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

WOST Workshop in Weimar – Thorsten Heidolf

June 24th 2022

Leviat
A CRH COMPANY

Imagine. Model. Make.

Content

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

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Who is Leviat?

Who is Leviat?

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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
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Ancon®

Aschwanden

Connolly

HALFEN

HELIFIX

ISEDIO®

MOMENT

PLAKA

scaldex

MB MeadowBurke®

thermomass®

Connecting, Fixing, Anchoring & Lifting Technology

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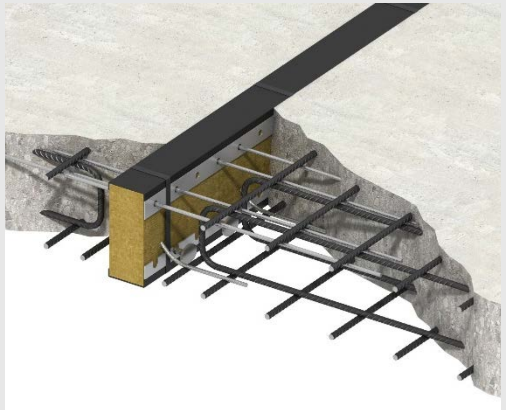
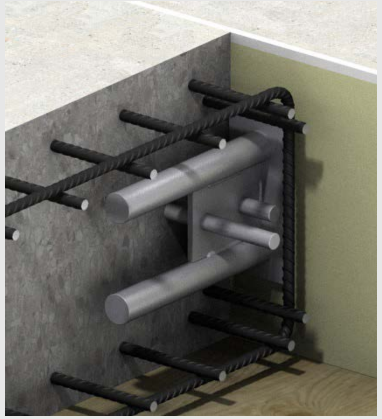


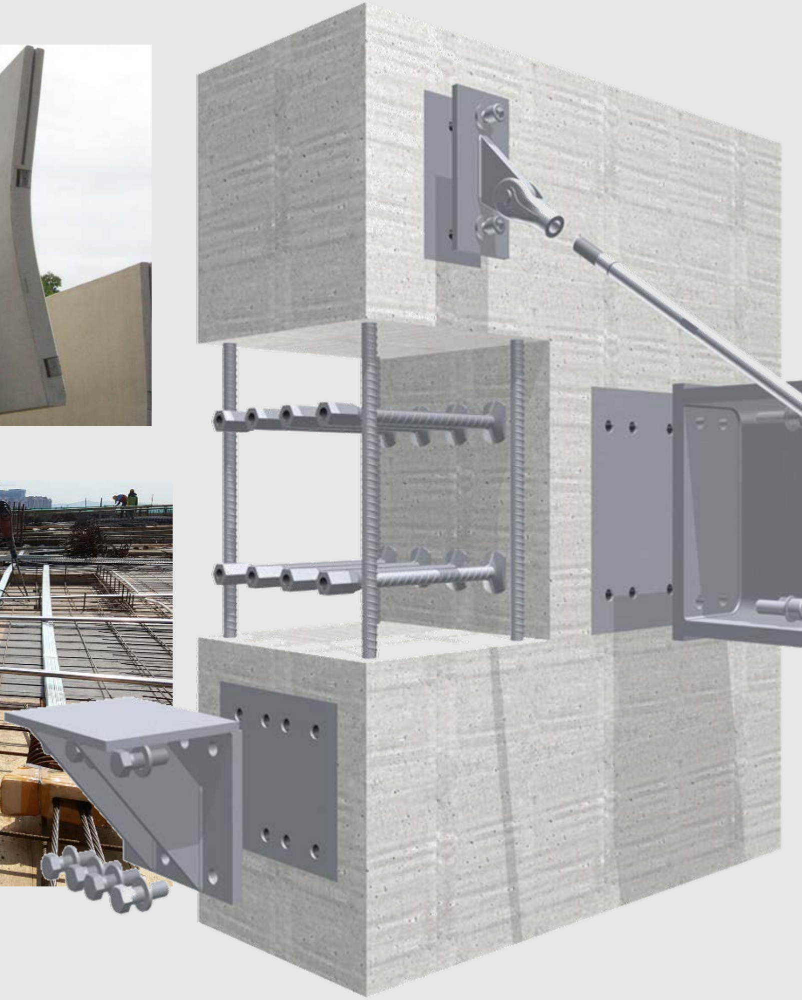

We help you build **better**, **safer**, **stronger** & **faster**

Sectors

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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?

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Cooling fins

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

What is a balcony connection?

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- Unfortunately the concept works equally well on a building.

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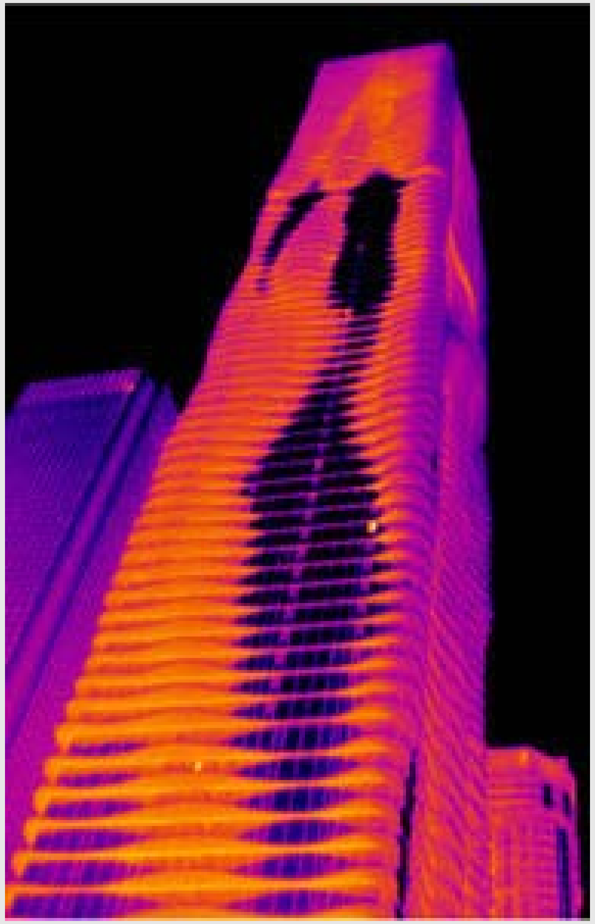

What is a balcony connection?

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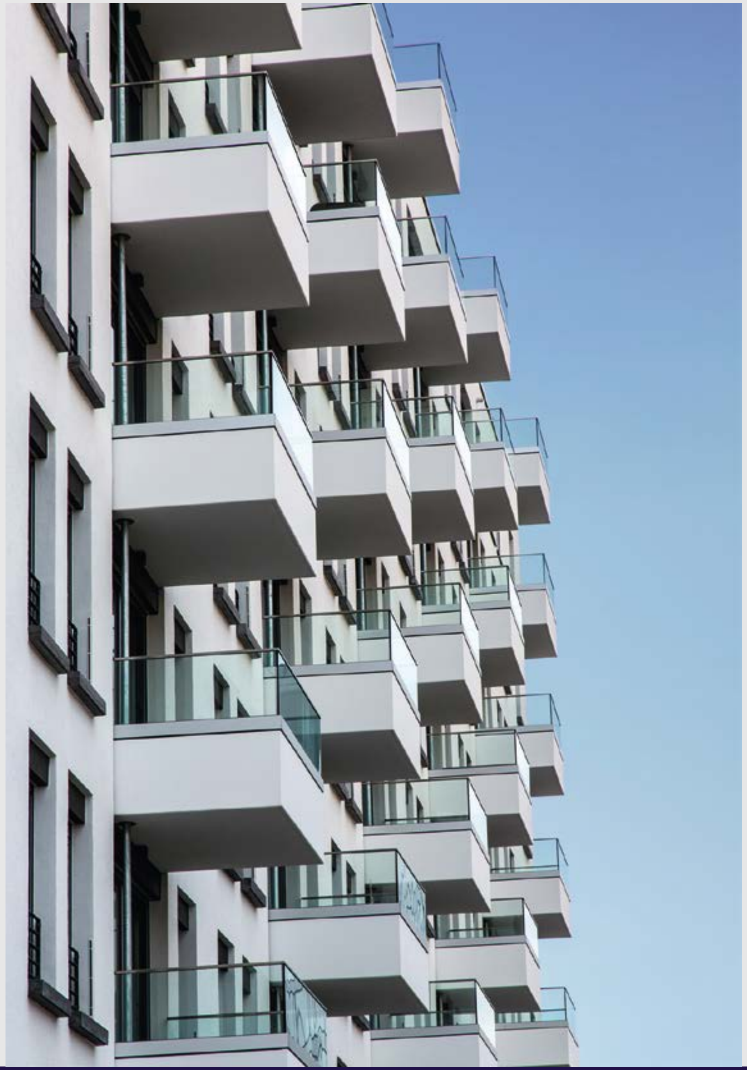

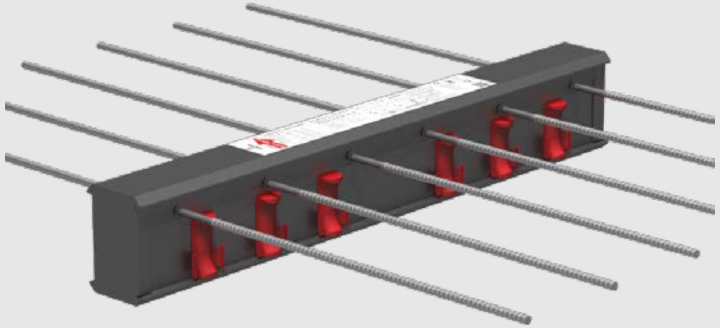

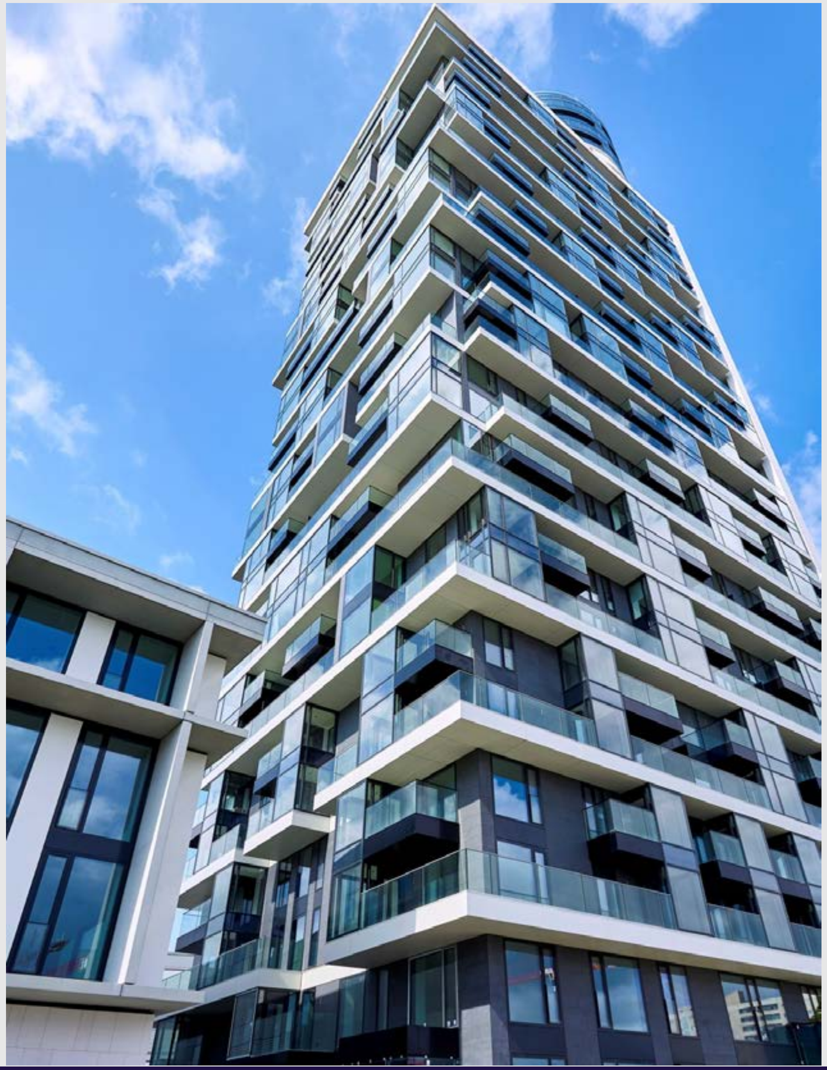

What are the building physics aspects?

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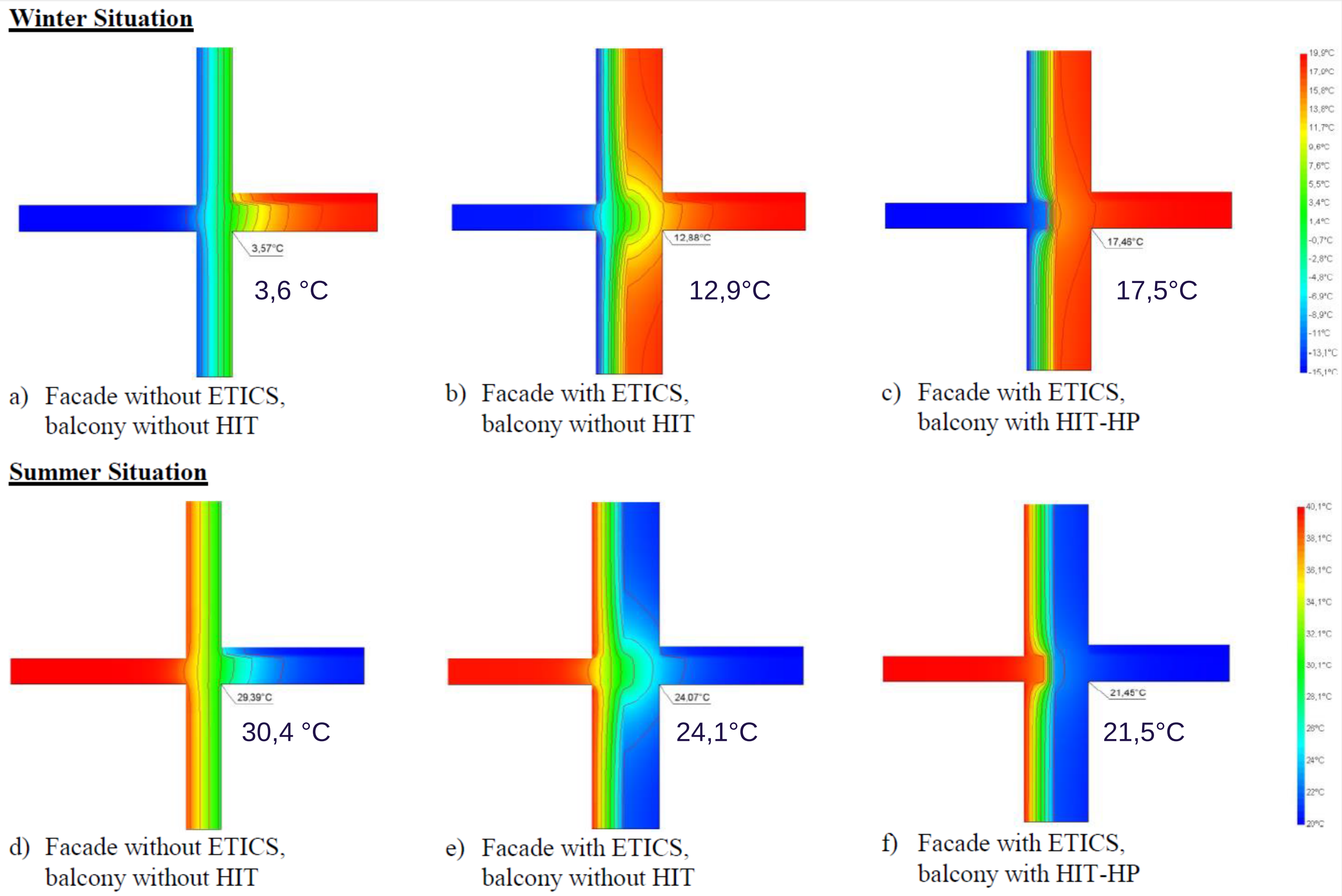

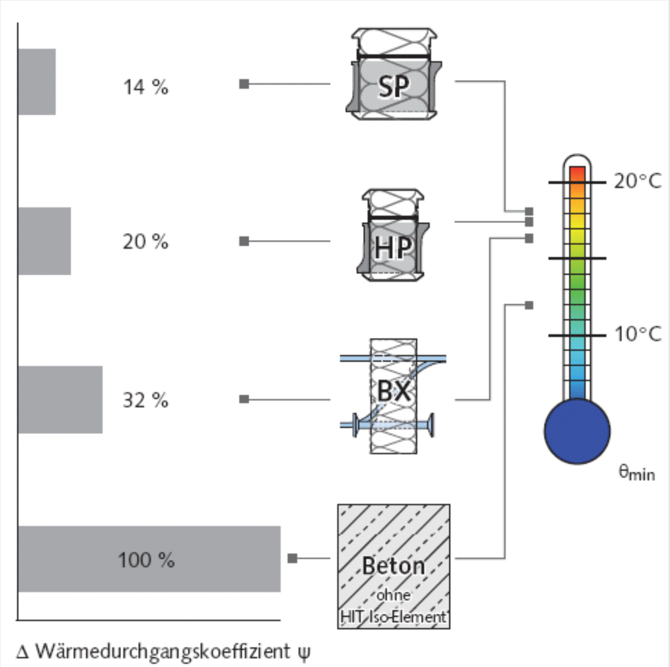

What are the building physics aspects?

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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	ΔU_{WB} = 0.10 W/(m²K) fixed additional value	ΔU_{WB} = 0.05 W/(m²K) 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?

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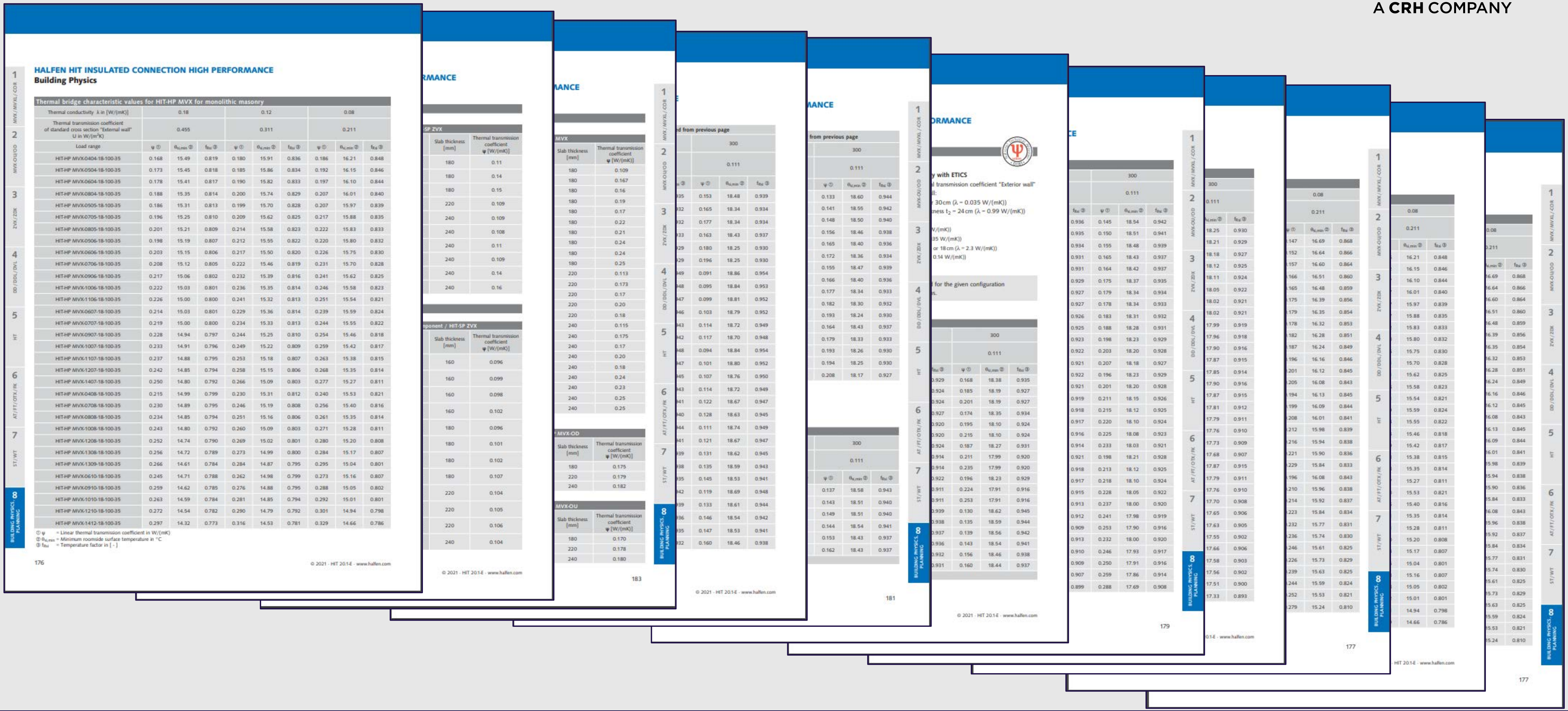

HALFEN HIT INSULATED CONNECTION HIGH PERFORMANCE
Building Physics

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

Thermal conductivity λ in [W/(mK)]	0.18			0.12			0.08		
Thermal transmission coefficient of standard cross section "External wall" U in W/(m²K)	0.455			0.311			0.211		
Load range	ψ ①	$\theta_{si,min}$ ②	f_{Rsi} ③	ψ ①	$\theta_{si,min}$ ②	f_{Rsi} ③	ψ ①	$\theta_{si,min}$ ②	f_{Rsi} ③
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-0505-18-100-35	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-0506-18-100-35	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	0.786

① ψ = Linear thermal transmission coefficient in W/(mK)
② $\theta_{si,min}$ = Minimum roomside surface temperature in °C
③ f_{Rsi} = Temperature factor in [-]

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What are the building physics aspects?

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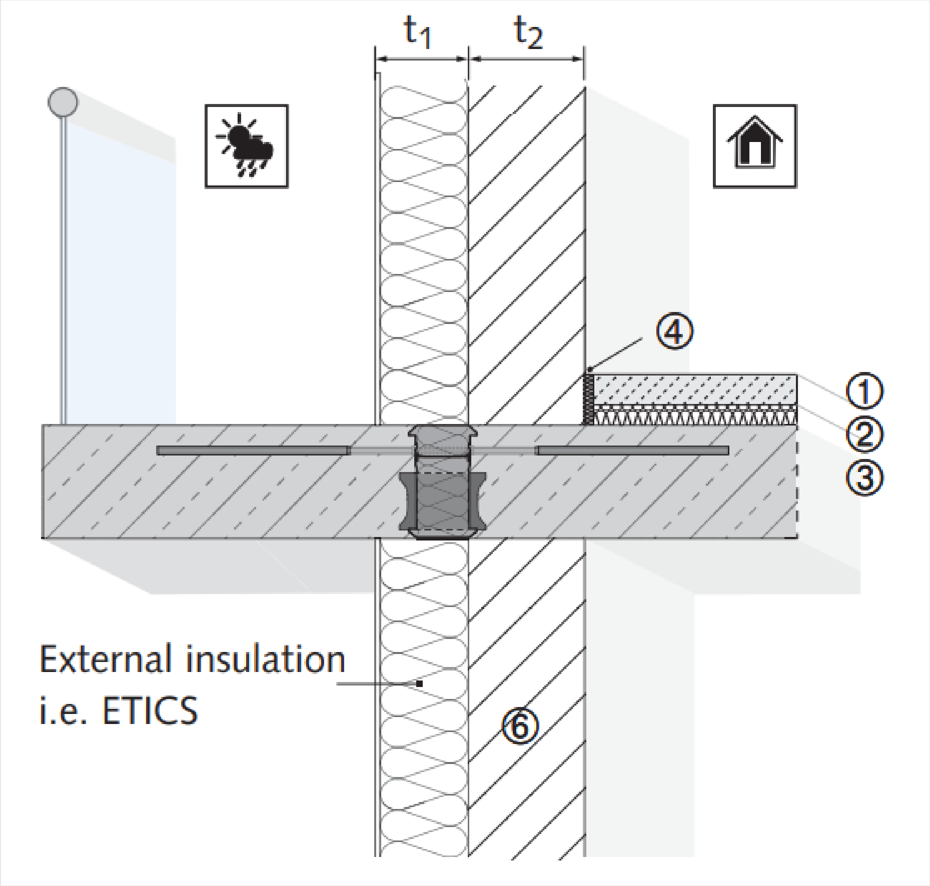
Variants:
- 2 joint widths,
- 2-12 CSB,
- 2-18 tension bars,
- 20 heights
- 3 concrete covers
- 4 wall types
- 6 variants with and without a window
- Countless wall properties

Conclusion:

More than 100 million variants



How have the metamodels helped us?

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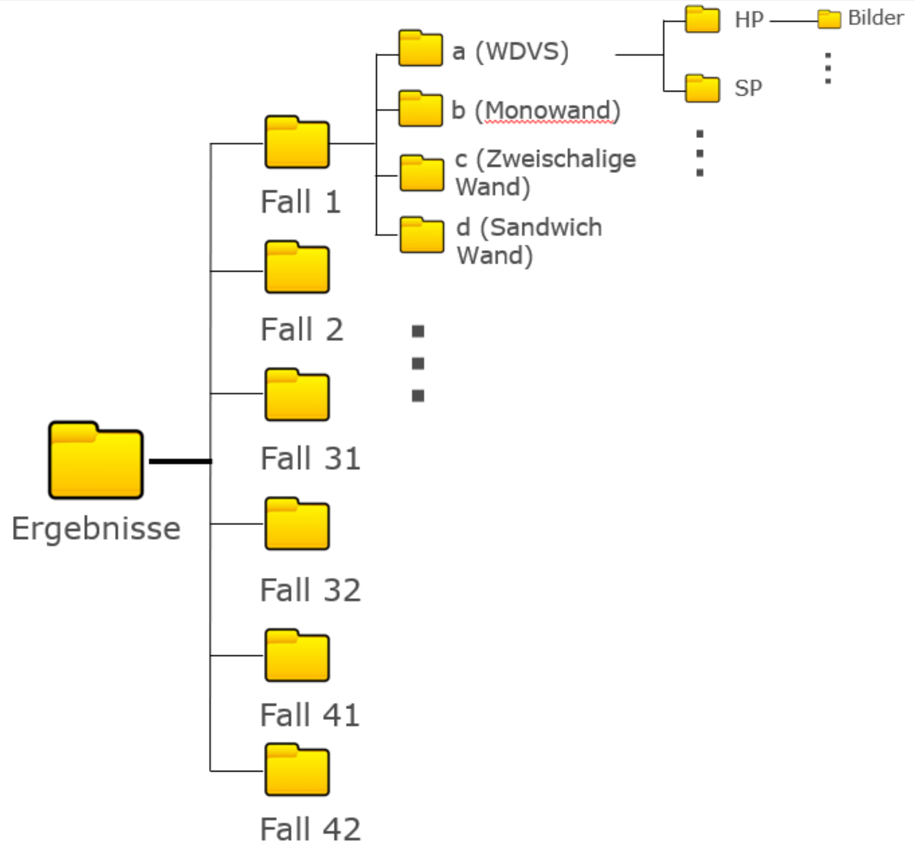

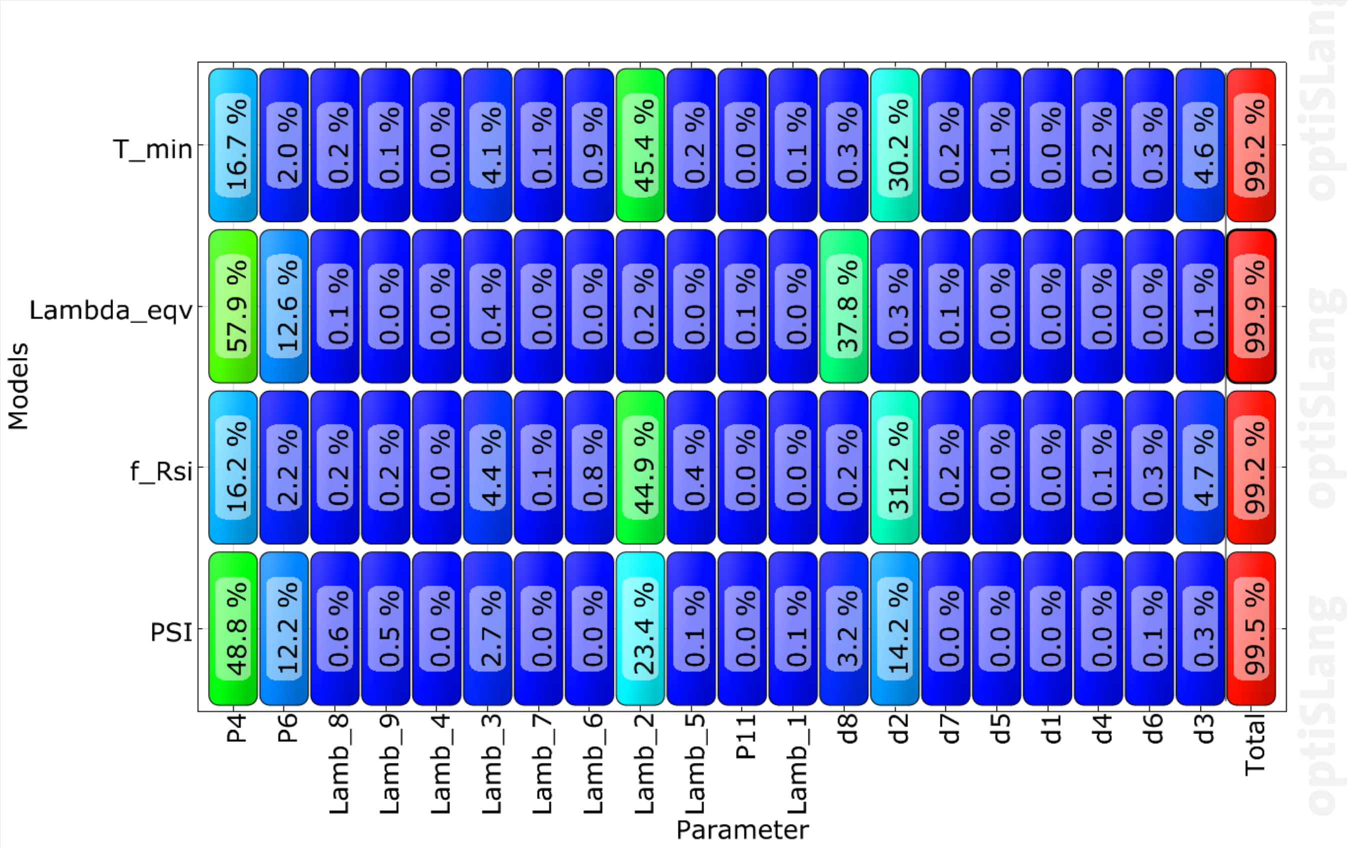

How have the metamodels helped us?

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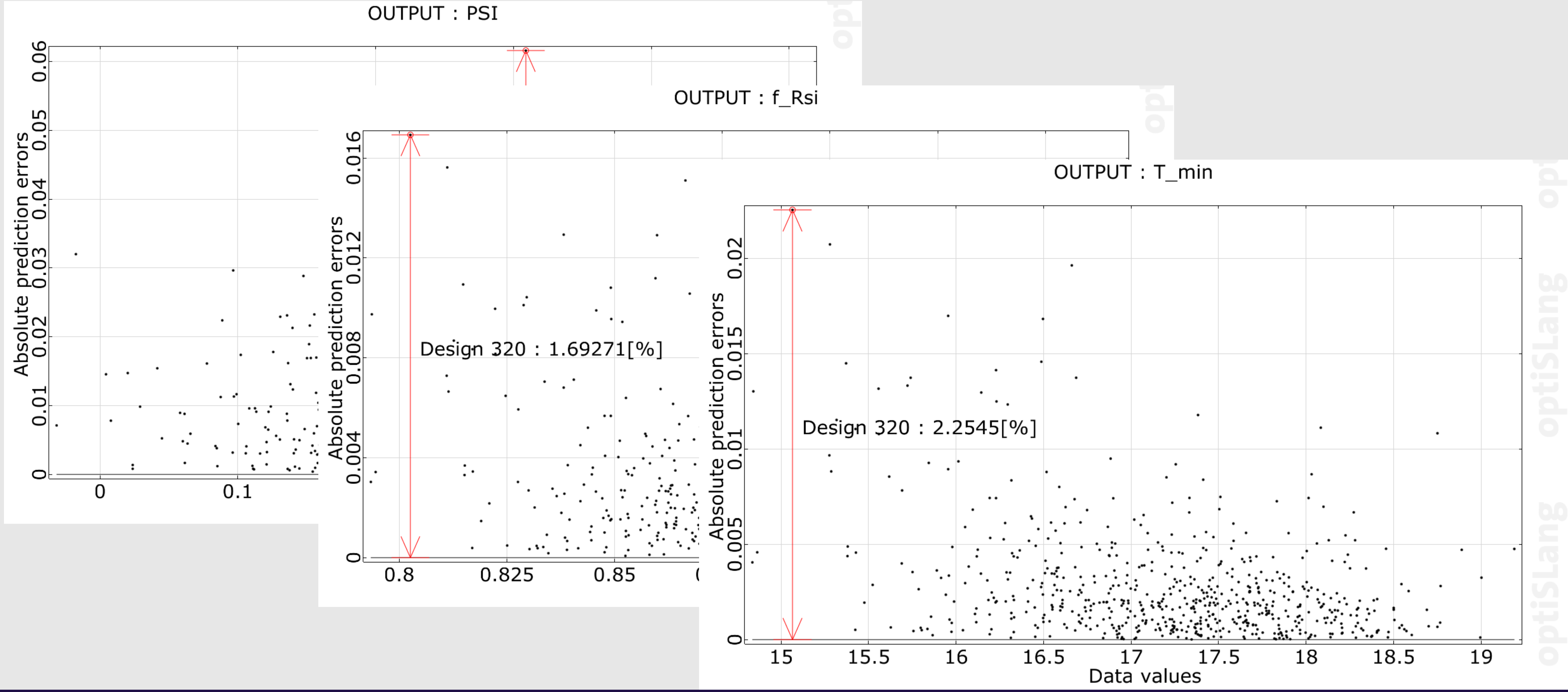

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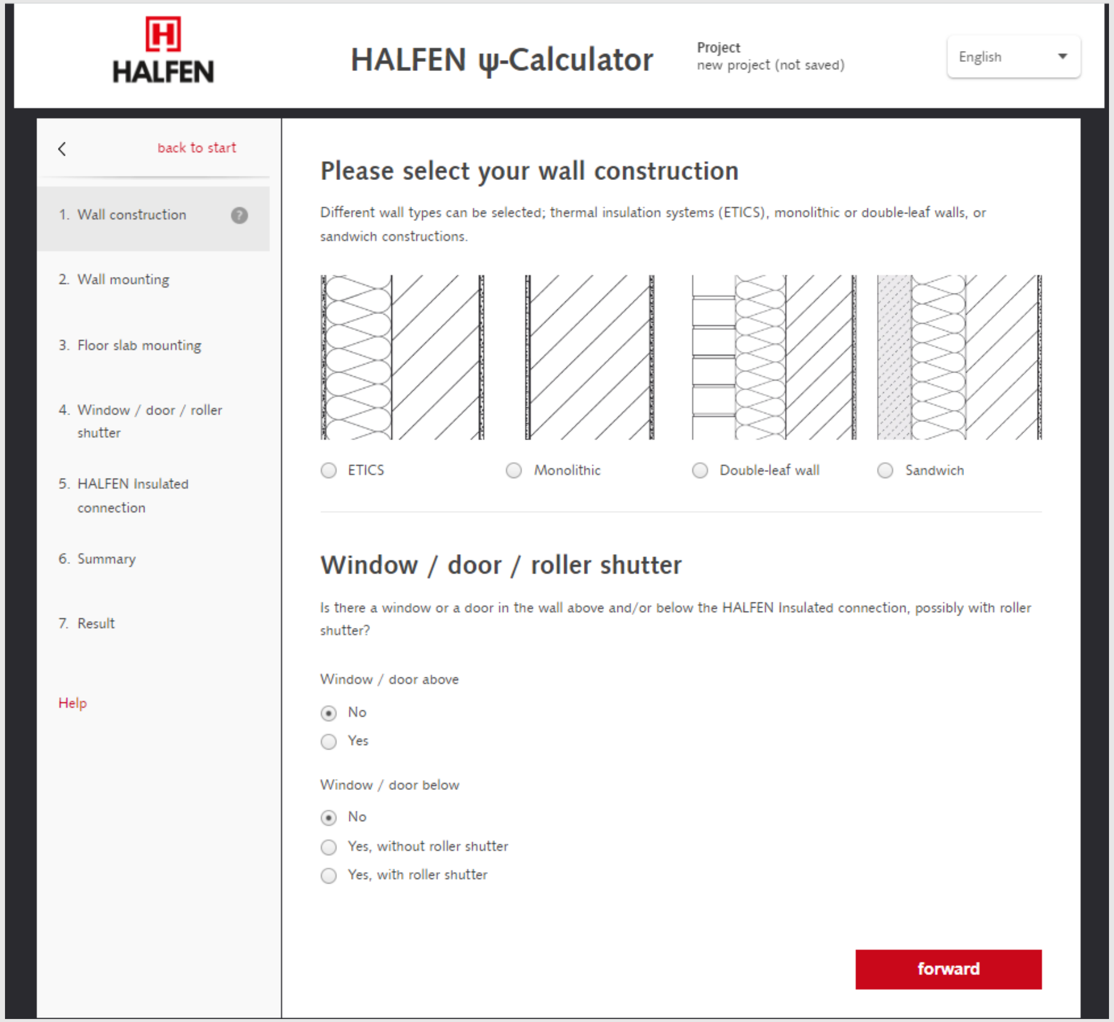

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THANK YOU FOR YOUR ATTENTION!

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