



REHVA 13th HVAC World Congress
26 - 29 May, Bucharest, Romania

BUILT ENVIRONMENT FACING CLIMATE CHANGE

Hybrid Geotabs Design Method

Built environment facing climate change

Authors: *Jelle Laverge, Eline Himpe, Rana Mahmoud, Mohsen Sharifi, Wim...*

Affiliation: Ghent University



hybrid
GEOTABS

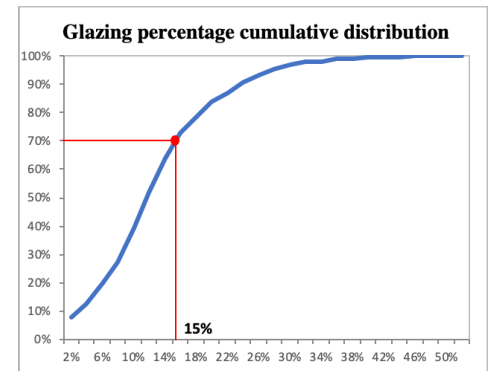
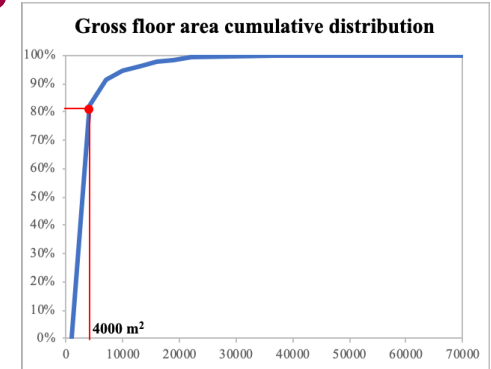
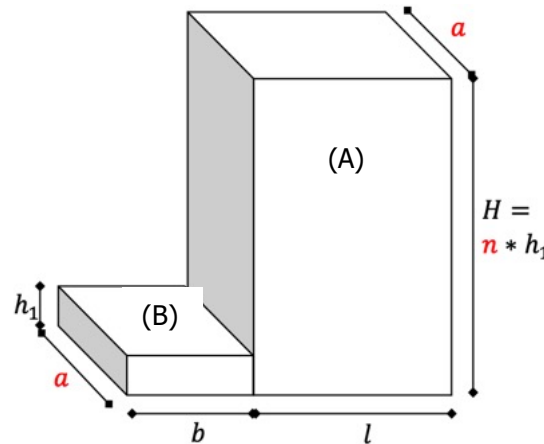
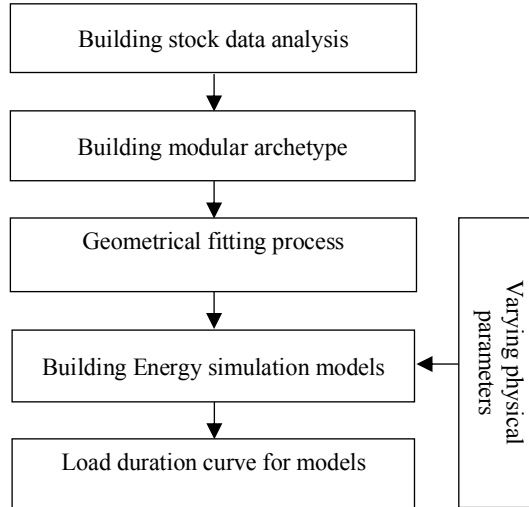
Controlling the power of the ground by integration

DEVELOPMENT OF A DESIGN METHOD

Background of the design tool



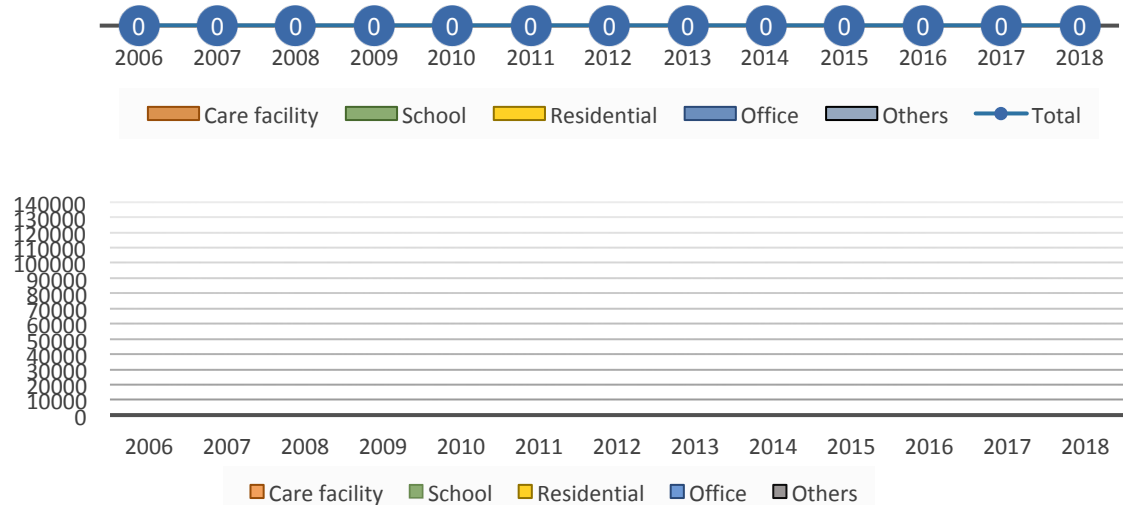
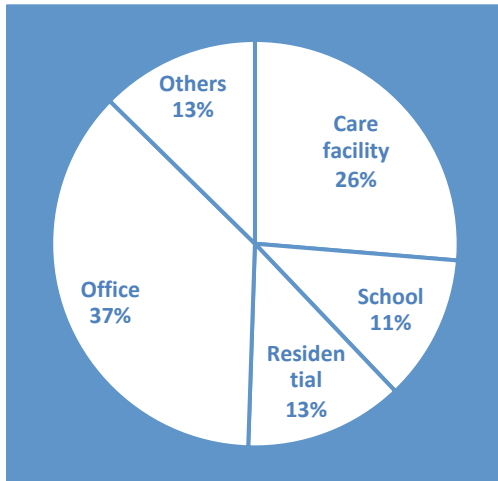
BUILDING STOCK ANALYSIS



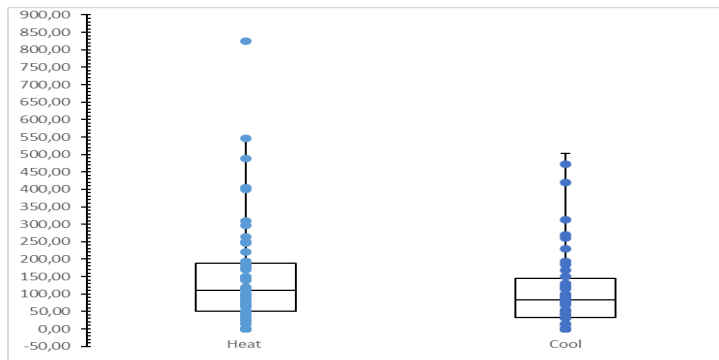


PROJECT DATA INVENTORY

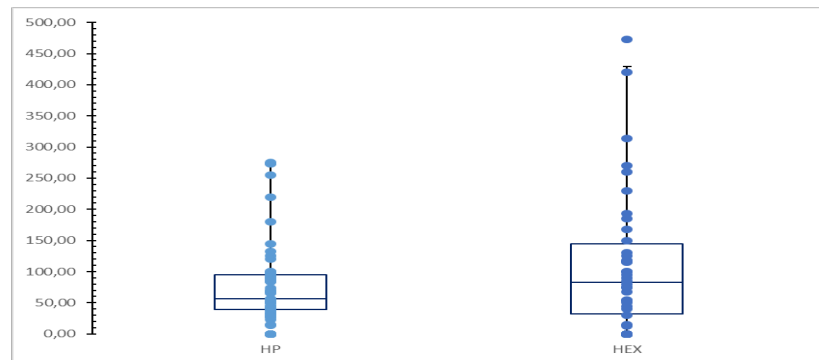
Type of Buildings



INFO ABOUT INSTALLED HVAC



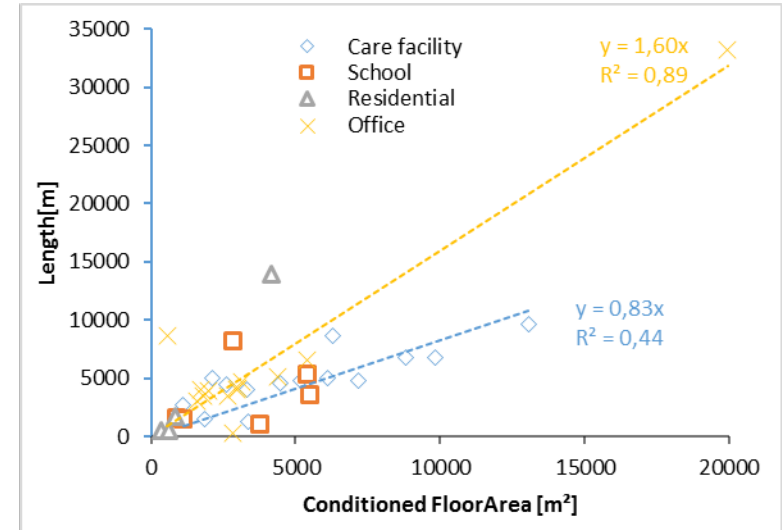
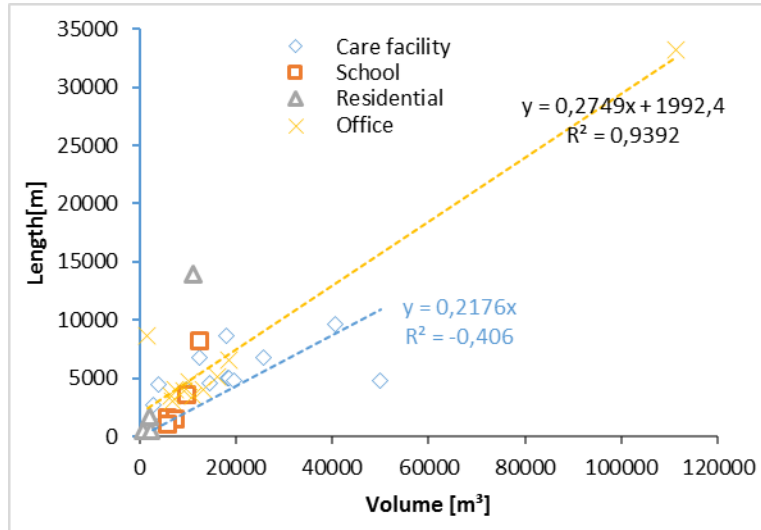
	Demand	
	Heat	Cool
Minimum	14,55	0,00
Q1	50,00	32,50
Median	110,00	82,50
Q3	187,75	145,00
Maximum	544,84	429,54



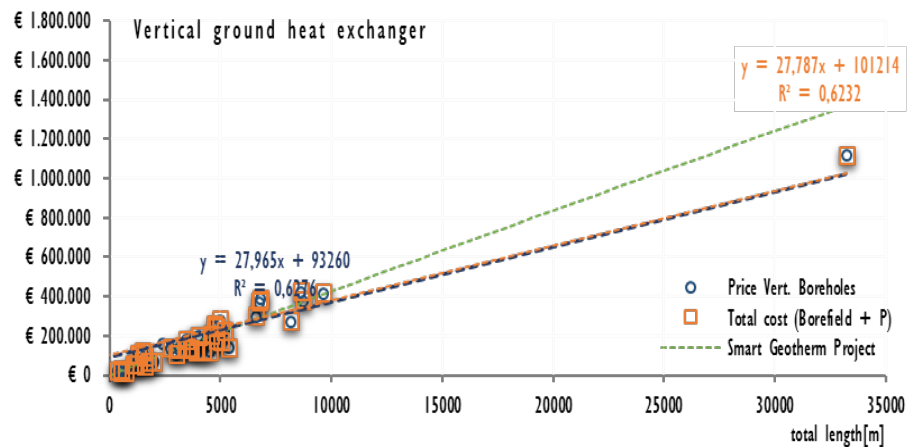
	Installation	
	HP	HEX
Minimum	15,75	0,00
Q1	38,90	32,50
Median	56,00	82,50
Q3	94,50	145,00
Maximum	273,00	429,54



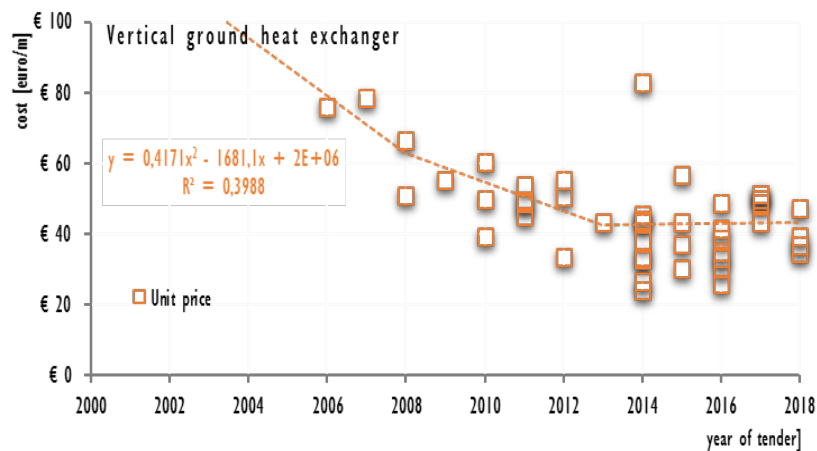
RELATION WITH BUILDING GEOMETRIE PARAMETERS



COST



Controlling the power of the ground by integration





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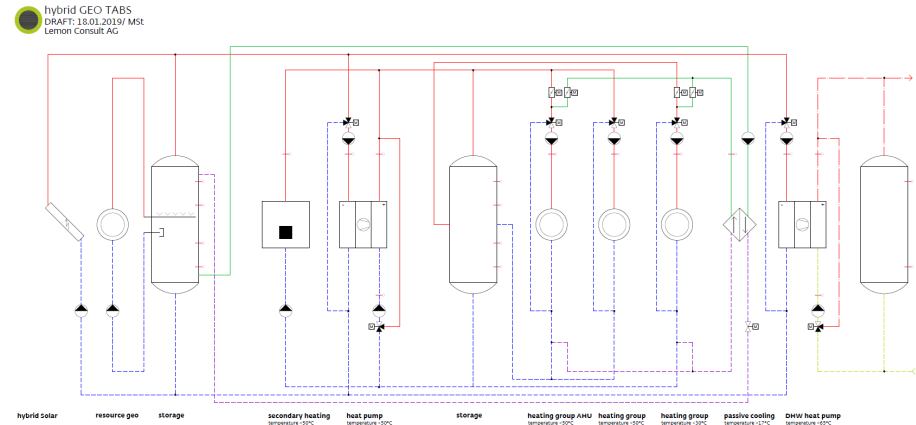
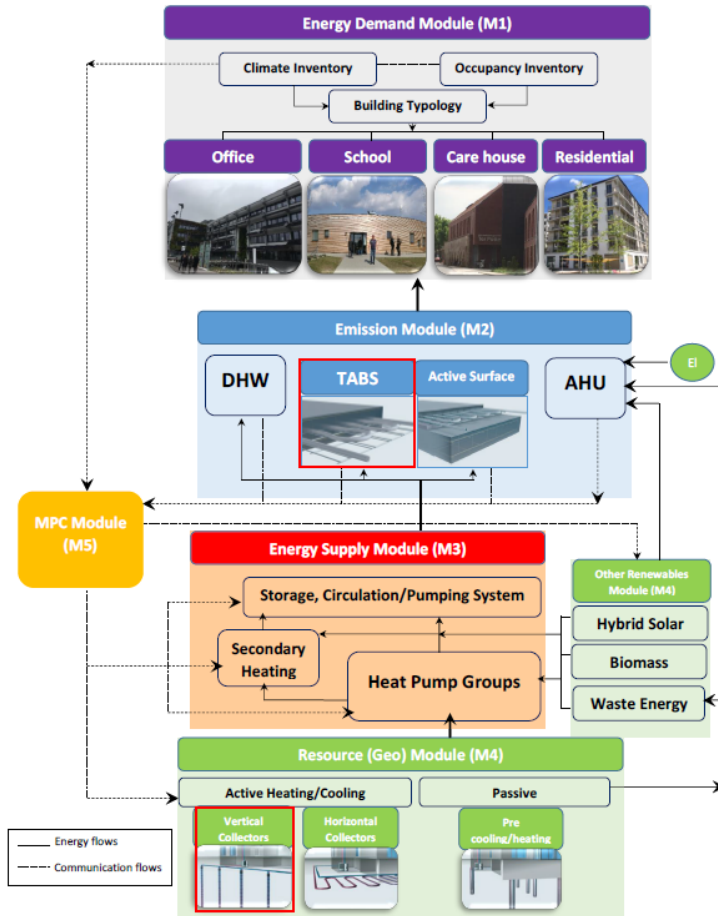
Controlling the power of the ground by integration

STANDARDISED MODULAR HYBRIDGEOTABS COMPONENT PACKAGES

- Standardised documentation and marketing material
 - Standard hydraulic schemes
 - Standard drawings
 - Standard Tender documents
 - Marketing material
 - ...
- Predefined – standardised – pre-engineered...
 - Avoid case-by-case work
 - Optimised combination
 - Degree of diversification?

hybrid GEOTABS System Scheme Model

Controlling the power of the ground by integration

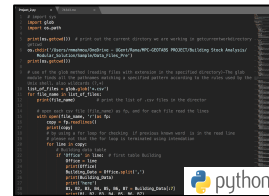
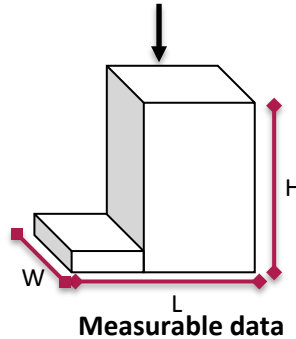




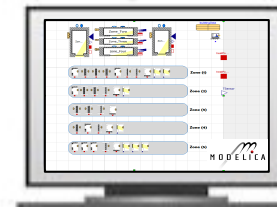
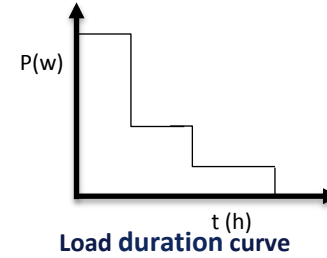
Sizing the GSHX and the Heat Pump based on **load duration curves** of building for building stock

ID	Construct year	Volume m ³	Heat loss area m ²	compact ratio m ² /m ³	Ratio floor area to volume m ² /m ³	Volume floor area to volume m ³ /m ³	Volume floor area to volume m ³ /m ³	Volume floor area to volume m ³ /m ³	Volume floor area to volume m ³ /m ³
0001	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0002	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0003	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0004	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0005	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0006	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0007	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0008	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0009	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0010	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0011	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0012	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0013	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0014	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0015	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0016	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0017	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0018	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0019	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00
0020	2000	10000	1000	1.00	1.00	1.00	1.00	1.00	1.00

Building General DATA



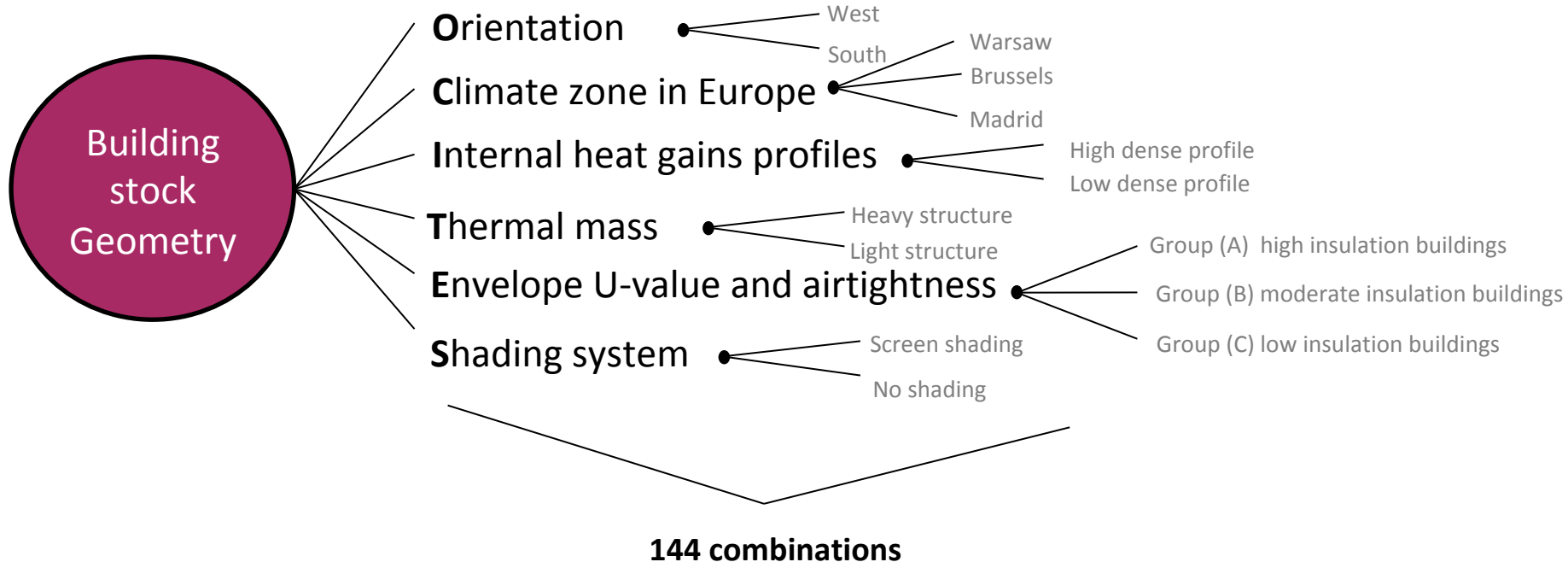
Interface



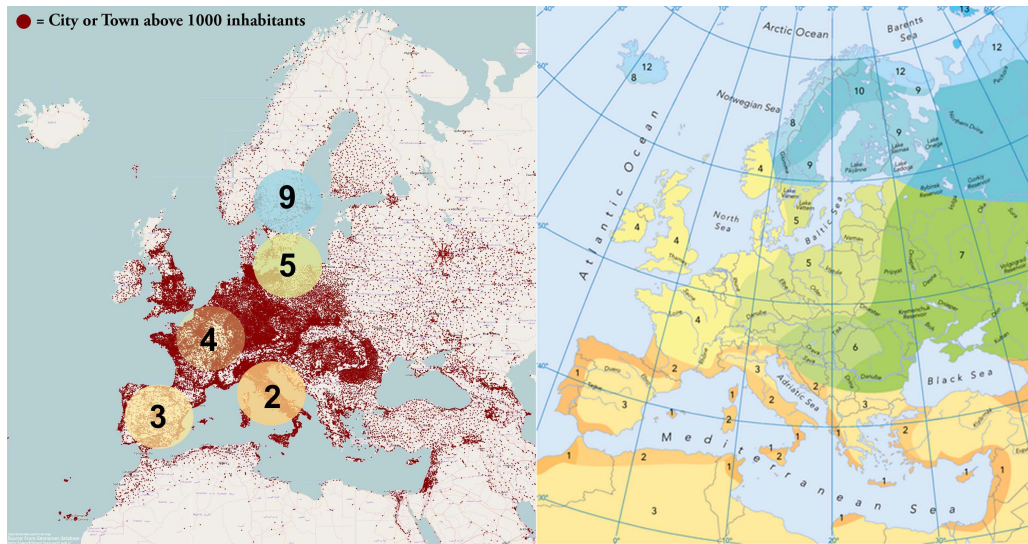
Simulations



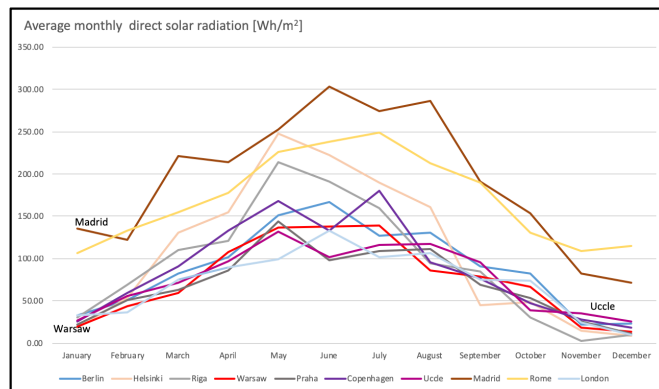
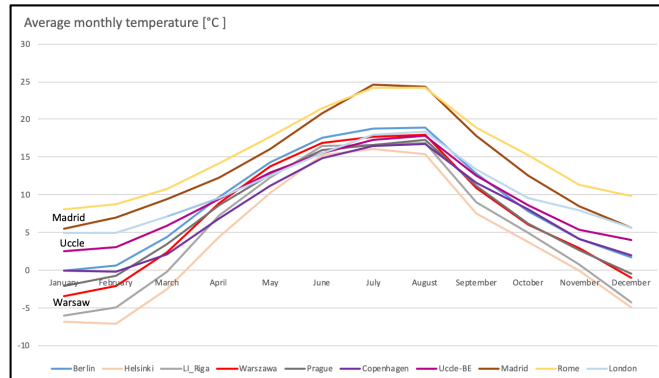
PARAMETERS VARIATIONS



Weather analysis

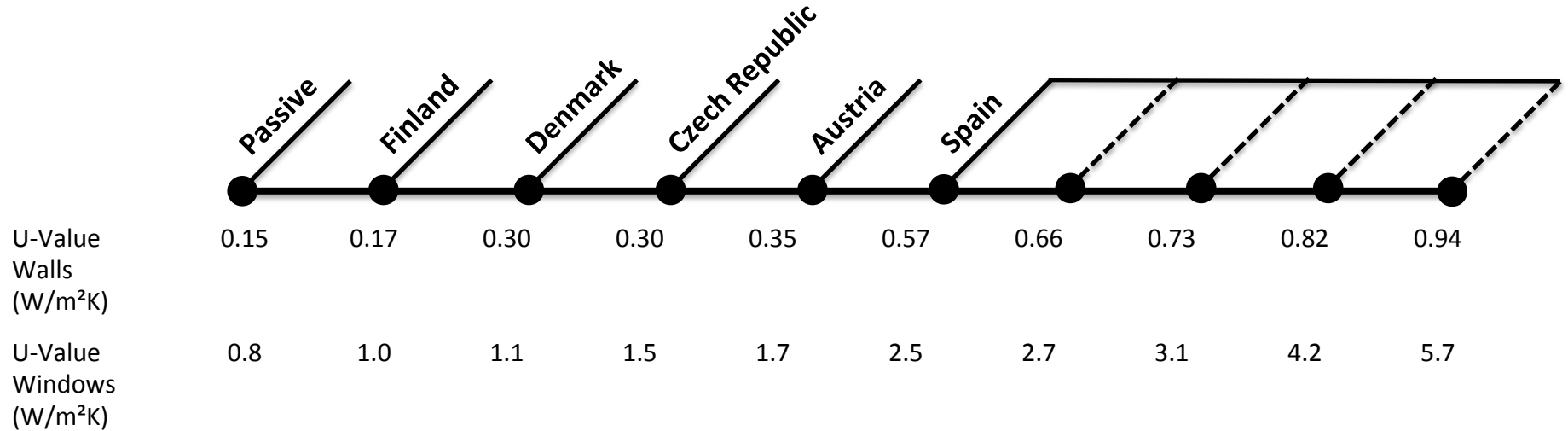


- 2 (Intermediate subtropical) → Rome, Toulouse
3 (continental subtropical) → Madrid, Athens
4 (Maritime, temperate warm) → Paris, Brussels, London
5 (transitional, temperate warm) → Copenhagen, Berlin, Warsaw
9 (transitional cold) → Stockholm, Helsinki





PARAMETER RANGES

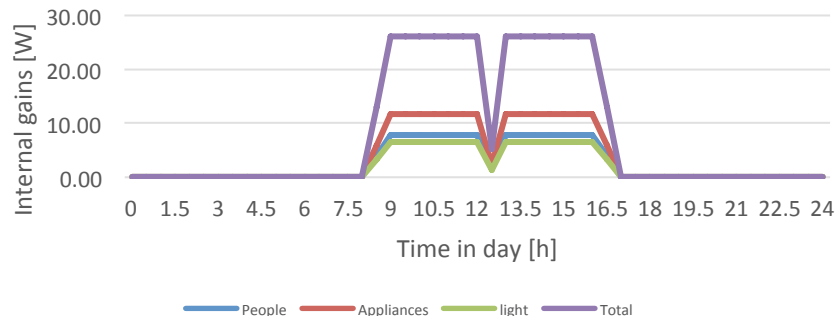


Building envelope & airtightness categories

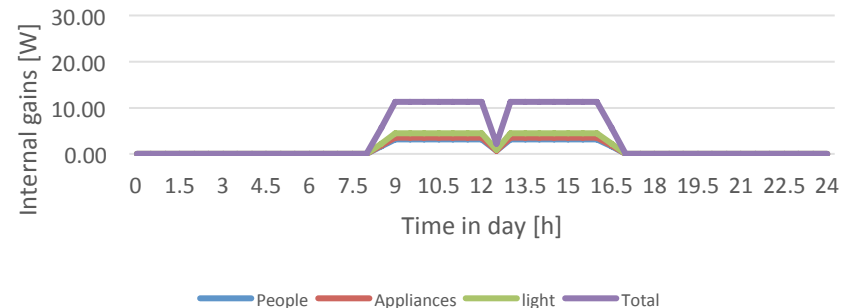
	U-value opaque [W/m ² . K]	U-value window [W/m ² . K]	Airtightness at n50 value
Group(A)	0.15	0.8	0.6
Group(B)	0.27	1.5	2.0
Group(C)	0.50	2.5	5.0

Ventilation system	Fixed flow with heat recovery	36 m ³ /h per person
Shading system	External screen	On at 200 W/m ²
Occupancy gains	Low dense High dense	1 person /20m ² 1 person /10m ²

Internal gains high dense office per m²



Internal gains high dense office per m²





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INPUT

Surface area
Heat loss surface area
Volume
Window ratio

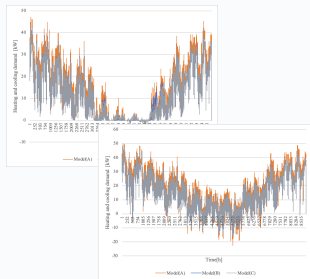


Building stock
database

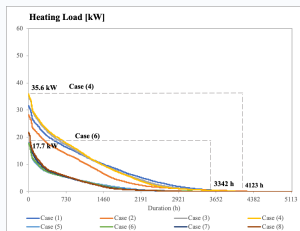
+

Climate &
Building
parameters

OUTPUT

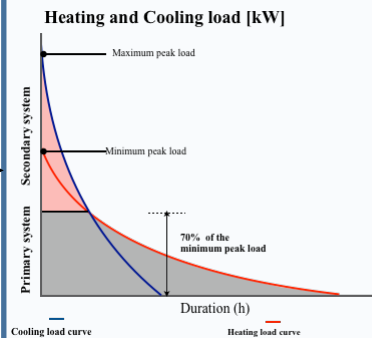


Automated dynamic
heating and cooling
demand curves



Heating and cooling
load duration curves

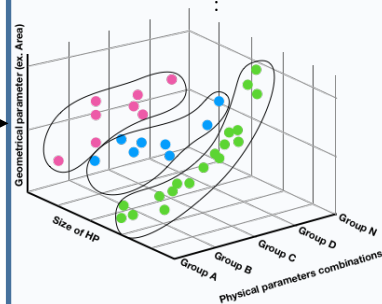
SIZING



Sizing of HP, GSHX and
secondary systems

CLUSTERING

Example:
Cluster 1 → 60 kW
Cluster 2 → 90 kW
Cluster 3 → 150 kW
⋮



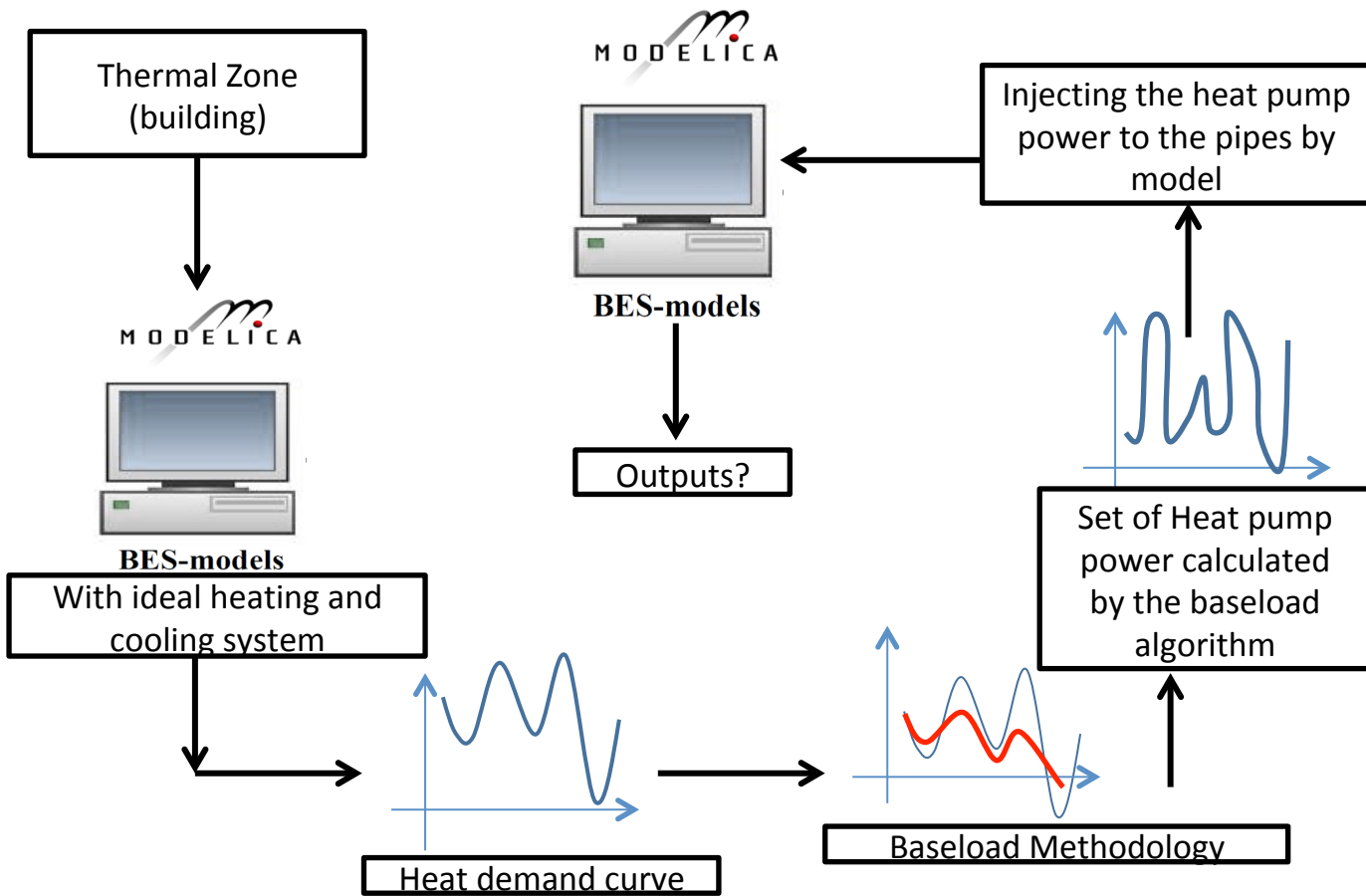
Cluster analysis based
on sizing and
parameter
combination



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HOW TO EVALUATE OUR BASELOAD ALGORITHM

Controlling the power of the ground by integration





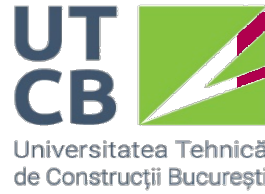
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Background of the design tool





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