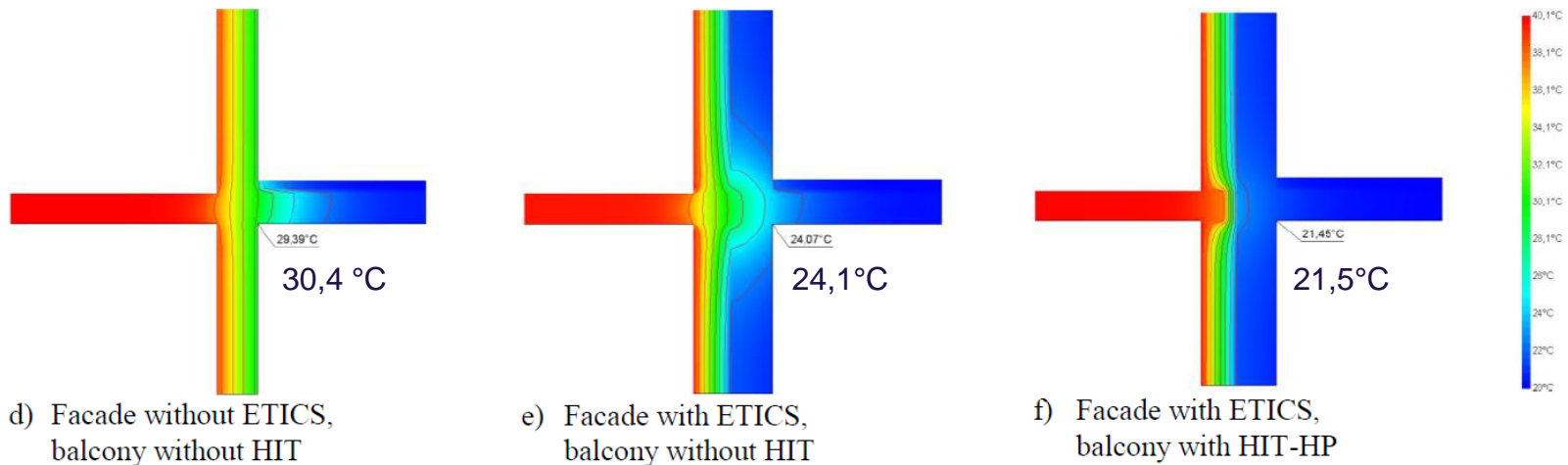
What are the building physics aspects?

What are the building physics aspects?

Winter Situation



Summer Situation



What are the building physics aspects?

Calculation of thermal bridges in residential buildings			
Description/ basics standard	Method 1 without verifications	Method 2 specification details or equivalent details	Method 3 Exact calculation of thermal bridges with linear thermal transmission coefficients (= ψ -values)
Consideration of thermal bridges	$\Delta U_{WB} = 0.10 \text{ W}/(\text{m}^2\text{K})$ fixed additional value	$\Delta U_{WB} = 0.05 \text{ W}/(\text{m}^2\text{K})$ half the fixed additional value	Approved ψ -values for all component connections (e. g. building edges, window reveals, wall and slab connections, slab supports, thermally separated balcony slabs)
specific transmission loss H_T	$H_T = \sum U_i A_i F_{x,i} + \Delta U_{WB} \times A$		$H_T = \sum U_i A_i F_{x,i} + \sum l_j \psi_j$

What are the building physics aspects?

HALFEN HIT INSULATED CONNECTION HIGH PERFORMANCE
Building Physics

Thermal bridge characteristic values for HIT-HP MVX for monolithic masonry

Thermal conductivity k in [W/(mK)]	0.18			0.12			0.08		
	ψ	$R_{s,ext}$	$f_{R,s}$	ψ	$R_{s,ext}$	$f_{R,s}$	ψ	$R_{s,ext}$	$f_{R,s}$
Thermal transmission coefficient of standard cross section "internal wall" U in W/(m ² K)	0.455			0.311			0.211		
Load range	ψ	$R_{s,ext}$	$f_{R,s}$	ψ	$R_{s,ext}$	$f_{R,s}$	ψ	$R_{s,ext}$	$f_{R,s}$
HIT-HP MVX-0404-18-100-35	0.168	15.49	0.819	0.180	15.91	0.836	0.186	16.21	0.848
HIT-HP MVX-0504-18-100-35	0.173	15.45	0.818	0.185	15.86	0.834	0.192	16.15	0.846
HIT-HP MVX-0604-18-100-35	0.178	15.41	0.817	0.190	15.82	0.833	0.197	16.10	0.844
HIT-HP MVX-0804-18-100-35	0.188	15.35	0.814	0.200	15.74	0.829	0.207	16.01	0.840
HIT-HP MVX-0905-18-100-35	0.186	15.31	0.813	0.199	15.70	0.828	0.207	15.97	0.839
HIT-HP MVX-0705-18-100-35	0.196	15.25	0.810	0.209	15.62	0.825	0.217	15.88	0.835
HIT-HP MVX-0805-18-100-35	0.201	15.21	0.809	0.214	15.58	0.823	0.222	15.83	0.833
HIT-HP MVX-0906-18-100-35	0.198	15.19	0.807	0.212	15.55	0.822	0.220	15.80	0.832
HIT-HP MVX-0606-18-100-35	0.203	15.15	0.806	0.217	15.50	0.820	0.226	15.75	0.830
HIT-HP MVX-0706-18-100-35	0.208	15.12	0.805	0.222	15.46	0.819	0.231	15.70	0.828
HIT-HP MVX-0906-18-100-35	0.217	15.06	0.802	0.232	15.39	0.816	0.241	15.62	0.825
HIT-HP MVX-1006-18-100-35	0.222	15.03	0.801	0.236	15.35	0.814	0.246	15.58	0.823
HIT-HP MVX-1106-18-100-35	0.226	15.00	0.800	0.241	15.32	0.813	0.251	15.54	0.821
HIT-HP MVX-0607-18-100-35	0.214	15.03	0.801	0.229	15.36	0.814	0.239	15.59	0.824
HIT-HP MVX-0707-18-100-35	0.219	15.00	0.800	0.234	15.33	0.813	0.244	15.55	0.822
HIT-HP MVX-0907-18-100-35	0.228	14.94	0.797	0.244	15.25	0.810	0.254	15.46	0.818
HIT-HP MVX-1007-18-100-35	0.233	14.91	0.796	0.249	15.22	0.809	0.259	15.42	0.817
HIT-HP MVX-1107-18-100-35	0.237	14.88	0.795	0.253	15.18	0.807	0.263	15.38	0.815
HIT-HP MVX-1207-18-100-35	0.242	14.85	0.794	0.258	15.15	0.806	0.268	15.35	0.814
HIT-HP MVX-1407-18-100-35	0.250	14.80	0.792	0.266	15.09	0.803	0.277	15.27	0.811
HIT-HP MVX-0408-18-100-35	0.215	14.99	0.799	0.230	15.31	0.812	0.240	15.53	0.821
HIT-HP MVX-0708-18-100-35	0.230	14.89	0.795	0.246	15.19	0.808	0.256	15.40	0.816
HIT-HP MVX-0808-18-100-35	0.234	14.85	0.794	0.251	15.16	0.806	0.261	15.35	0.814
HIT-HP MVX-1008-18-100-35	0.243	14.80	0.792	0.260	15.09	0.803	0.271	15.28	0.811
HIT-HP MVX-1208-18-100-35	0.252	14.74	0.790	0.269	15.02	0.801	0.280	15.20	0.808
HIT-HP MVX-1308-18-100-35	0.256	14.72	0.789	0.273	14.99	0.800	0.284	15.17	0.807
HIT-HP MVX-1309-18-100-35	0.266	14.61	0.784	0.284	14.87	0.795	0.295	15.04	0.801
HIT-HP MVX-0610-18-100-35	0.245	14.71	0.788	0.262	14.98	0.799	0.273	15.16	0.807
HIT-HP MVX-0910-18-100-35	0.259	14.62	0.785	0.276	14.88	0.795	0.288	15.05	0.802
HIT-HP MVX-1010-18-100-35	0.263	14.59	0.784	0.281	14.85	0.794	0.292	15.01	0.801
HIT-HP MVX-1210-18-100-35	0.272	14.54	0.782	0.290	14.79	0.792	0.301	14.94	0.798
HIT-HP MVX-1412-18-100-35	0.297	14.32	0.773	0.316	14.53	0.781	0.329	14.66	0.796

ψ = Linear thermal transmission coefficient in W/(mK)
 $R_{s,ext}$ = Minimum outside surface temperature in °C
 $f_{R,s}$ = Temperature factor in [-]

PERFORMANCE

SP-ZYX

Slab thickness [mm]	Thermal transmission coefficient ψ [W/(mK)]
180	0.11
180	0.14
180	0.15
180	0.16
220	0.109
240	0.109
240	0.108
240	0.11
240	0.109
240	0.14
240	0.16

ponent / HIT-SP ZYX

Slab thickness [mm]	Thermal transmission coefficient ψ [W/(mK)]
160	0.096
160	0.099
160	0.098
160	0.102
180	0.096
180	0.101
180	0.102
180	0.107
220	0.104
220	0.105
220	0.106
240	0.104

PERFORMANCE

MVX

Slab thickness [mm]	Thermal transmission coefficient ψ [W/(mK)]
180	0.109
180	0.167
180	0.16
180	0.19
180	0.17
240	0.109
240	0.22
240	0.21
240	0.24
240	0.24
240	0.25
220	0.113
220	0.173
220	0.17
220	0.20
220	0.18
240	0.115
240	0.175
240	0.17
240	0.20
240	0.18
240	0.24
240	0.23
240	0.25

MVX-OD

Slab thickness [mm]	Thermal transmission coefficient ψ [W/(mK)]
180	0.175
220	0.179
240	0.182
240	0.182

MVX-OU

Slab thickness [mm]	Thermal transmission coefficient ψ [W/(mK)]
180	0.170
220	0.178
240	0.180

PERFORMANCE

with ETICS

Transmission coefficient "Exterior wall" U in W/(m²K)
 for $t_2 = 24$ cm ($\lambda = 0.035$ W/(mK))
 or 18 cm ($\lambda = 2.3$ W/(mK))
 or 14 cm ($\lambda = 0.99$ W/(mK))

$R_{s,ext}$	ψ	$R_{s,ext}$	$f_{R,s}$
0.936	0.145	18.54	0.942
0.935	0.150	18.51	0.941
0.931	0.164	18.42	0.937
0.927	0.175	18.37	0.935
0.927	0.179	18.34	0.934
0.927	0.178	18.34	0.933
0.926	0.183	18.31	0.932
0.925	0.188	18.28	0.931
0.923	0.198	18.23	0.929
0.922	0.203	18.20	0.928
0.921	0.207	18.18	0.927
0.921	0.196	18.23	0.929
0.921	0.201	18.20	0.928
0.919	0.211	18.15	0.926
0.918	0.215	18.12	0.925
0.917	0.220	18.10	0.924
0.916	0.225	18.08	0.923
0.914	0.233	18.03	0.921
0.914	0.211	17.99	0.920
0.914	0.235	18.10	0.924
0.912	0.196	18.23	0.929
0.911	0.224	17.91	0.916
0.911	0.253	17.91	0.916
0.909	0.130	18.62	0.949
0.908	0.135	18.59	0.944
0.907	0.139	18.56	0.942
0.906	0.143	18.54	0.941
0.902	0.156	18.46	0.938
0.891	0.160	18.44	0.937

Leviat.com

Imagine. Model. Make.

What are the building physics aspects?

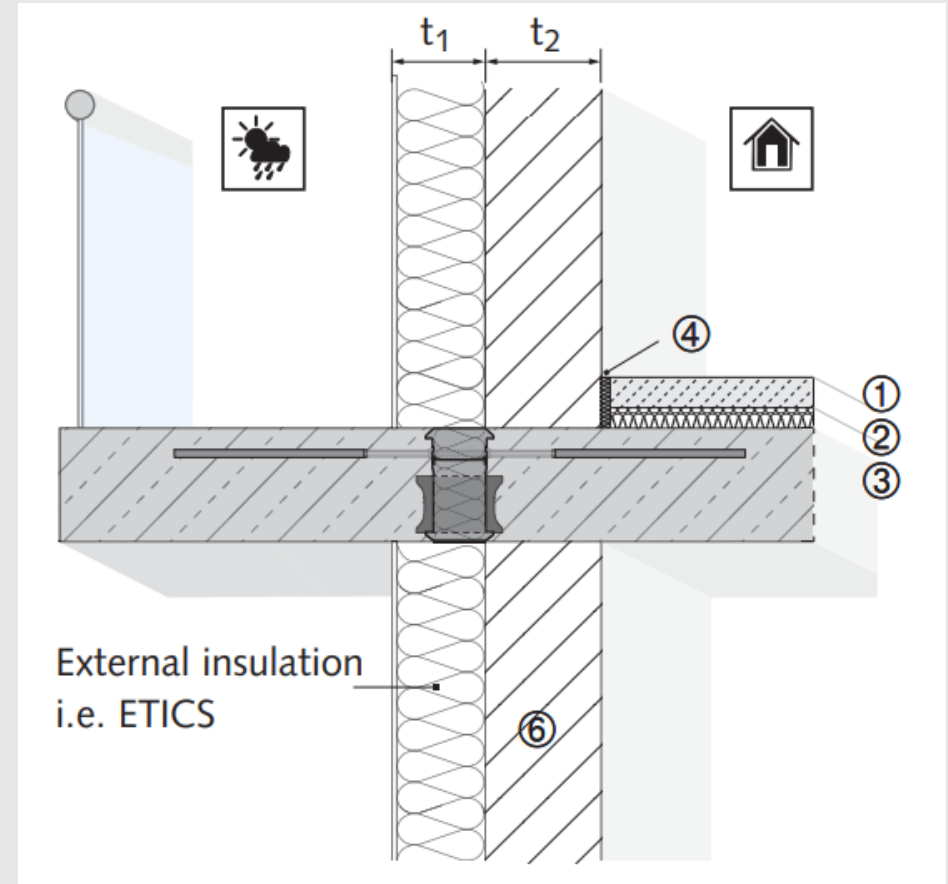
Variants:

- 2 joint widths,
- 2-12 CSB,
- 2-18 tension bars,
- 20 heights
- 3 concrete covers
- 4 wall types
- 6 variants with and without a window
- Countless wall properties

Conclusion:



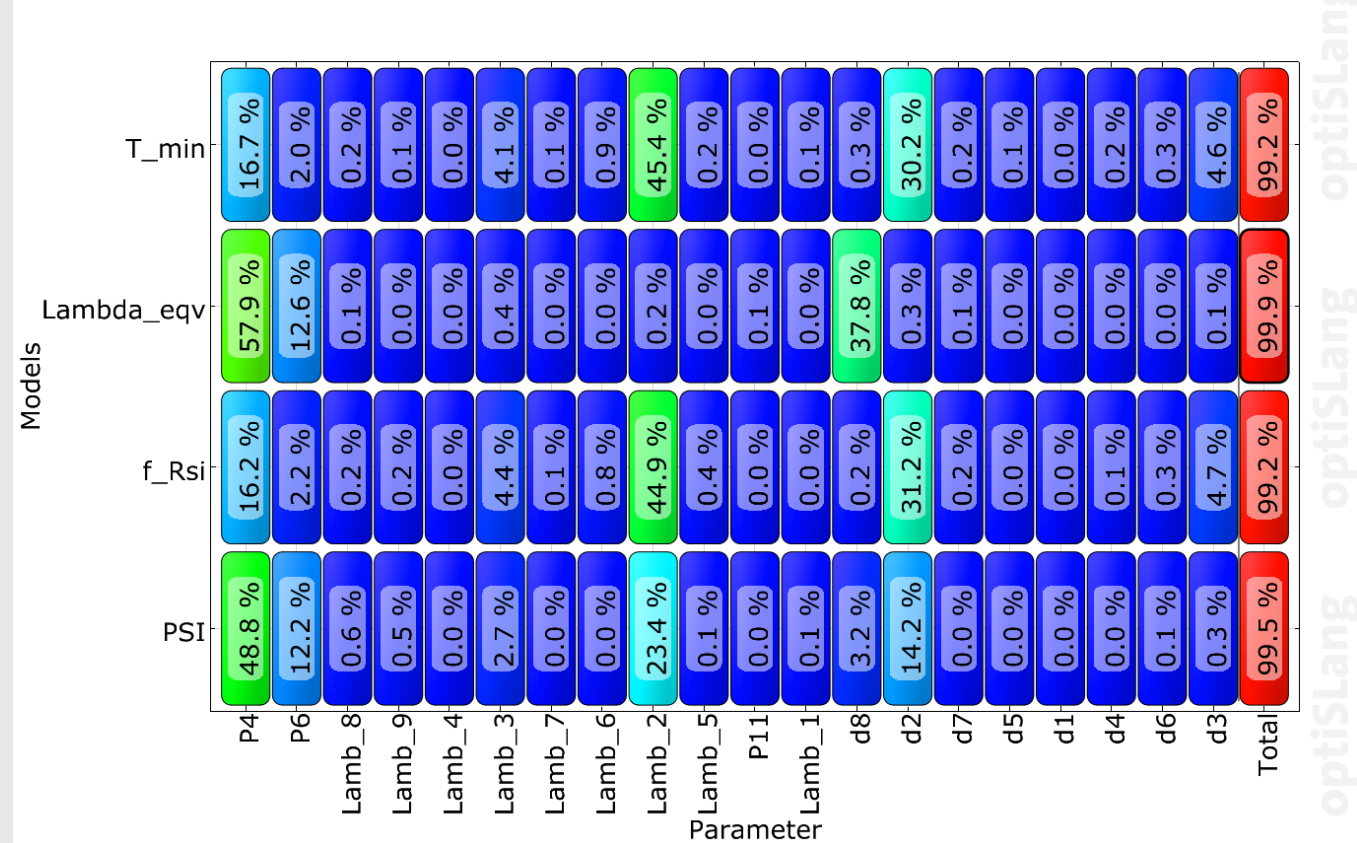
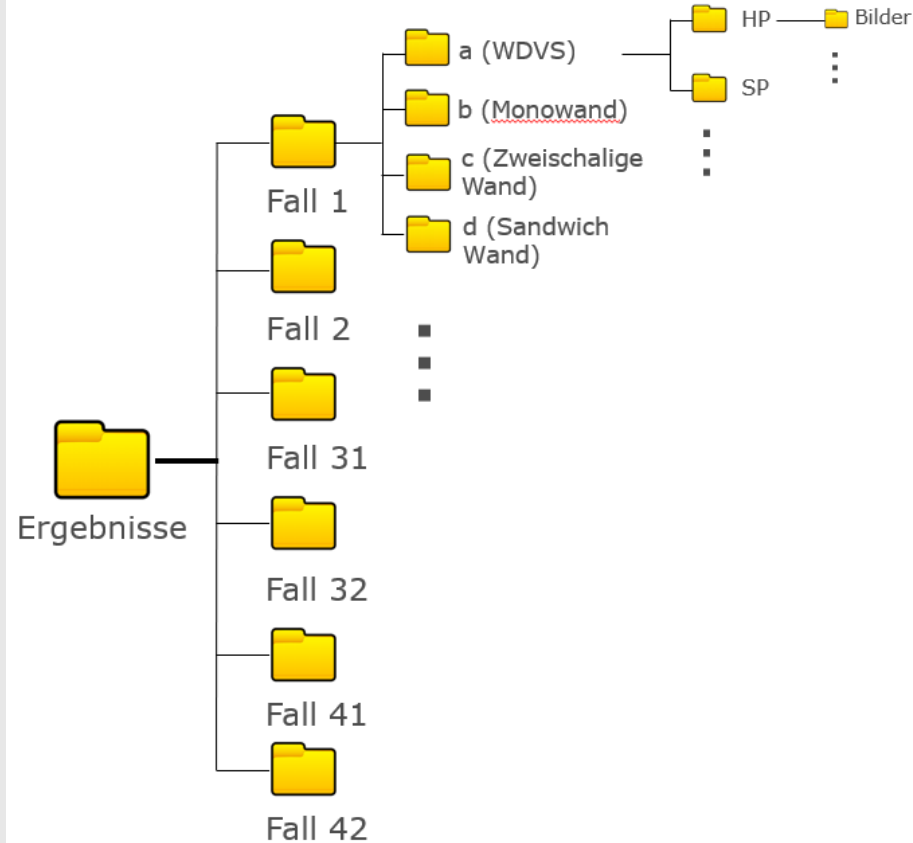
More than 100 million variants



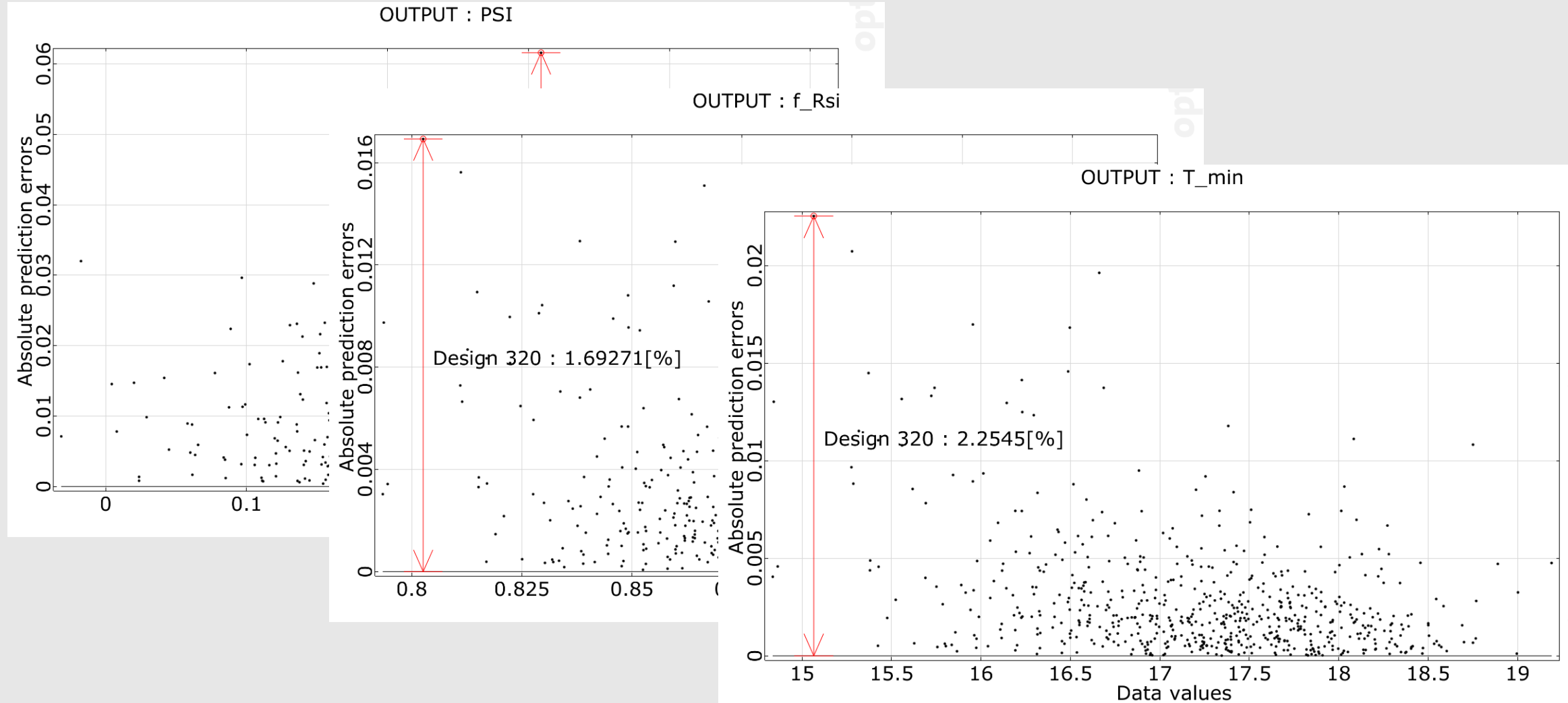
External insulation
i.e. ETICS

How have the metamodels helped us?


How have the metamodels helped us?



How have the metamodels helped us?



How have the metamodels helped us?



HALFEN ψ -Calculator

Project
new project (not saved)

English

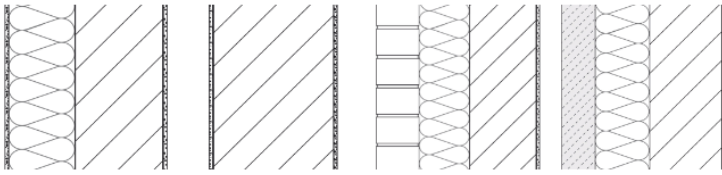
< back to start

- 1. Wall construction ?
- 2. Wall mounting
- 3. Floor slab mounting
- 4. Window / door / roller shutter
- 5. HALFEN Insulated connection
- 6. Summary
- 7. Result

Help

Please select your wall construction

Different wall types can be selected; thermal insulation systems (ETICS), monolithic or double-leaf walls, or sandwich constructions.



ETICS Monolithic Double-leaf wall Sandwich

Window / door / roller shutter

Is there a window or a door in the wall above and/or below the HALFEN Insulated connection, possibly with roller shutter?

Window / door above

No
 Yes

Window / door below

No
 Yes, without roller shutter
 Yes, with roller shutter

forward

<https://psi.halfen.com/en-gb/start>

**THANK YOU FOR YOUR
ATTENTION!**

Leviat
A CRH COMPANY

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