Heat and Cold Energy Demands of Buildings

Module 2.2
Space heating and cooling demand

SHaKE – Sharing Heat and Knowledge on Energy Communities
Erasmus+ KA220-HED Cooperation Partnerships in HE
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Version 1.0

SHaKE
Sharing Knowledge on Energy Communities

1. Introduction

How to calculate the space heating and the DHW demand for a building ?

Historical measurement data

Thermal signature method

Fast method archetype or Design data

European standard

Building energy simulation

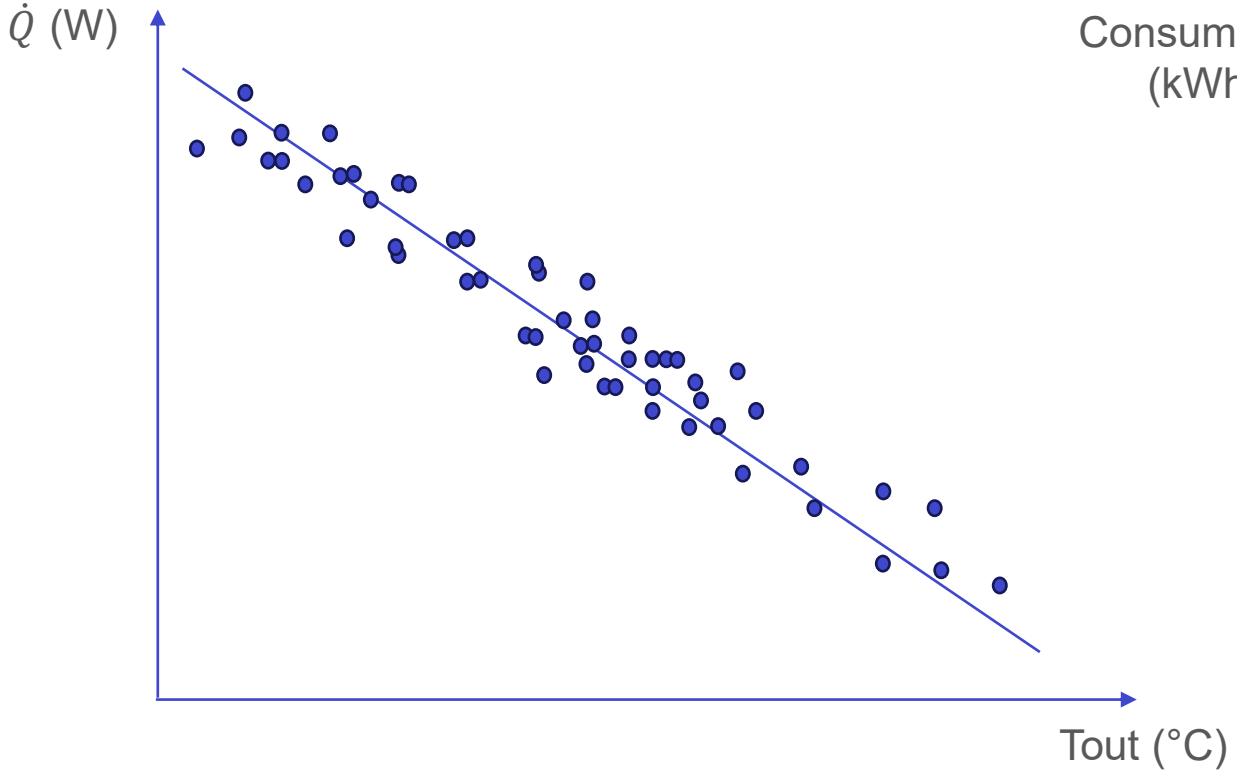
Existing buildings

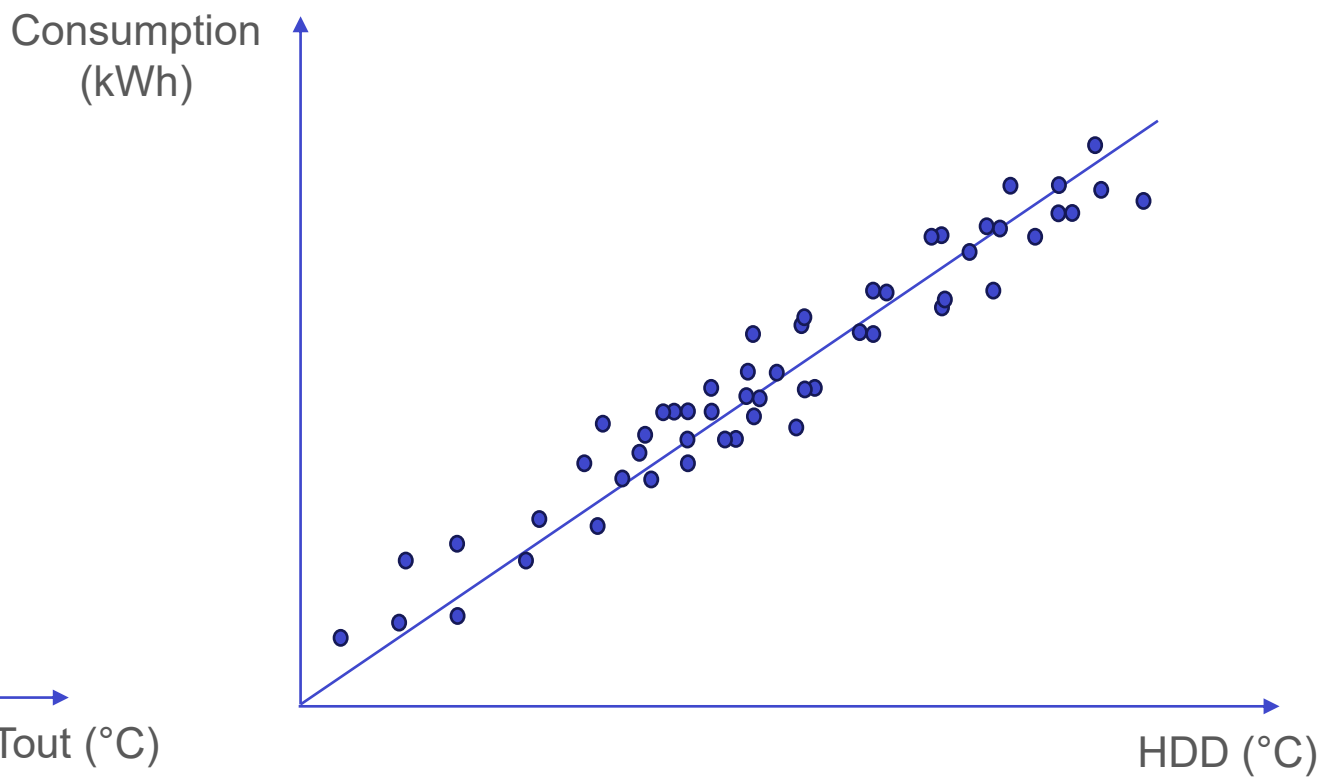
New buildings

\- Need for data +

2. Thermal signature method

$$\dot{Q} = K\ (T_{in} - T_{out})\ \ [W]$$



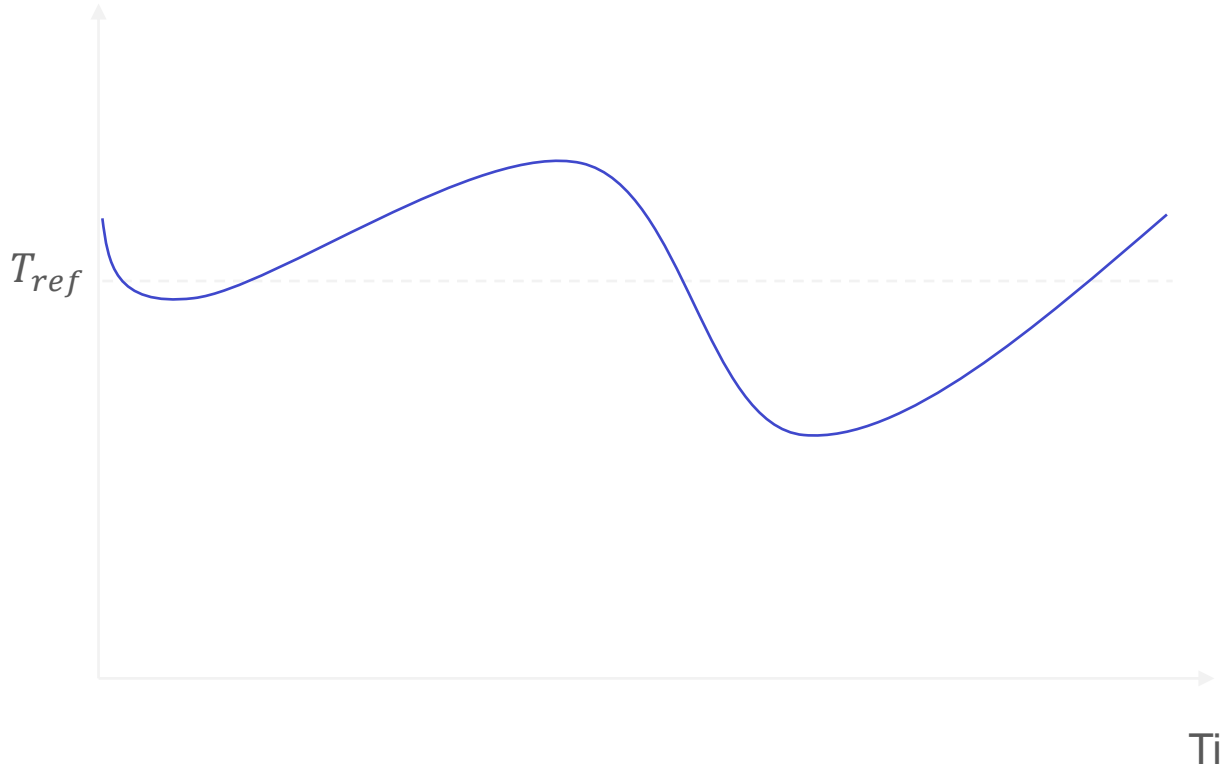


2. Thermal signature method

Heating degree days (HDD)

$$HDD = \sum_{d=1}^{365} \left| T_{ref} - \left(\frac{T_{max}^{d} + T_{min}^{d}}{2} \right) \right|_{+}$$

Outdoor temperature



If $T_{moy} = \frac{T_{max}^{d} + T_{min}^{d}}{2} \leq 15°C$

$$HDD = \sum_{d=1}^{365} 18 - \left(\frac{T_{max}^{d} + T_{min}^{d}}{2} \right)$$

Else

$$HDD = 0$$

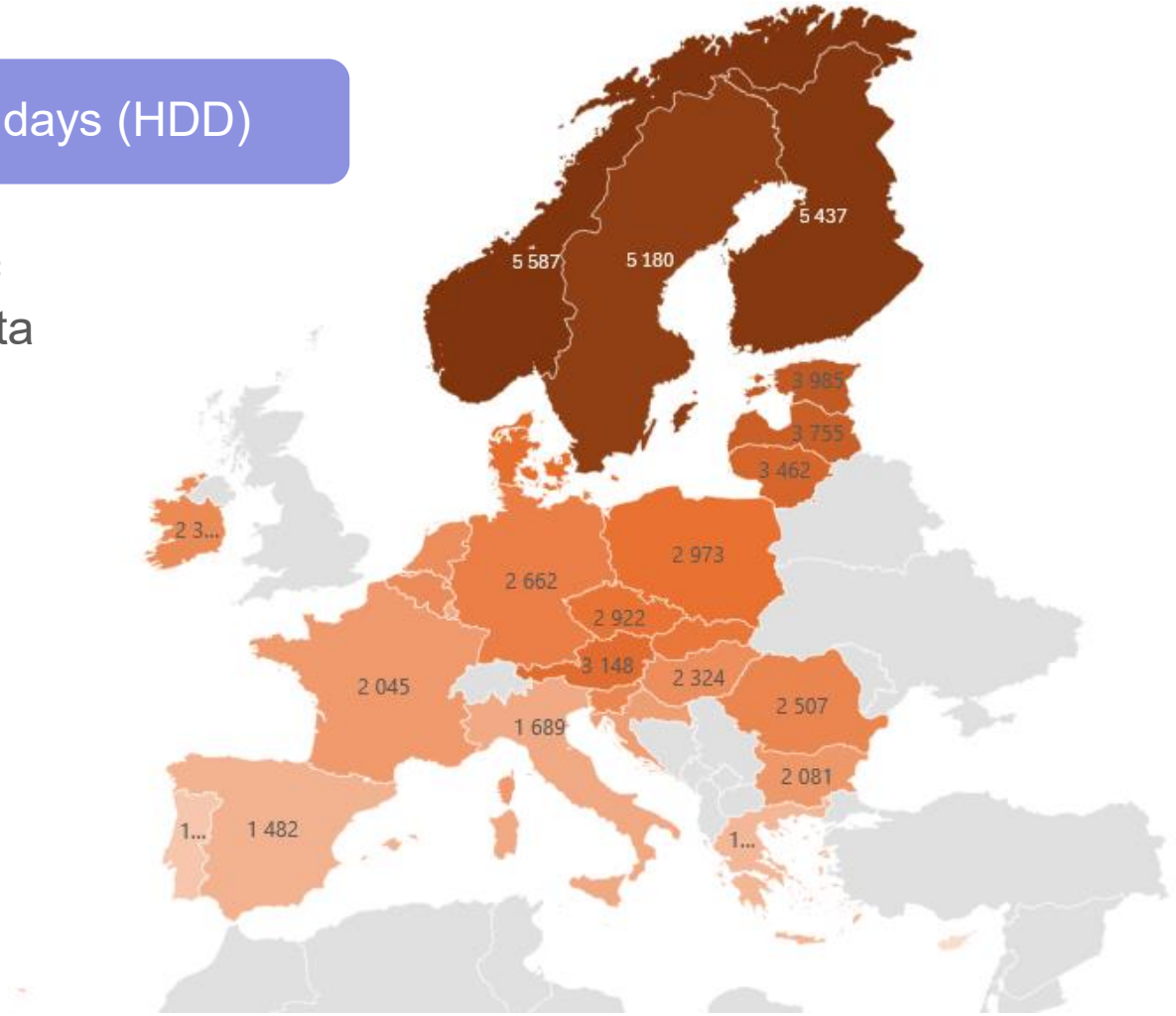
$with\ Tref = 18°C\ (EUROSTAT\ DATA)$

$https://ec.europa.eu/eurostat/cache/metadata/en/nrg_chdd_esms.htm$

2. Thermal signature method

Heating degree days (HDD)

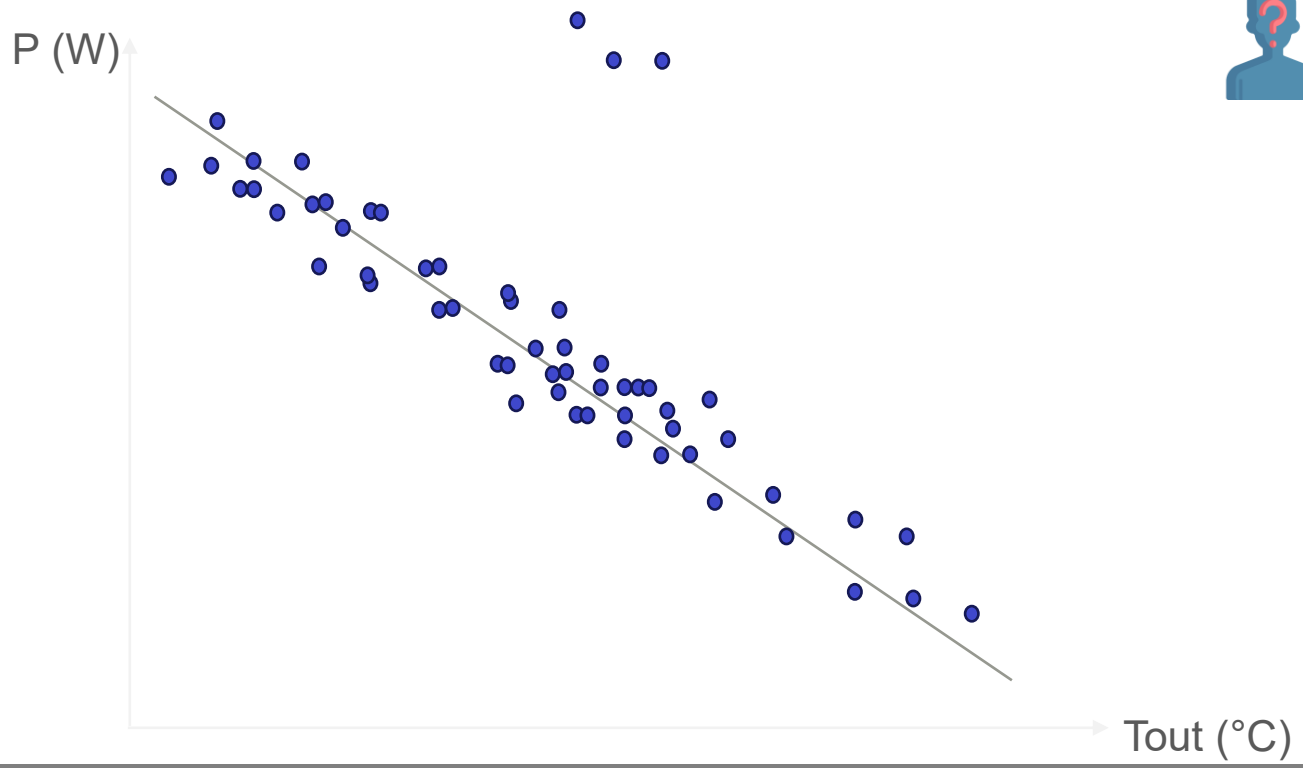
Year 2023, $T_{ref} = 18°C$, eurostat data



https://ec.europa.eu/eurostat/databrowser/view/nrg_chdd_a/default/map?lang=en

2. Thermal signature method

Interpretation of the thermal signature

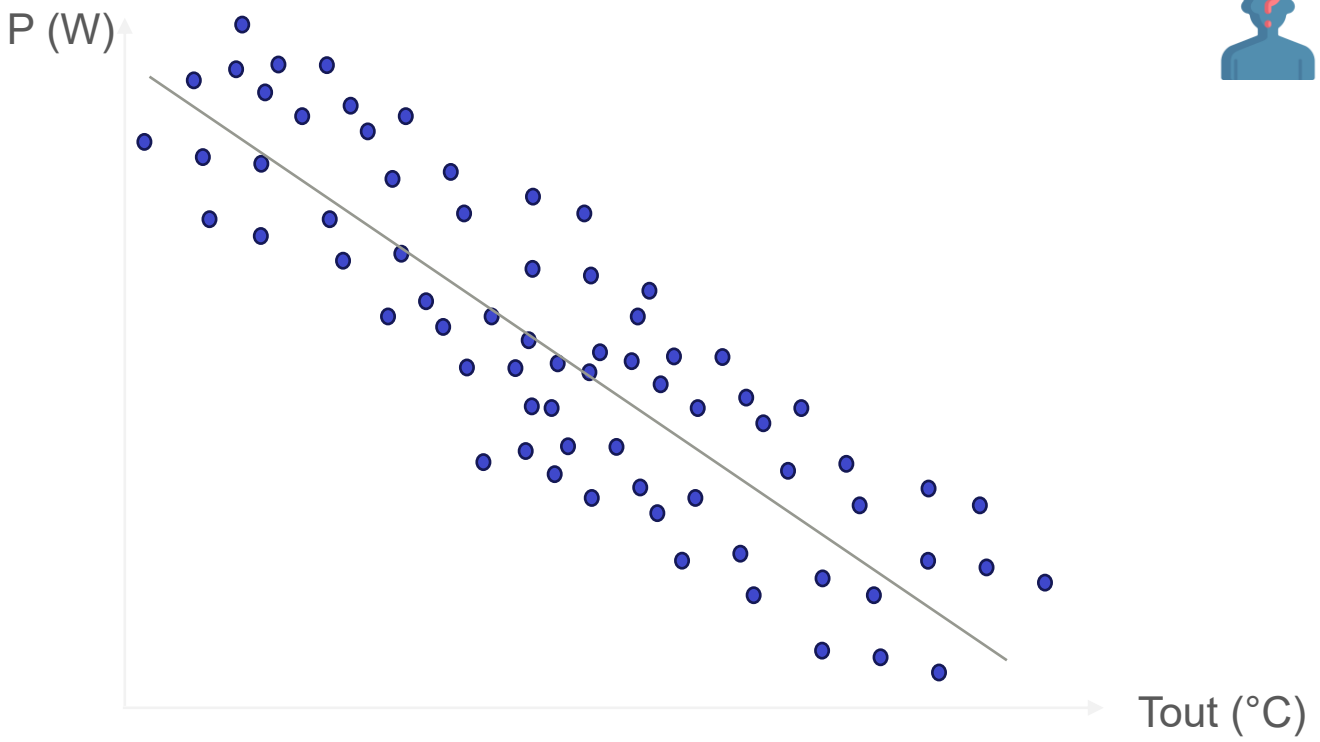


Few points deviating from the reference operation

- Measurement errors (outliers)
- Reading errors
- Data encoding errors
- Sudden drift

2. Thermal signature method

Interpretation of the thermal signature



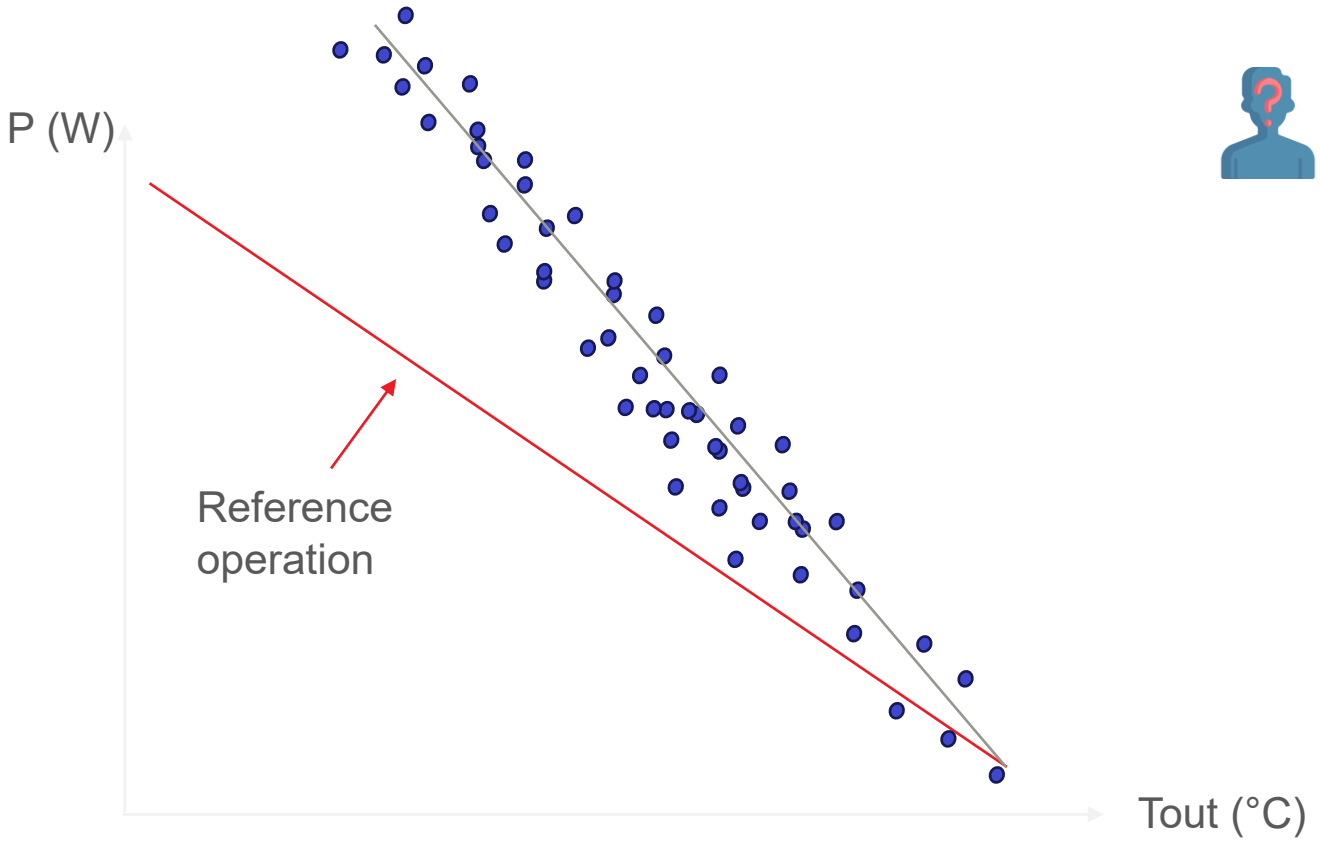
A wide spread of the measurement points

Control problems

- Valves
- Sensors
- Controller

2. Thermal signature method

Interpretation of the thermal signature



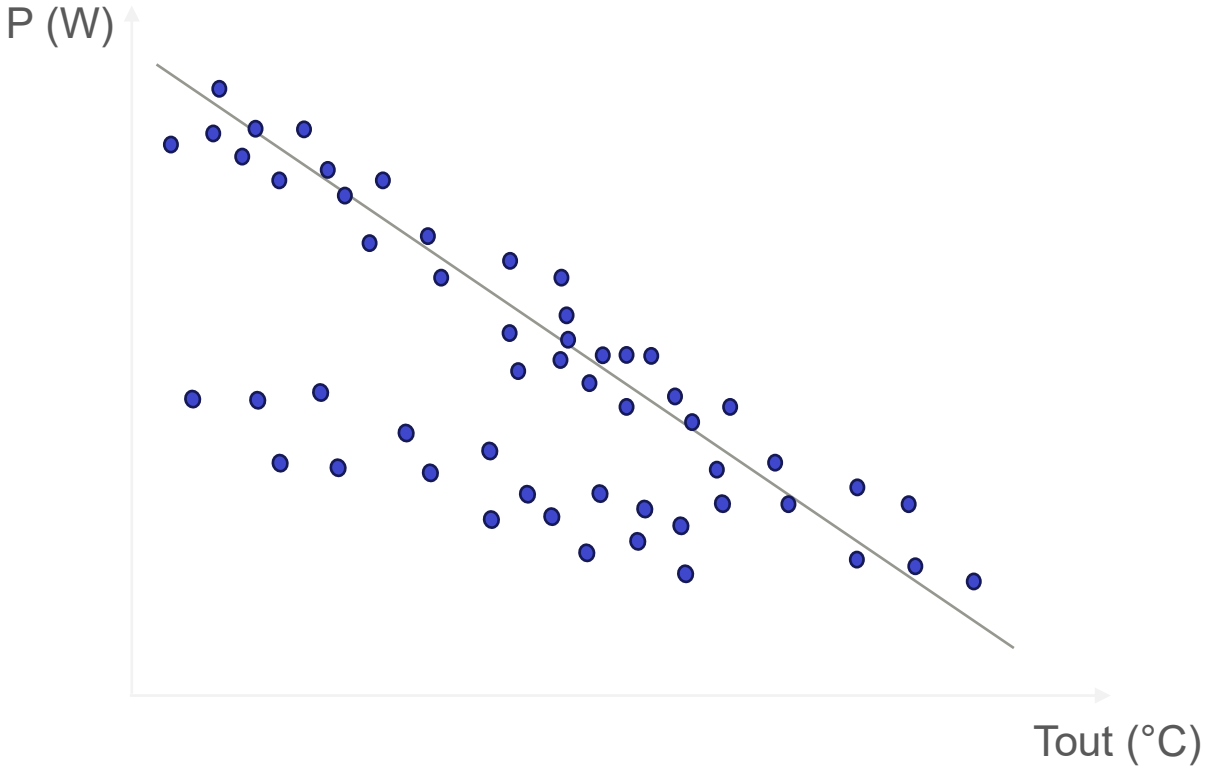
Progressive drift of the measurement points

Behavioral change

- Building overheating
- Leaky envelope
- Heat supply problem

2. Thermal signature method

Interpretation of the thermal signature



Progressive drift of the measurement points

Behavioral change

- Building overheating
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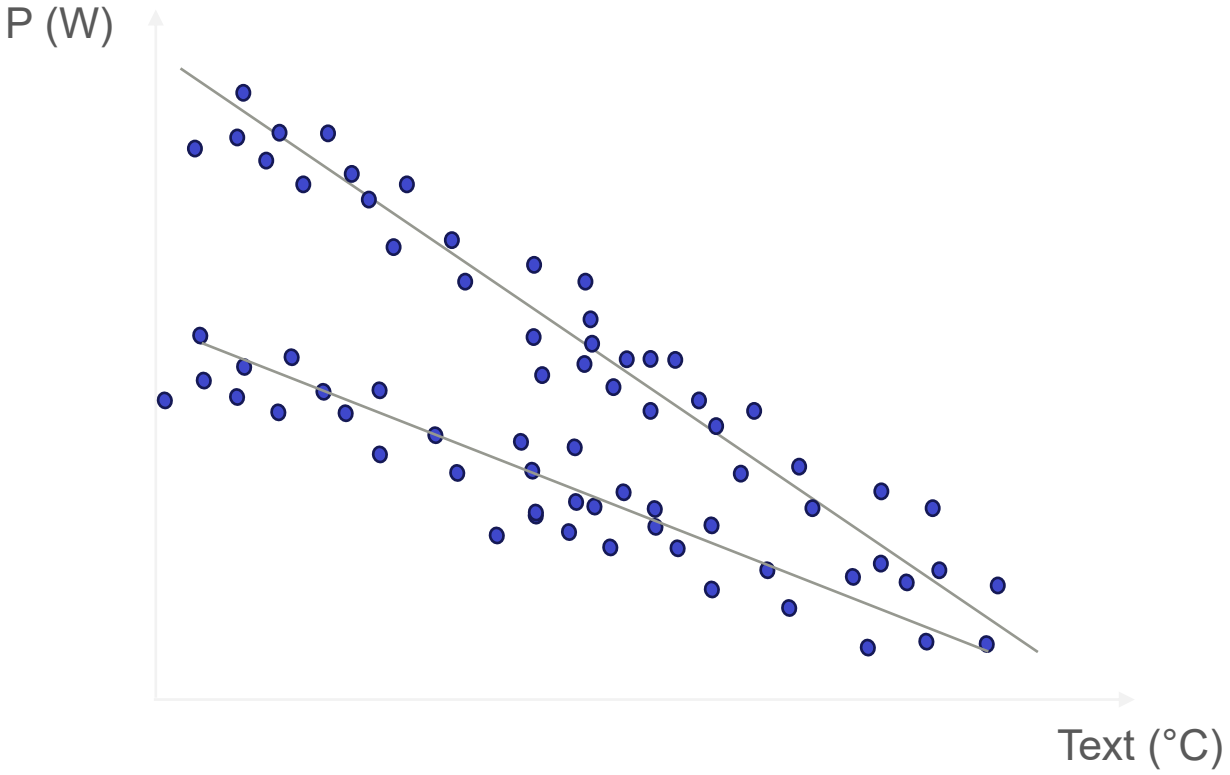
- Heat supply problem

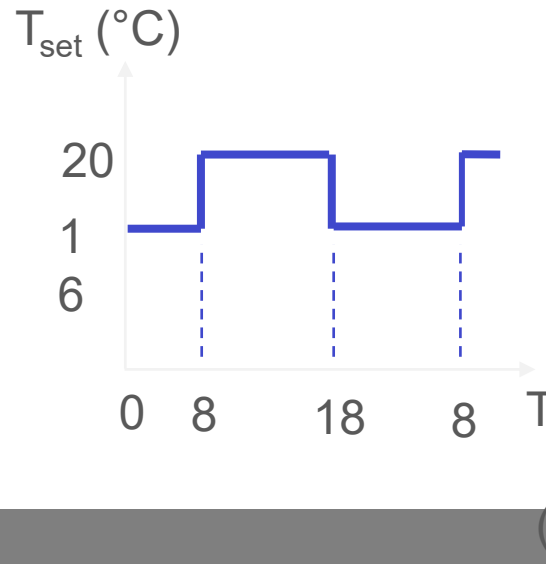
2. Thermal signature method

Interpretation of the thermal signature



Two separate behaviors

Time clock operation (tertiary buildings)



3. Fast method archetype

Starting from the common TABULA concept, the project partners developed national building typologies representing the residential building stock of their countries. The typologies consist of the following elements

A classification concept for existing residential buildings according to age, size and further parameters,

A set of example buildings that represents specific building types of the national stocks,

Typical energy consumption values for the example buildings,

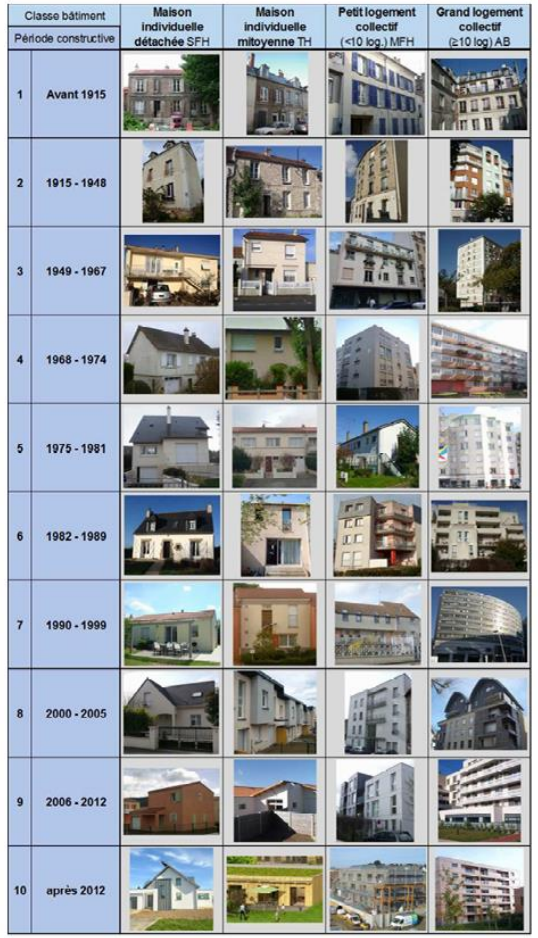
Showcase calculations of the possible energy savings,

Statistical data for buildings and supply systems.

3. Fast method archetype

Hungary

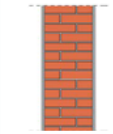
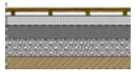
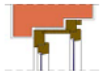
France



3. Fast method archetype

Hungary

SFH.02.
Single family house, built between 1945-1979

Külső határoló szerkezetek Elements of the building envelope		U (W/m²K)	SFH.02
Fal - Wall			
	Eredeti állapot		Existing state
	vakolat (1.5cm); tömör téglafal (38cm vagy 25cm); vakolat (3cm)	1,36 (1,77)	plaster (1.5cm); solid brick wall (38cm or 25cm); plaster (3cm)
	Általános felújítás		Standard refurbishment
	meglévő szerkezet külső oldalára, 5cm hőszigetelés	0,50	Additional 5 cm external insulation on existing structure
	Mélyfelújítás		Ambitious refurbishment
	meglévő szerkezet külső oldalára, 20cm hőszigetelés	0,17	Additional 20 cm external insulation on existing structure
Padlásfödém – Attic slab (top ceiling)			
	Eredeti állapot		Existing state
	Borított gerendás födém: agyagterítés (6cm); deszkaborítás (2,5cm); fagerenda (80-90cm-ként); deszkázat (2cm); nádszövet (1,5); vakolat (2cm)	1,30	Wooden slab: clay (6cm); wooden planks (2.5cm); wooden beams (at every 80-90cm); planks (2cm); reed (1.5cm); plaster (2cm)
	Általános felújítás		Standard refurbishment
	meglévő szerkezetre, felül 12cm hőszigetelés	0,27	Additional 12 cm external insulation on top of existing structure
	Mélyfelújítás		Ambitious refurbishment
	meglévő szerkezetre, felül 24cm hőszigetelés	0,14	Additional 24 cm external insulation on top of existing structure
Talajon fekvő padló – Floor above ground			
	Eredeti állapot		Existing state
	hajópadló (3cm); aljzatbeton (8cm); vízszigetelés; aljzatbeton (10cm); kavicsfeltöltés (15cm)	0,98	wood (3 cm); concrete (8 cm); waterproofing; concrete (10cm); gravel (15cm)
	Általános felújítás		Standard refurbishment
	nincs változás	0,98	no changes
	Mélyfelújítás		Ambitious refurbishment
	nincs változás	0,98	no changes
Ablak - Window			
	Eredeti állapot		Existing state
	Kapcsolt gerébtokos vagy pallótokos fa ablak	3,00	Box-type wooden window with single glazing
	Általános felújítás		Standard refurbishment
	Hőszigetelt, kétszeres üvegezésű (fa vagy műanyag) ablak, low-e bevonattal, argon gáz töltéssel	1,60	Wooden or PVC window with double-glazing, low-e coating and argon gas filling
	Mélyfelújítás		Ambitious refurbishment
	Fa-alumínium ablak, háromrétegű üvegezéssel, low-e bevonattal, argon gáz töltéssel	1,00	Composite system: timber-alum. window with triple-glazing, low-e coating and argon gas filling
Ajtó - Door			
	Eredeti állapot		Existing state
	Fa bejárati ajtó	3,50	Old wooden entrance door
	Általános felújítás		Standard refurbishment
	Új hőszigetelt ajtó	1,80	New door
	Mélyfelújítás		Ambitious refurbishment
	Új hőszigetelt ajtó	1,30	New door

France

05 - MFH	Classe bâtiment Immeuble collectif (<10 log.)	Période constructive De 1975 à 1981	Code TABULA FR.N.MFH.05.Gen.ReEx.001

Description générale du type

Petit immeuble collectif, aligné sur rue avec mitoyenneté ou isolé (plus souvent). Construction massive (grande majorité) en poteau-dalle et maçonnerie de remplissage, en parpaing ou brique creuse, panneau sandwich préfabriqué, avec ou sans revêtement extérieur. Taux de vitrage moyen à élevé. Menuiseries bois, aluminium ou PVC double vitrage. Toiture double pente ou toiture terrasse. Sur terre-plein, sur cave, sur passage ou parking. Avec isolation thermique selon RT 74.

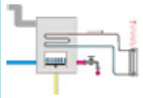
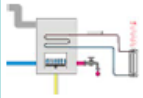
Données statistiques pour ce type de logement en France

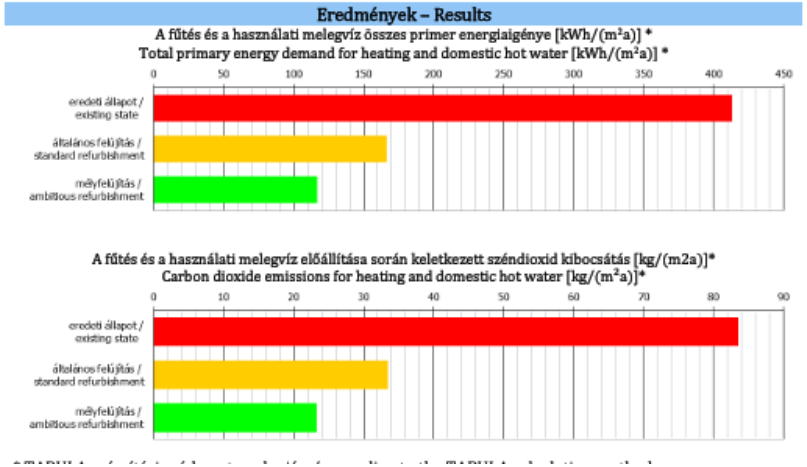
Nombre de logements en milliers :	208	Surface habitable en millions de m² :	14,0
Part du parc existant :	0,7%	Part du parc existant :	0,6%

		ETAT INITIAL		RÉNOVATION STANDARD		RÉNOVATION PERFORMANTE	
Eléments du bâti	*Surface [m²]*	*Description*	*Coef. U W/m²K*	*Description*	*Coef. U W/m²K*	*Description*	*Coef. U W/m²K*
Toiture / plancher haut	126	Plancher leger vers combles + 10 cm Laine minéral Th60	0,49	Isolation 22 cm LM sur plancher haut	0,14	Isolation 30 cm LM sur plancher haut	0,10
Façades	145	Parpaing 20 cm + ITI 4 cm PSE Th40 + BA13	0,61	ITE avec 12 cm PSE	0,26	ITE avec 16 cm PSE	0,19
Baies vitrées	40	Menuiserie bois avec DV, 4/6/4, air	2,80	Menuiserie bois ou PVC avec DV ITR Ug=1,1	1,40	Menuiserie bois ou PVC avec TV ITR Ug=0,8	1,00
Porte d'entrée	4	Porte pleine bois ancienne	3,10	Remplacement par porte isolée Ud=2,0	2,00	Remplacement par porte isolée Ud=1,5	1,50
Plancher bas	126	Dalle béton 15 cm + 2 cm PSE Th40	1,25	Isolation sous chape avec 7 cm PUR	0,32	Isolation sous chape avec 10 cm PUR	0,23

3. Fast method archetype

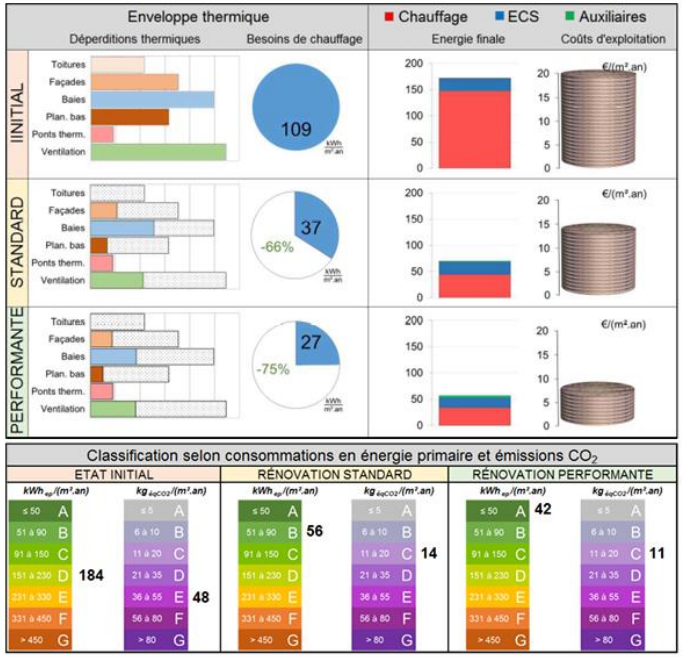
Hungary

Heating and hot water systems		expend.coeff.	
Fűtés - Heating system			
	Eredeti állapot		Existing state
	állandó hőmérsékletű gázkazán	1,24	constant temperature non-condensing boiler
	Általános felújítás		Standard refurbishment
	kondenzációs gázkazán, fűtött térben	1,05	condensing boiler, internal
	Mélyfelújítás		Ambitious refurbishment
	kondenzációs gázkazán	1,05	condensing boiler
Használati melegvíz - Hot water system			
	Eredeti állapot		Existing state
	állandó hőmérsékletű gázkazán, puffertároló nélkül	1,82	constant temperature non-condensing boiler, without buffer tank
	Általános felújítás		Standard refurbishment
	kondenzációs gázkazán, puffertároló nélkül	1,19	condensing boiler, internal, without buffer tank
	Mélyfelújítás		Ambitious refurbishment
	kondenzációs gázkazán, napkollektoros rásegítéssel (60%)	1,19	heat generation combined with heating system + solar thermal system (60%)



France

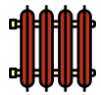
Eléments des systèmes techniques	*Description*	*Coef. Effort*	*Description*	*Coef. Effort*	*Description*	*Coef. Effort*
Chauffage	Chaudière gaz à condens. individ., >2000 / Radiateurs + RTh / Réseau individuel (<65°C) isolé	**1,23**	Chaudière gaz à condens. individ. >2012 grd. modul. / Radiateurs + RTh / Réseau individuel (≤55°C) isolé	**1,32**	Chaudière gaz à condens. collective, >2012 / Radiateurs + RTh / Réseau collectif (≤55°C) isolé	**1,54**
Ventilation	Ventilation naturelle		VMC SF hygro B collective		VMC SF hygro B collective	
Eau chaude sanitaire	Chauffe-eau gaz individuel / Distribution individ., sans bouclage	**1,45**	ECS instantanée par chaudière individ. / Distribution individ., sans bouclage	**1,10**	ECS par chaudière collective + ballon ECS / Distribution collective, bouclage	**1,26**
Production d'électricité sur site						



4. European standard

$$\dot{Q}_{sh} = \dot{Q}_t + \dot{Q}_v - [\dot{Q}_s + \dot{Q}_i]$$

Space heating

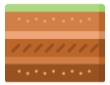

Radiators


Fan-coil unit


Radiant floor

Transmission losses


Walls


Ground


Windows


Thermal bridges


Non heated spaces

Ventilation losses


Mechanical ventilation


Infiltrations

Solar gains

Internal gains


Lights

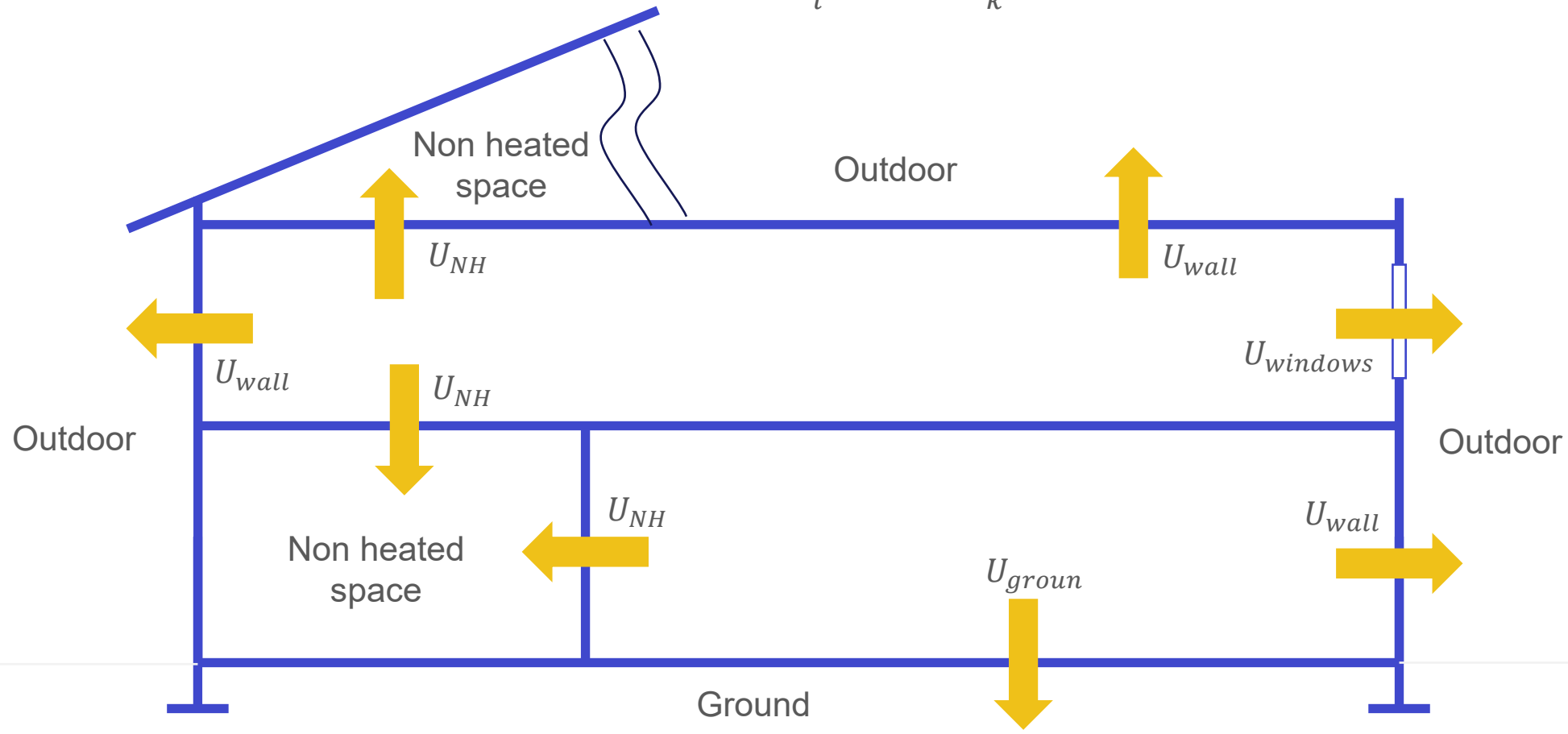

Occupants


Electric appliances

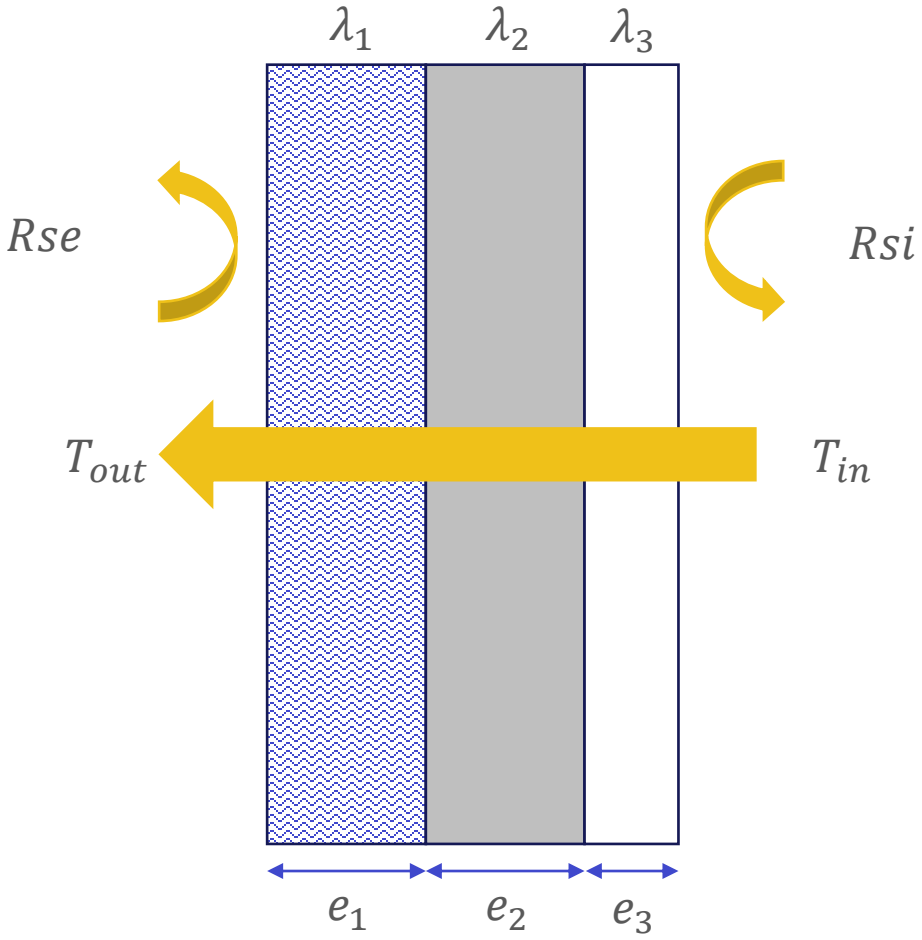
[EN 12831,2017]

4. European standard

$$U_{tot} = \sum U * A * f_i + \sum_i \psi_i L_i + \sum_k \mathrm{X}_k$$



4. European standard



Thermal transfer by conduction :

$$\dot{Q}_{wall} = \frac{\lambda_i S}{e_i} \Delta T \quad [W]$$

Thermal transfer by convection:

$$\dot{Q}_{wall} = h_i \, S \, \Delta T \quad [W]$$

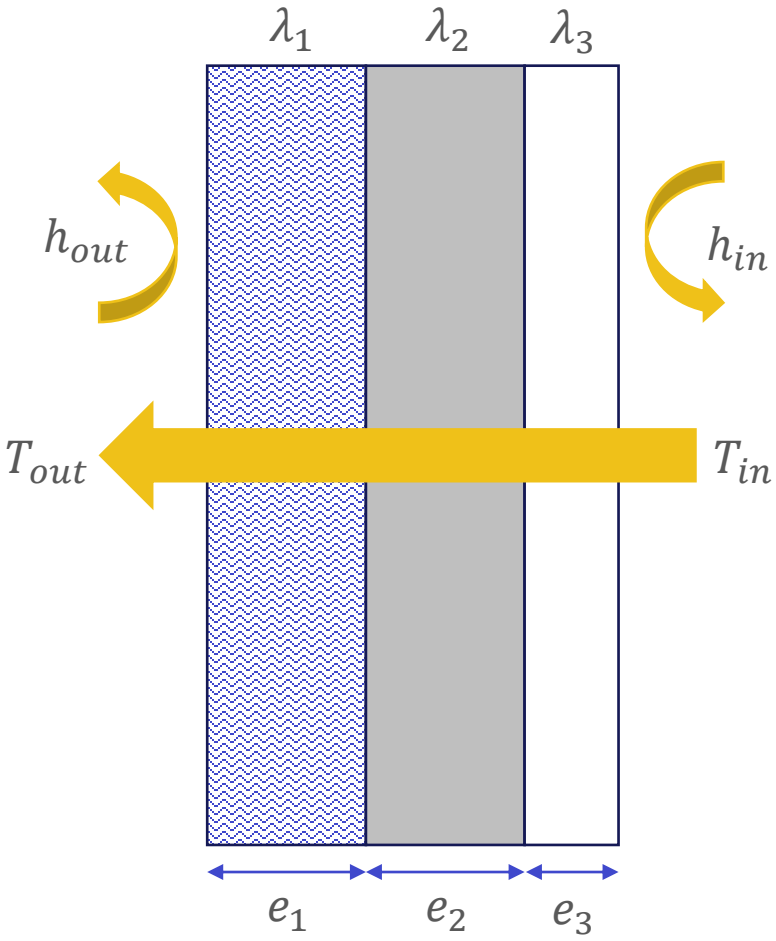
Thermal transfer through the wall:

$$\dot{Q}_{wall} = UA_{wall} \, (T_{in} - T_{out}) \quad [W]$$

With

$$U_{wall} = \left(Rse + Rsi + \sum_i \frac{e_i}{\lambda_i} \right)^{-1} \quad [W/K]$$

4. European standard



Thermal transfer through the wall:

$$\dot{Q}_{wall} = UA_{wall}\,(T_{in} - T_{out}) \quad [W]$$

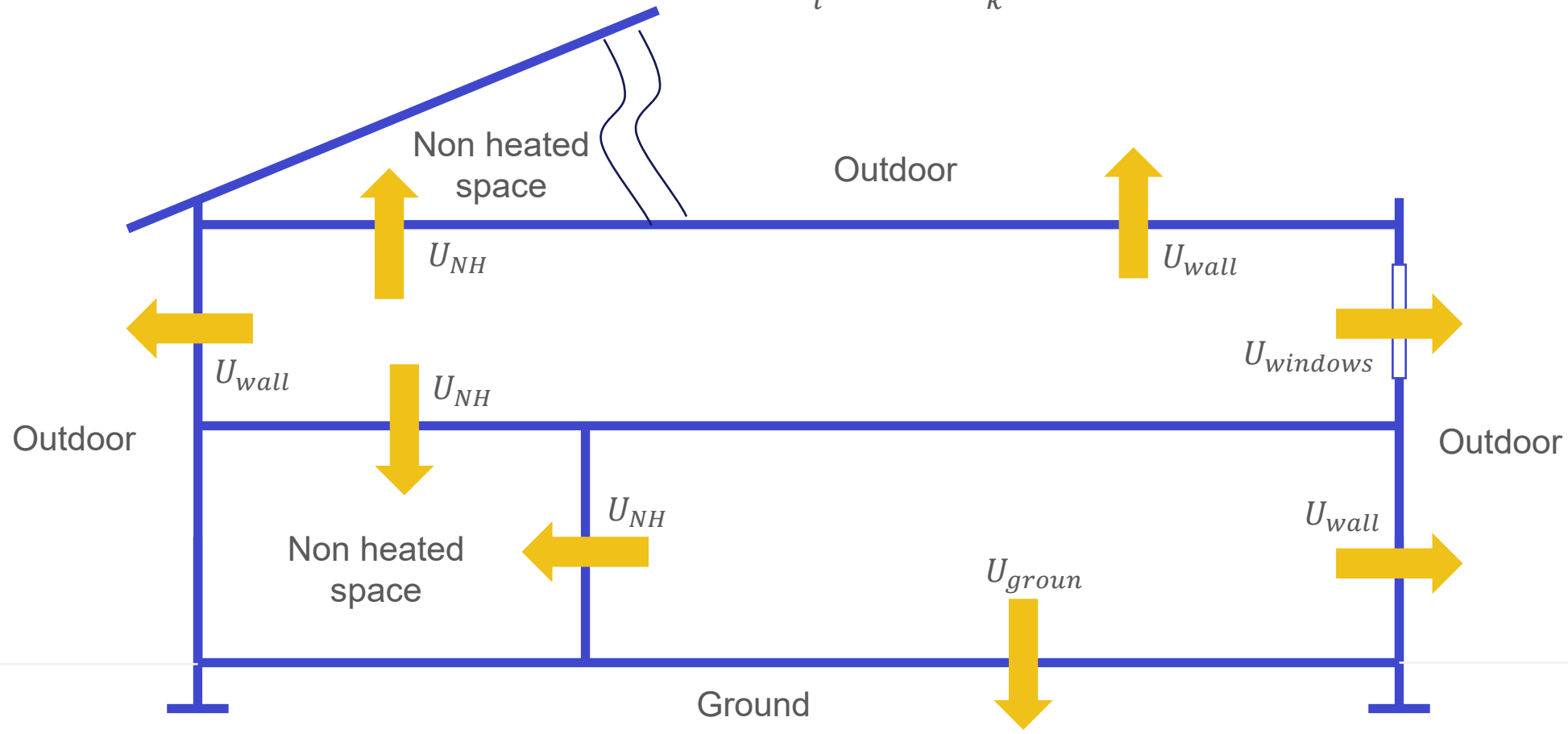
With

$$U_{wall} = \left(Rsi + Rse + \sum_i \frac{e_i}{\lambda_i} \right)^{-1} \quad [W/K]$$

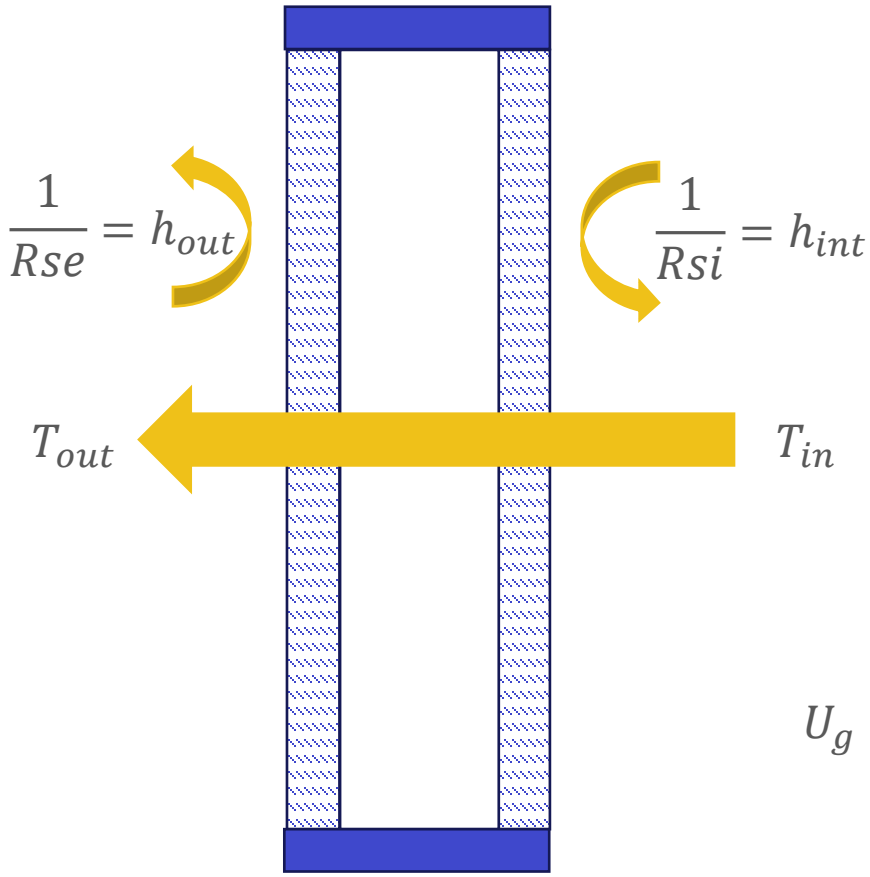
Surface thermal resistance (m².K/W)			
Wall type and flow direction	Rsi	Rse	Rsi+Rse
Horizontal flow (>60°) (wall)	0,13	0,04	0,17
Upward flow (Roof)	0,1	0,04	0,14
Downward flow (floor)	0,17	0,04	0,21

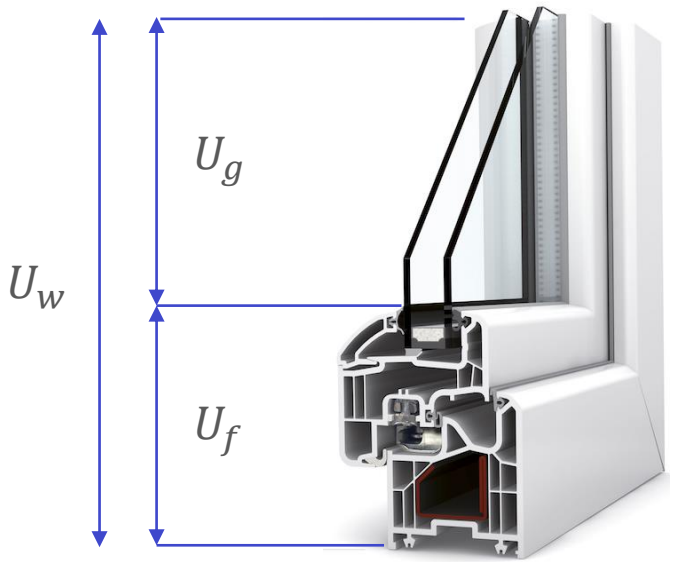
4. European standard

$$U_{tot} = \sum U * A * f_i + \sum_i \psi_i L_i + \sum_k \mathrm{X}_k$$



4. European standard





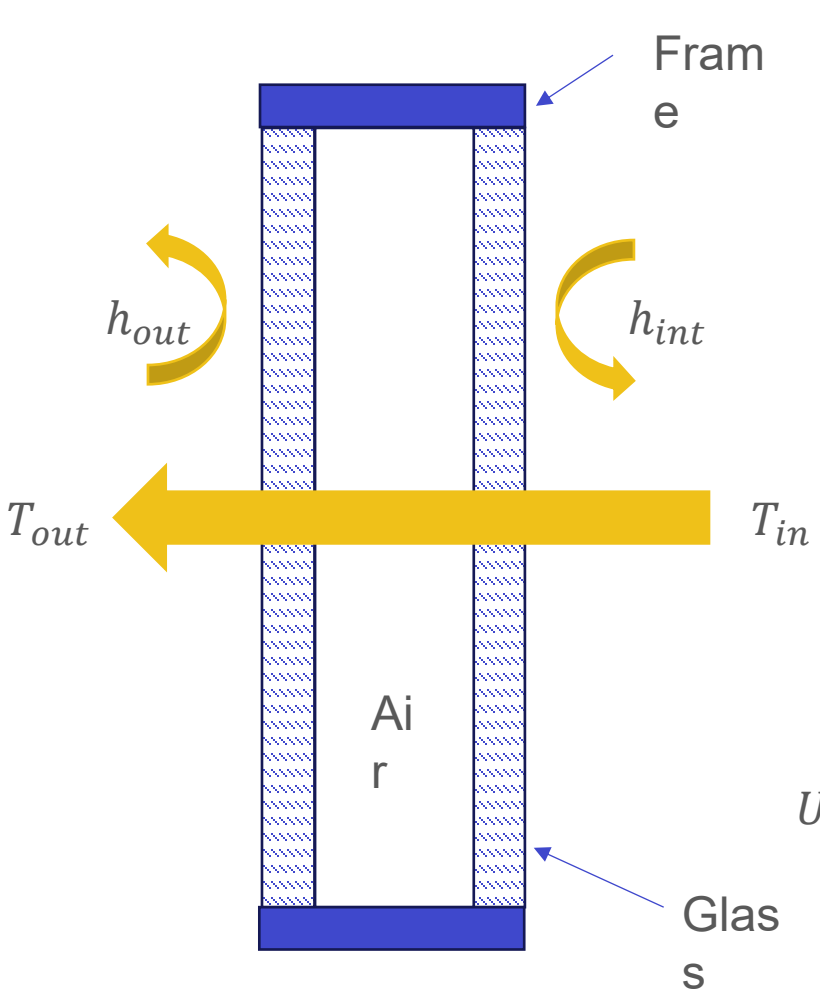
$$U_{windows} = \frac{U_g\, A_g + U_f\, A_f}{A_g + A_f}$$

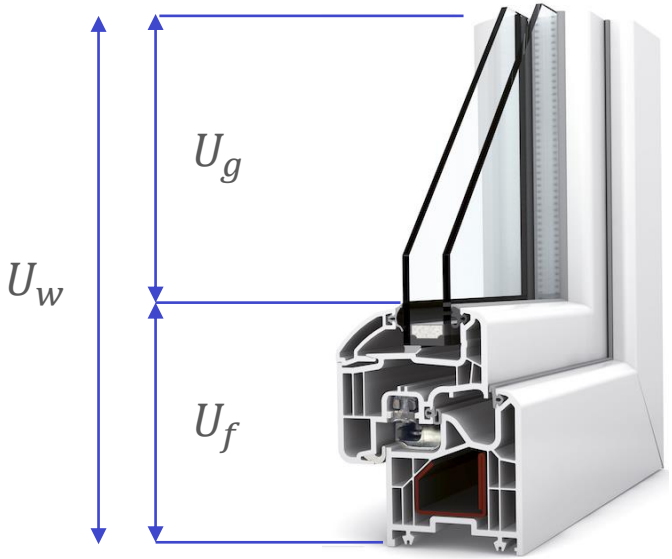
$$\dot{Q}_{window} = UA_{windows}\,(T_{in} - T_{out}) \quad [W]$$

$$U_g = \left(Rsi + Rse + \sum_i \frac{e_i}{\lambda_i} \right)^{-1} [W/K]$$

U_f and U_g are listed in the manufacturer's technical data sheet

4. European standard





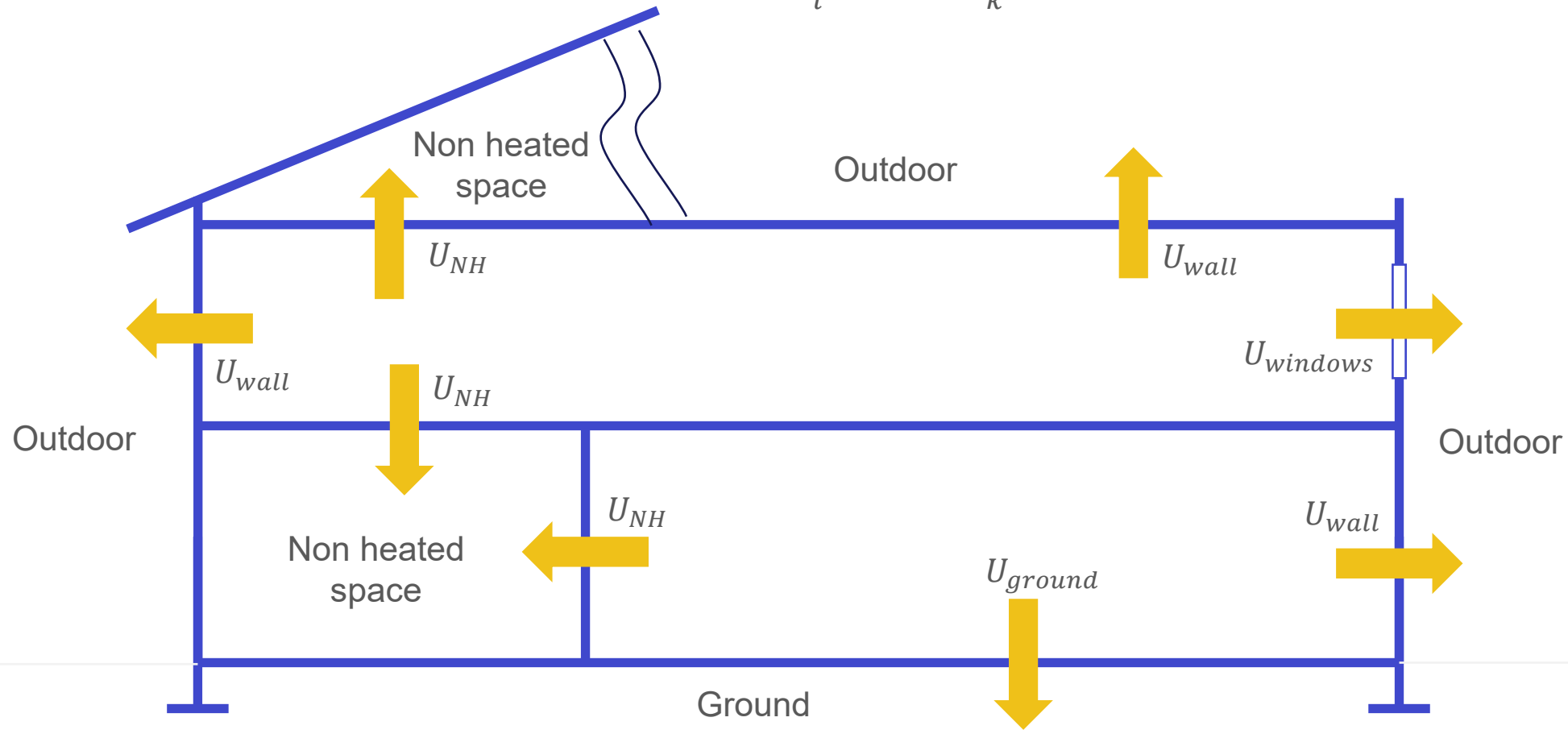
$$U_{windows} = \frac{U_g\, A_g + U_f\, A_f}{A_g + A_f}$$

$$\dot{Q}_{window} = UA_{windows}\,(T_{in} - T_{out}) \quad [W]$$

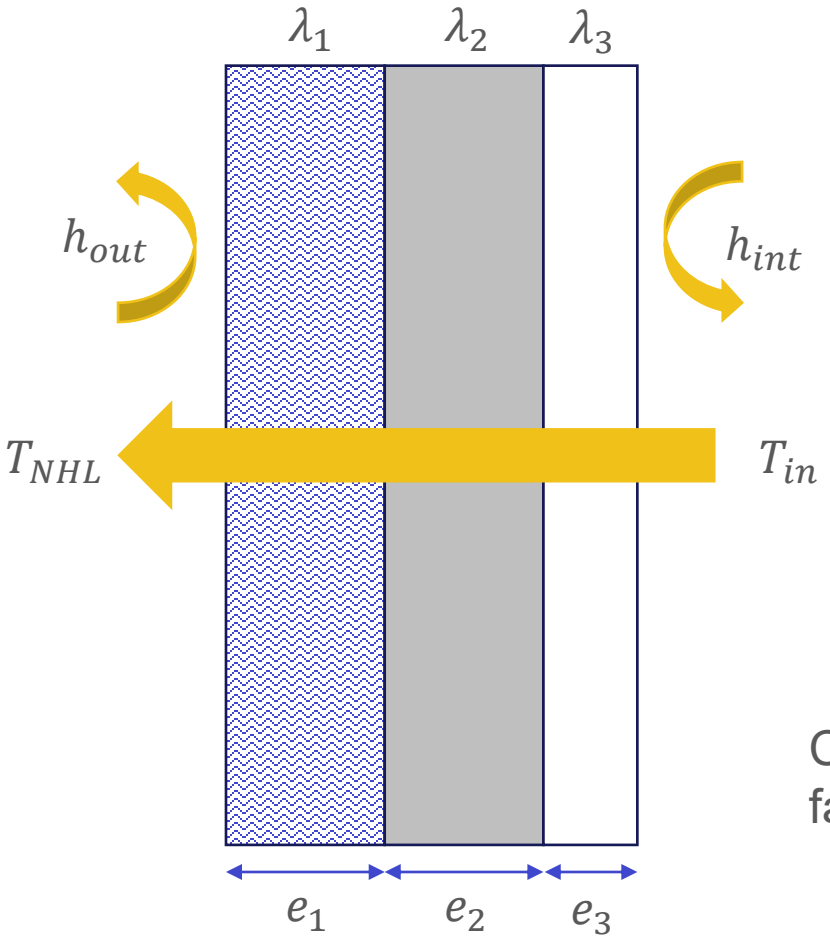
$$U_g = \left(Rsi + Rse + \sum_i \frac{e_i}{\lambda_i} \right)^{-1} \quad [W/K]$$

4. European standard

$$U_{tot} = \sum U * A * f_i + \sum_i \psi_i L_i + \sum_k \mathrm{X}_k$$



4. European standard



Thermal transfer through non heated space :

$$\dot{Q}_{NH} = UA_{NH}\,(T_{in} - T_{out})\,f_i \quad [W]$$

With

$$U_{NH} = \left(Rsi + Rse + \sum_i \frac{e_i}{\lambda_i}\right)^{-1} \quad [W/K]$$

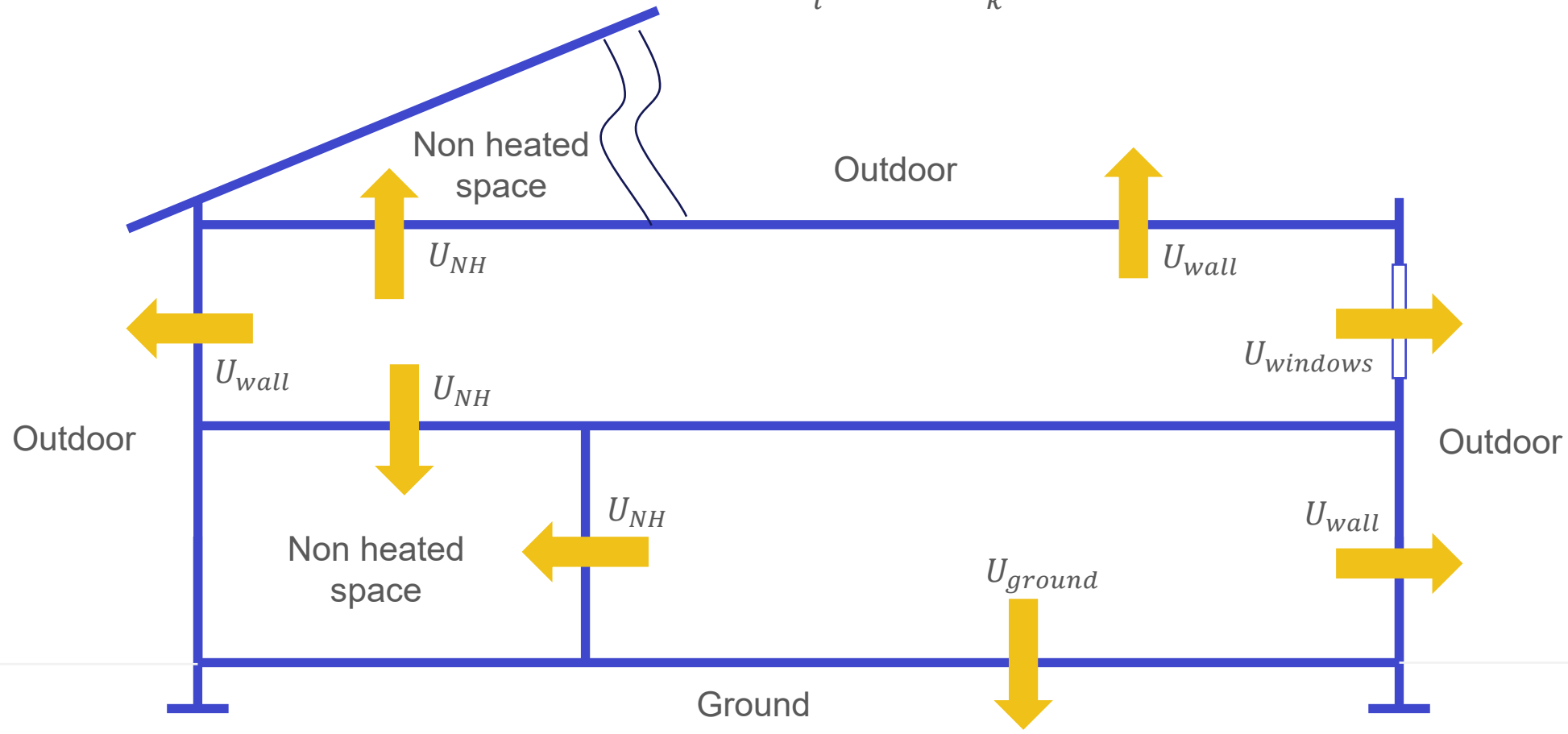
$$f_i = f_1 + f_2 = \frac{T_{int} - T_{NHL}}{T_{int} - T_{out}} + \frac{T_{int} - T_{int}^*}{T_{int} - T_{out}}$$

Corrective factor

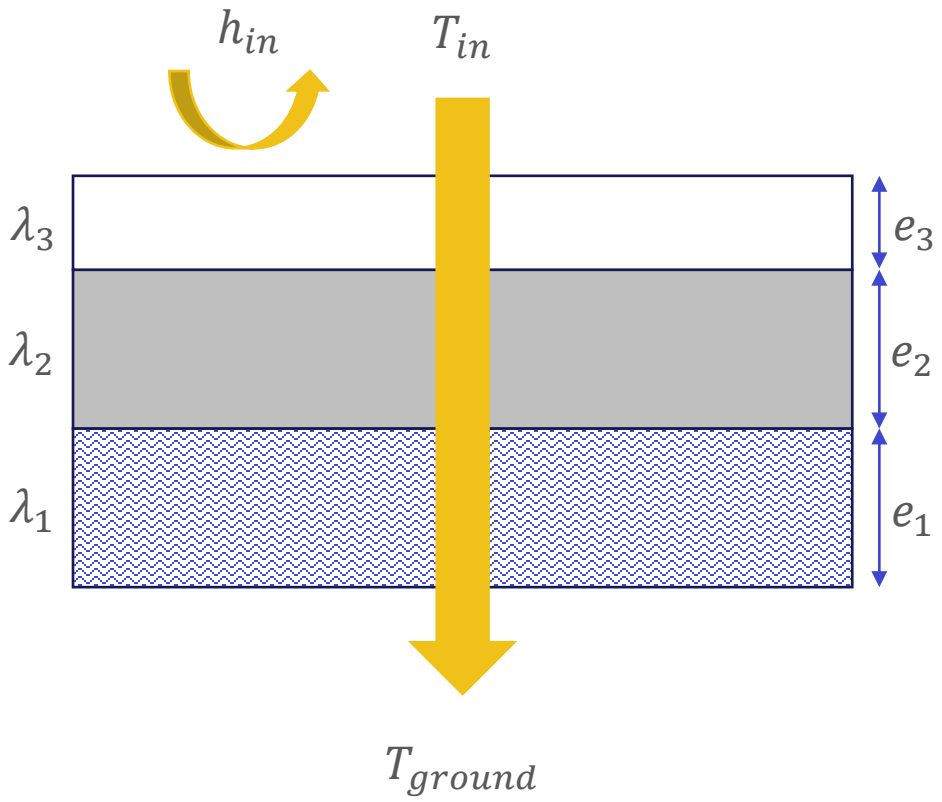
With T_{int}^* the mean temperature of the inside wall
T_{NHL} the temperature of the non-heated space

4. European standard

$$U_{tot} = \sum U * A * f_i + \sum_i \psi_i L_i + \sum_k \mathrm{X}_k$$



4. European standard



Thermal transfer through non heated space :

$$\dot{Q}_{floor} = UA_{floor}\,(T_{in} - T_{out})\,f_i\ [W]$$

Avec

$$U_{floor} = \left(Rsi + \sum_i \frac{e_i}{\lambda_i}\right)^{-1}\ [W/K]$$

$$f_i = \frac{T_{int} - T_{ground}}{T_{int} - T_{out}} \qquad T_{ground} = \text{moy}\,(T_{out})$$

4. European standard

$$\dot{Q}_{sh} = \dot{Q}_t + \dot{Q}_v - [\dot{Q}_s + \dot{Q}_i]$$

Space heating

- Radiators
- Fan-coil unit
- Radiant floor

Transmission losses

- Walls
- Ground
- Windows
- Thermal bridges
- Non heated spaces

Ventilation losses

- Mechanical ventilation
- Infiltrations

Solar gains

Internal gains

- Lights
- Occupants
- Electric appliances

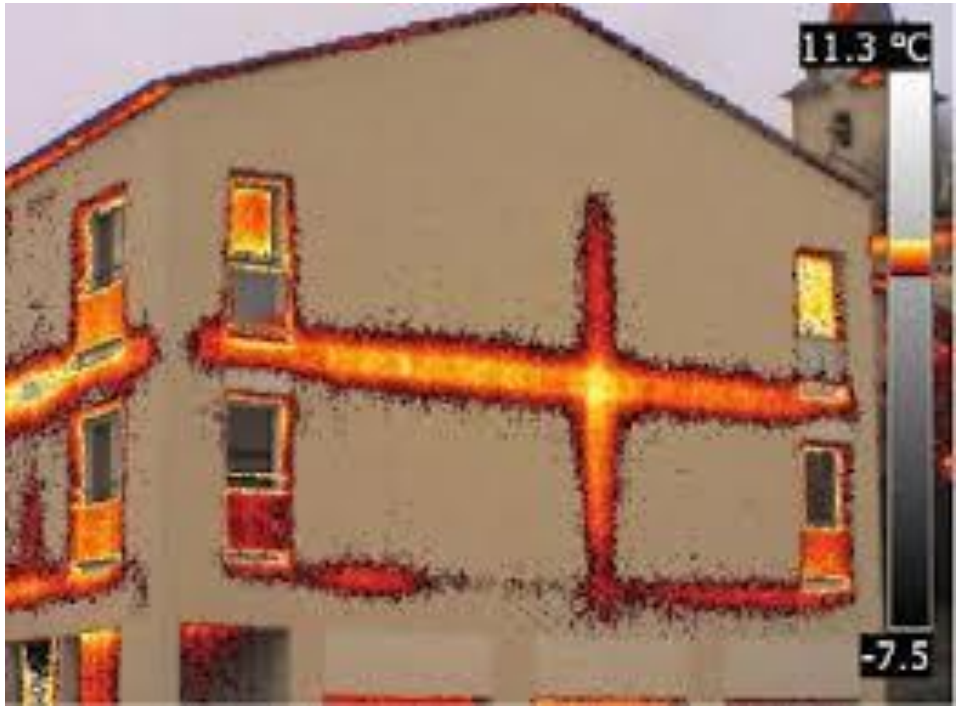
4. European standard

Thermal bridge: It's a punctual or linear zone in the envelope of a building which presents a variation in thermal resistance: connections between joinery and an opaque wall, intermediate floors, partition walls, door thresholds, etc.

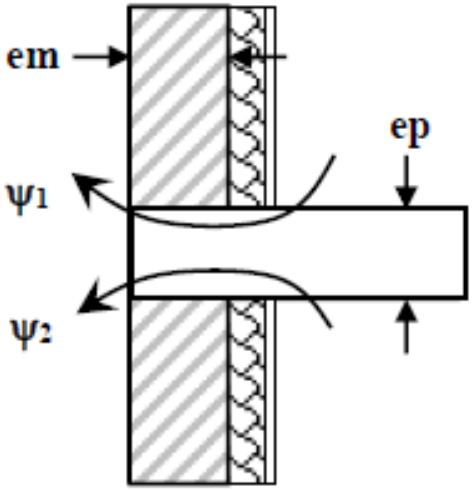
$$\dot{Q}_{tb} = \sum_i \psi_i L_i \ (T_{in} - T_{out})$$

The thermal bridge coefficient depends on:

- The materials
- The geometry
- The insulation
- The type of walls



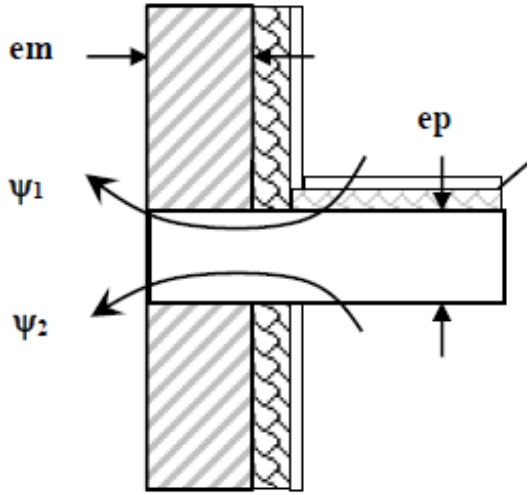
4. European standard



Distribution : $\psi_1 = \psi_2 = 50\%\,\psi$

$em\ (cm)$	$ep\ (cm)$		
	15	20	25
$20 < em < 25$	0.67	0.82	0.96
$25 < em < 30$	0.63	0.77	0.90

Value of $\psi\ [W/m.K]$



Distribution : $\psi_1 = 12\%\,\psi$, $\psi_2 = 88\%\,\psi$

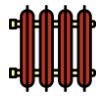
$em\ (cm)$	$ep\ (cm)$		
	15	20	25
$20 < em < 25$	0.62	0.74	0.86
$25 < em < 30$	0.59	0.70	0.81

Value of $\psi\ [W/m.K]$

4. European standard

$$\dot{Q}_{sh} = \dot{Q}_t + \dot{Q}_v - [\dot{Q}_s + \dot{Q}_i]$$

Space heating

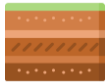

Radiators


Fan-coil unit


Radiant floor

Transmission losses


Walls


Ground


Windows


Thermal bridges


Non heated spaces

Ventilation losses


Mechanical ventilation


Infiltrations

Solar gains

Internal gains


Lights


Occupants


Electric appliances

4. European standard

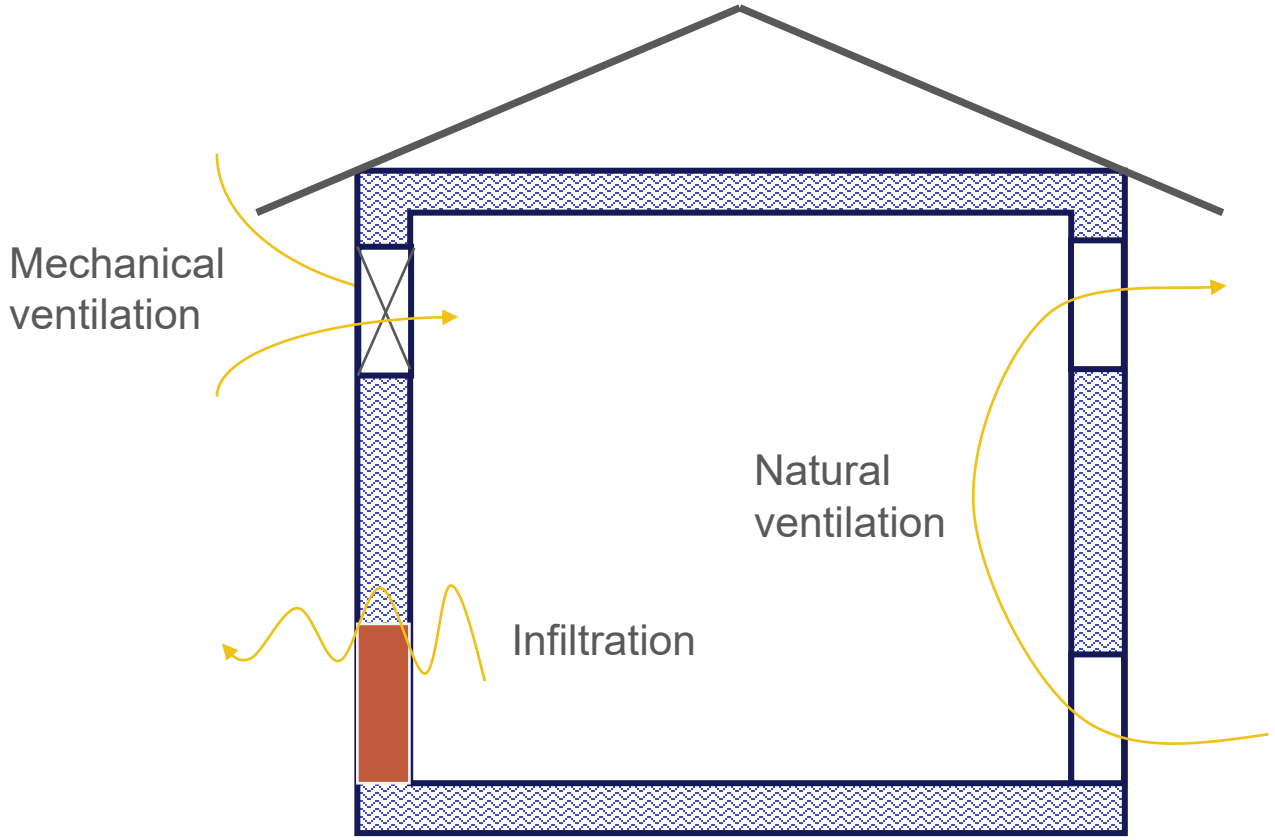
$$\dot{Q}_v = 0{,}34\, q_v\, (T_{int} - T_{out}) \quad [W] \qquad q_v = q_{mv} + q_{inf} + q_{nv} \quad [m^3/h]$$

Losses through air renewal are caused by :

Mechanical ventilation imposing a regulatory fresh air flow rate → q_{mv}

Infiltration due to leaks in the building envelope → q_{inf}

Natural ventilation due to the wind and thermal draught → q_{nv}



4. European standard

$$\dot{Q}_v = 0{,}34\, q_v\, (T_{int} - T_{out}) \quad [W] \qquad q_v = q_{mv} + q_{inf} + q_{nv} \quad [m^3/h]$$

Mechanical ventilation

Type of mechanical ventilation

- Self-adjusting single flow
- Humidity sensitive single flow
- Humidity sensitive dual flow
- Thermodynamic dual flow

Number of rooms	1	2	3	4	5	6	7
Minimum Fresh air flow rate (m^3/h)	35	60	75	90	105	120	135

The minimum fresh air flow rate depends on each country regulation. The values presented here are derived from the French regulation (*Arrêté du 24 mars 1982 relative à l'aération des logements*)

4. European standard

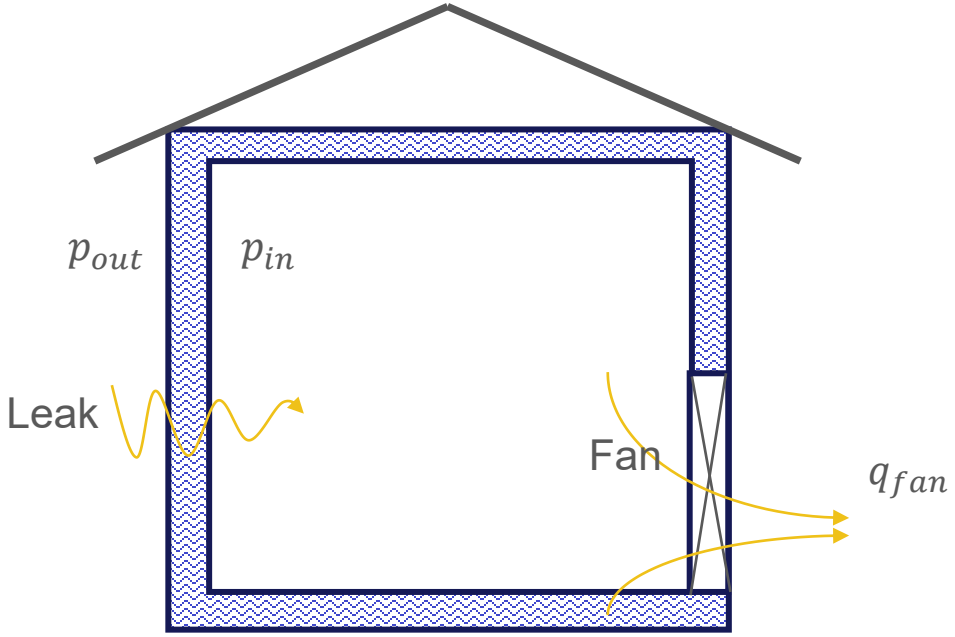
Infiltration

$$\dot{Q}_v = 0{,}34\, q_v\, (T_{int} - T_{out}) \quad [W]$$

$$q_v = q_{mv} + q_{inf} + q_{nv} \quad [m^3/h]$$

Blower door test

$$Q_{inf} = \mathrm{K}\, \Delta p^n$$



Type of buildings	Maximal infiltration surface flow rate $Q_{4\,pa\,surf}$ $(\Delta p = 4\,Pa)$ (m³/h/m²)	Maximal infiltration flow rate n_{50} $(\Delta p = 50\,Pa)$ (Vol/h)
Individual house	0,6	2,3
Multi-family house	1	3,9
Tertiary building	1,6	6,2

[French Energy régulation RE2020, 2024]

4. European standard

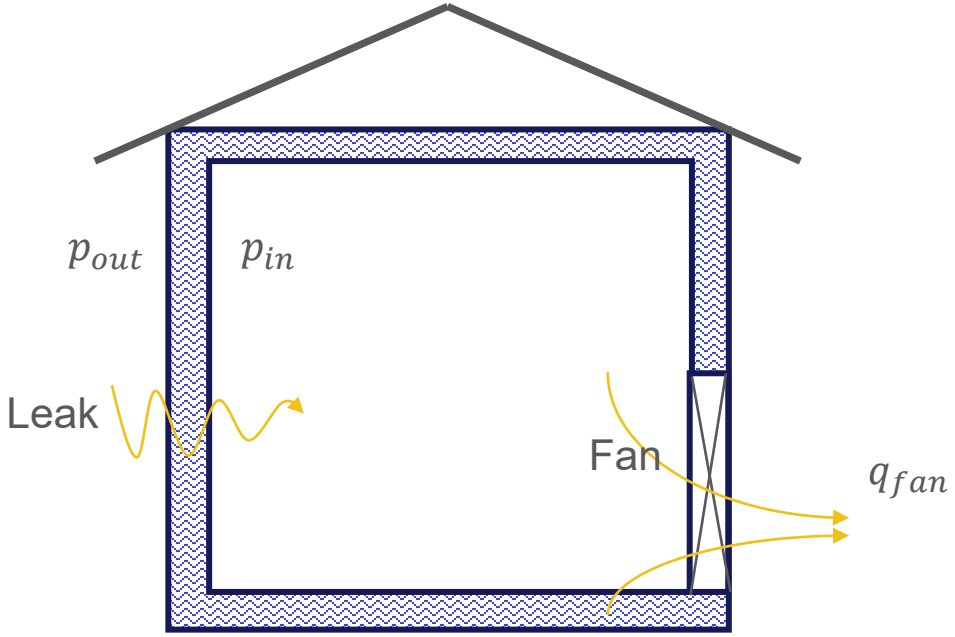
Infiltration

$$q_v = q_{mv} + q_{inf} + q_{nv} \qquad [m^3/h]$$

Maximal value for q_{inf} for new low consumption buildings

Blower door test

$$Q_{inf} = \mathrm{K}\,\Delta p^n$$



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Individual house	0,6	2,3
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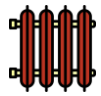
Tertiary building	1,6	6,2

[French Energy régulation RE2020, 2024]

4. European standard

$$\dot{Q}_{sh} = \dot{Q}_t + \dot{Q}_v - [\dot{Q}_s + \dot{Q}_i]$$

Space heating

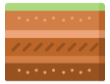

Radiators


Fan-coil unit


Radiant floor

Transmission losses


Walls


Ground


Windows


Thermal bridges


Non heated spaces

Ventilation losses


Mechanical ventilation


Infiltrations

Solar gains

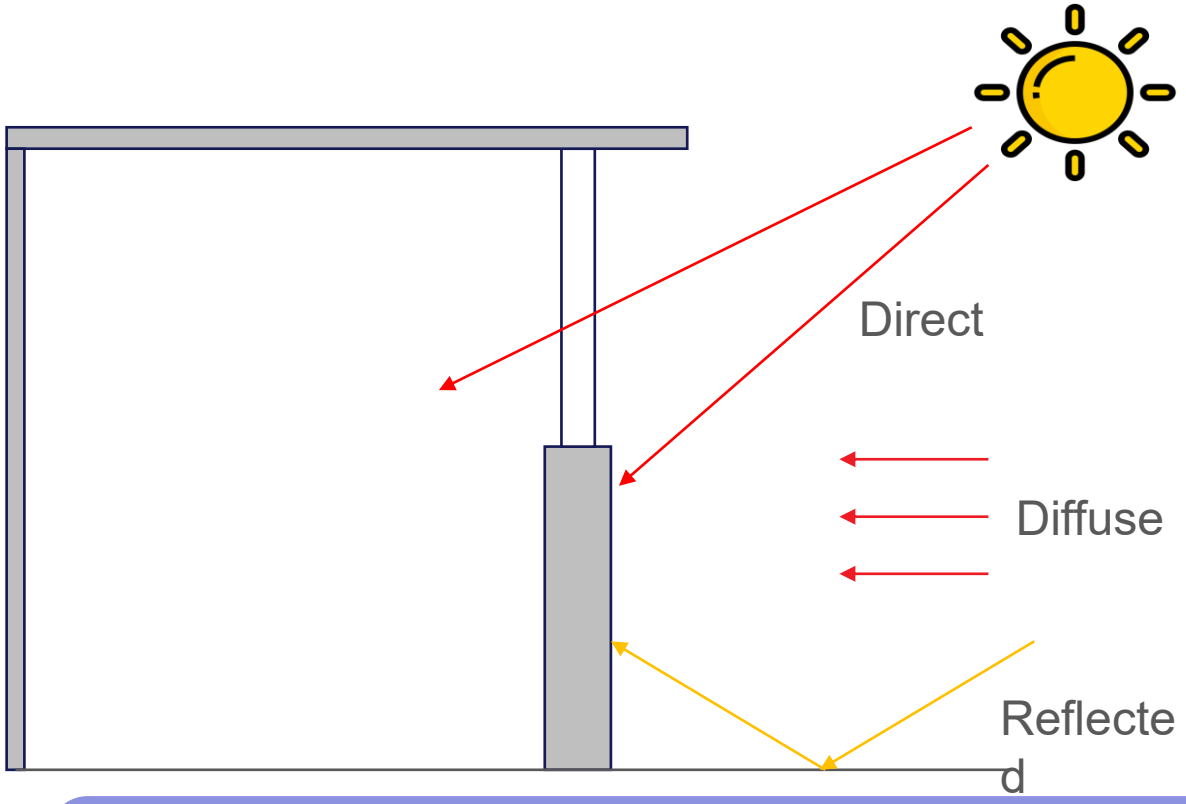
Internal gains


Lights


Occupants


Electric appliances

4. European standard



Area [m²]

Reflected insolation [W/m²]

$$\dot{Q}_{sol} = \alpha\, S \left(E_{dir} + E_{ref} + E_{dif}\right)$$

Diffuse insolation [W/m²]

Absorptivity [-]

Direct insolation [W/m²]

In the European norm the solar and internal gains for the space heating demand determination are not considered. Indeed, the worst-case scenario is considered. They will be used for the calculus of space cooling demand

5. Space cooling demand

$$\dot{Q}_{sc} = \dot{Q}_{gla} + \dot{Q}_v + \dot{Q}_w + \dot{Q}_i$$

Space cooling

Fan-coil unit

Cooling floor

Transmission (transparent) gains

Windows glazing

Ventilation gains

Transmission (opaque) gains

Walls

Windows frame & door

Internal gains

Lights

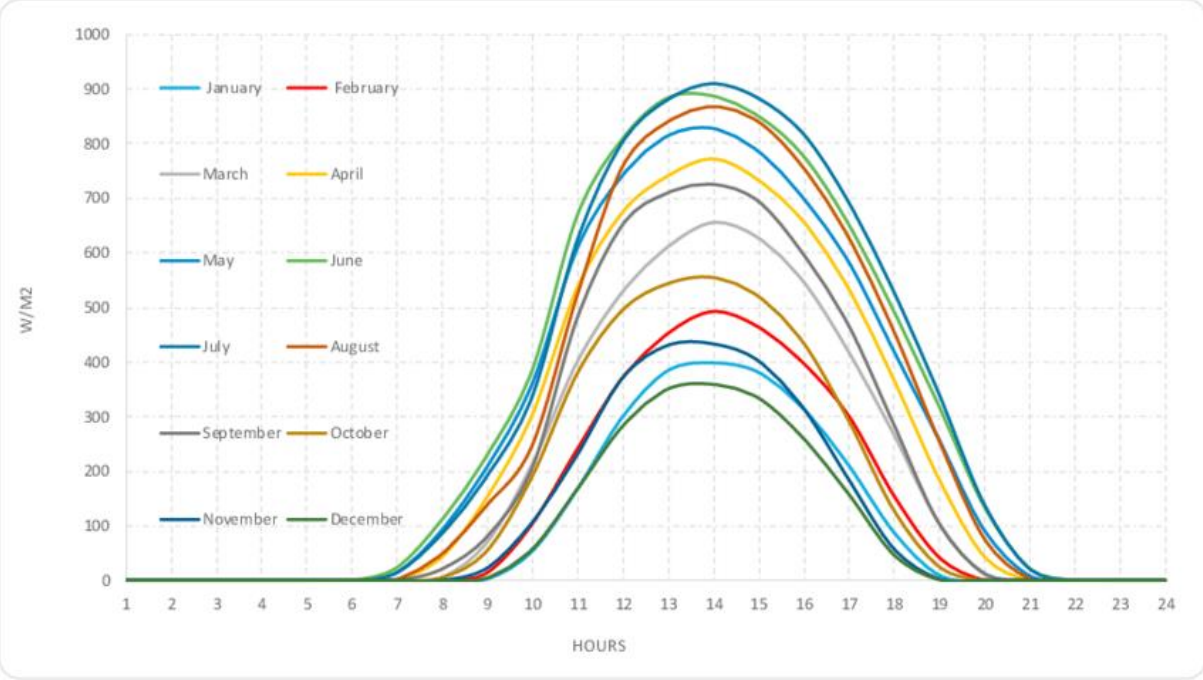
Occupants

Electric appliances

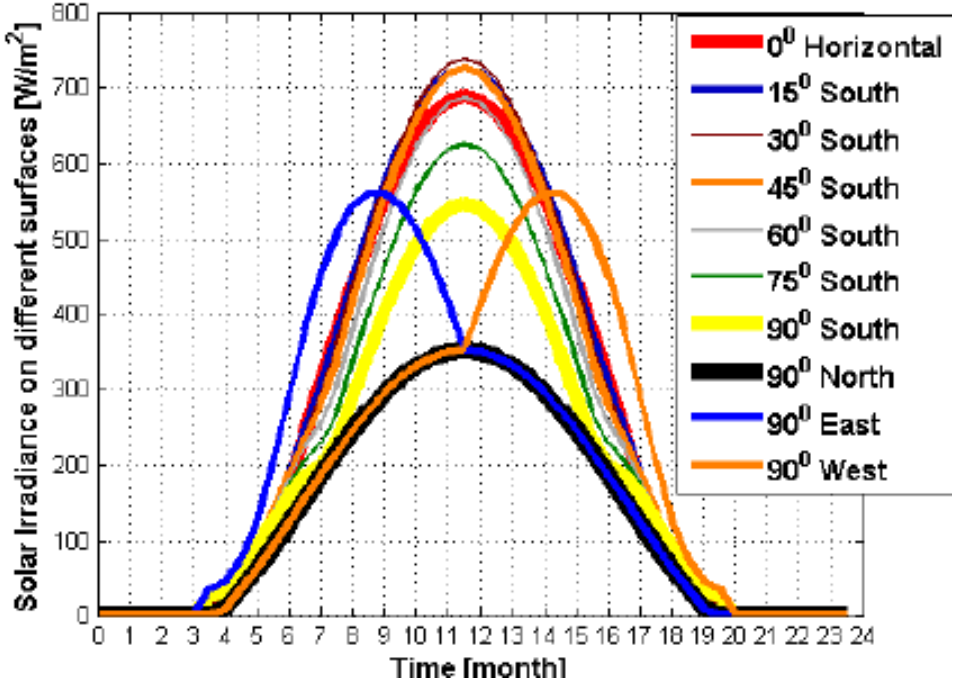
5. Space cooling demand

The difficulty on space cooling demand calculus is the impact of the solar gain

Effect of the daytime



Effect of the direction



5. Space cooling demand

$$\dot{Q}_{gla} = S_{cor} * \varphi_{glaz} * g$$

Solar factor depending on the type of glass, windows and solar protection

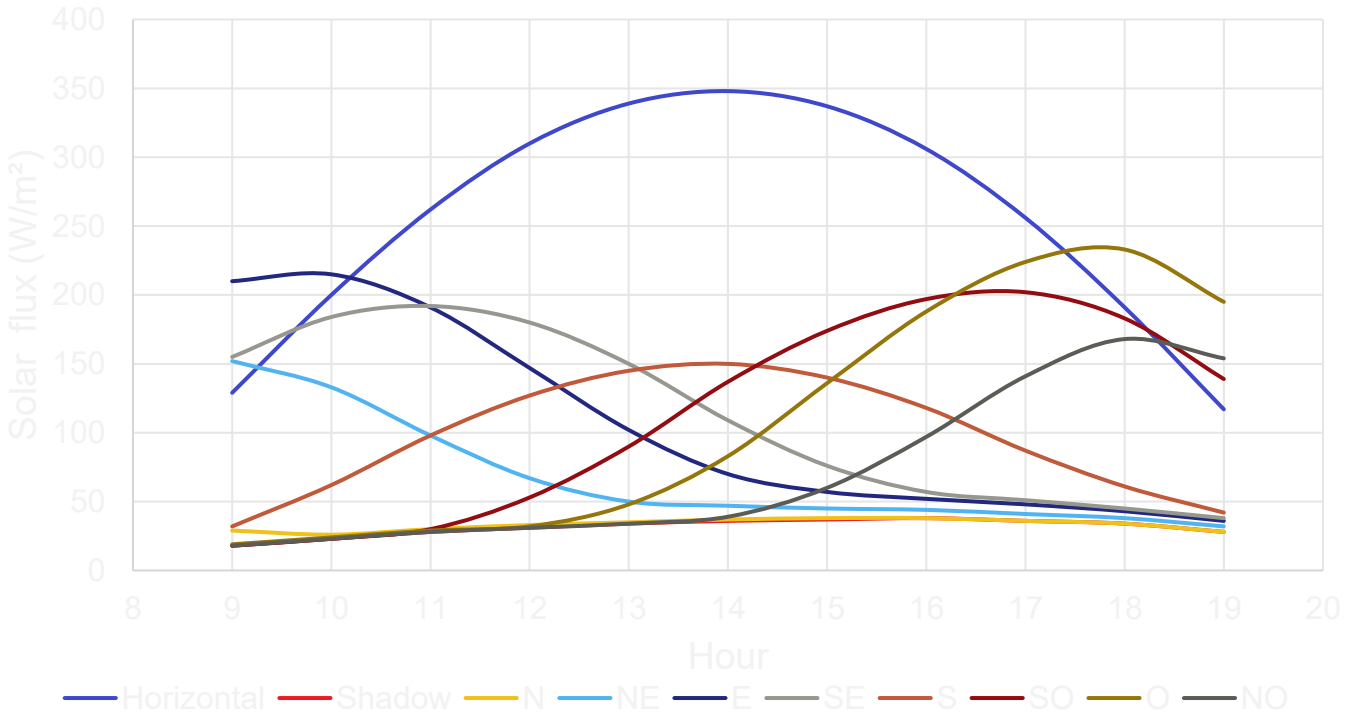
Depending on the climatic zone

$$S_{cor} = S_{window} * B_v$$

Frame	Part of window surface (%)	
	Transparent (glazing)	Opaque (frame)
Metallic	75	25
Plastic	60	40
Wood	55	45

Can be adapted through other tables according to the color of the glass, solar protection, double or simple glazing

[AICVF,1999]



5. Space cooling demand

$$\dot{Q}_{sc} = \dot{Q}_{gla} + \dot{Q}_v + \dot{Q}_w + \dot{Q}_i$$

Space cooling

Fan-coil unit

Cooling floor

Transmission (transparent) gains

Windows glazing

Ventilation gains

Transmission (opaque) gains

Walls

Windows frame & door

Internal gains

Lights

Occupants

Electric appliances

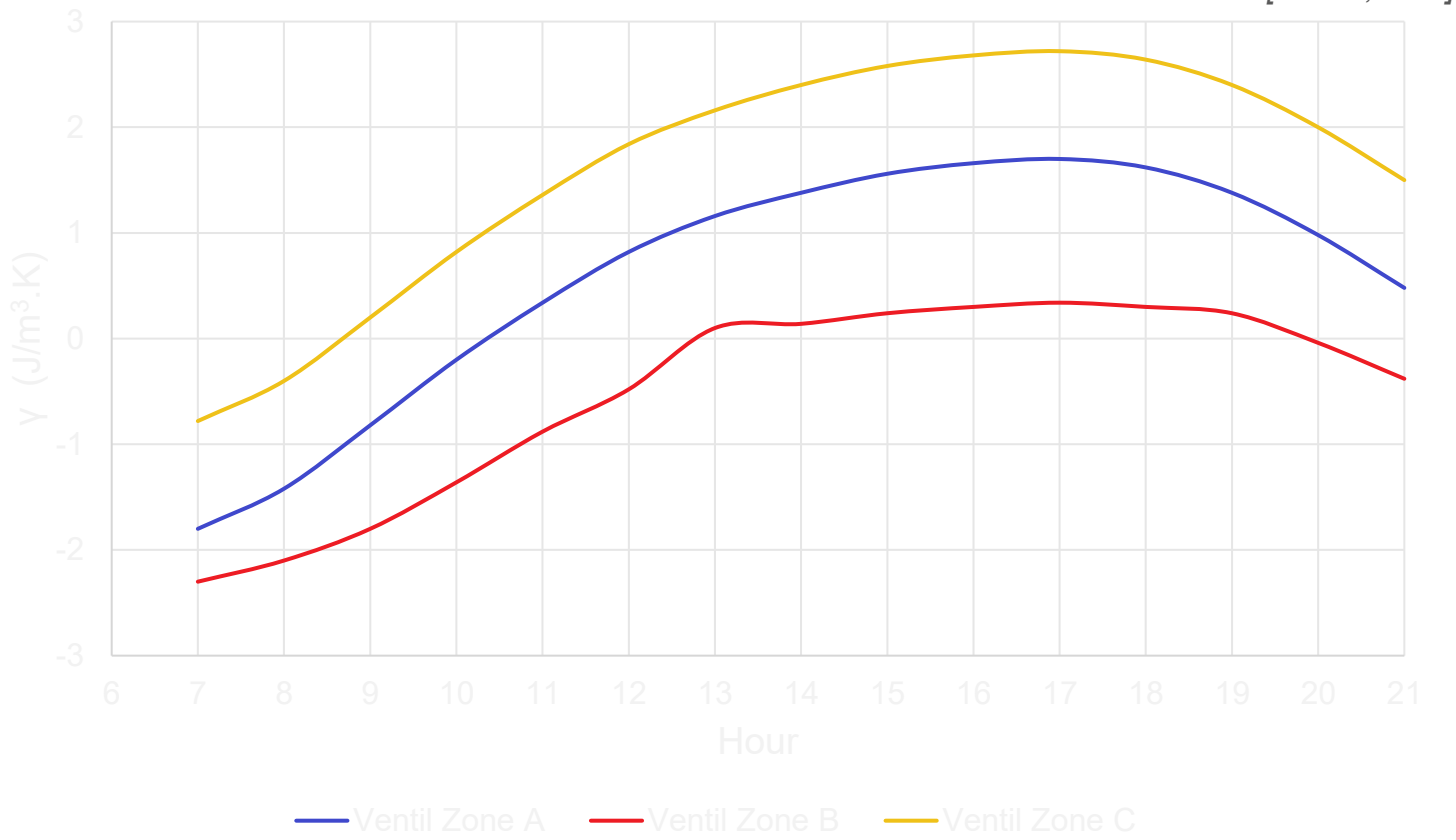
5. Space cooling demand

$$\dot{Q}_v = q_v * \gamma$$

[AICVF,1999]

Living room : $q_v = 20\ m^3/h$

Other room : $q_v = 10\ m^3/h$



The γ value depends on the geographic region. Only French geographic regions are listed here:

Zone A: Northern half of France (excluding west Brittany)
Zone B: West Brittany
Zone C: Southern half of France

5. Space cooling demand

$$\dot{Q}_{sc} = \dot{Q}_{gla} + \dot{Q}_v + \dot{Q}_w + \dot{Q}_i$$

Space cooling

Fan-coil unit

Cooling floor

Transmission (transparent) gains

Windows glazing

Ventilation gains

Transmission (opaque) gains

Walls

Windows frame & door

Internal gains

Lights

Occupants

Electric appliances

5. Space cooling demand

$$\dot{Q}_w = \dot{Q}_{ext,wall} + \dot{Q}_{window,frame}$$

$$\dot{Q}_{ext,wall} = U\ S\ (T_{e,v} - T_{indoor})$$

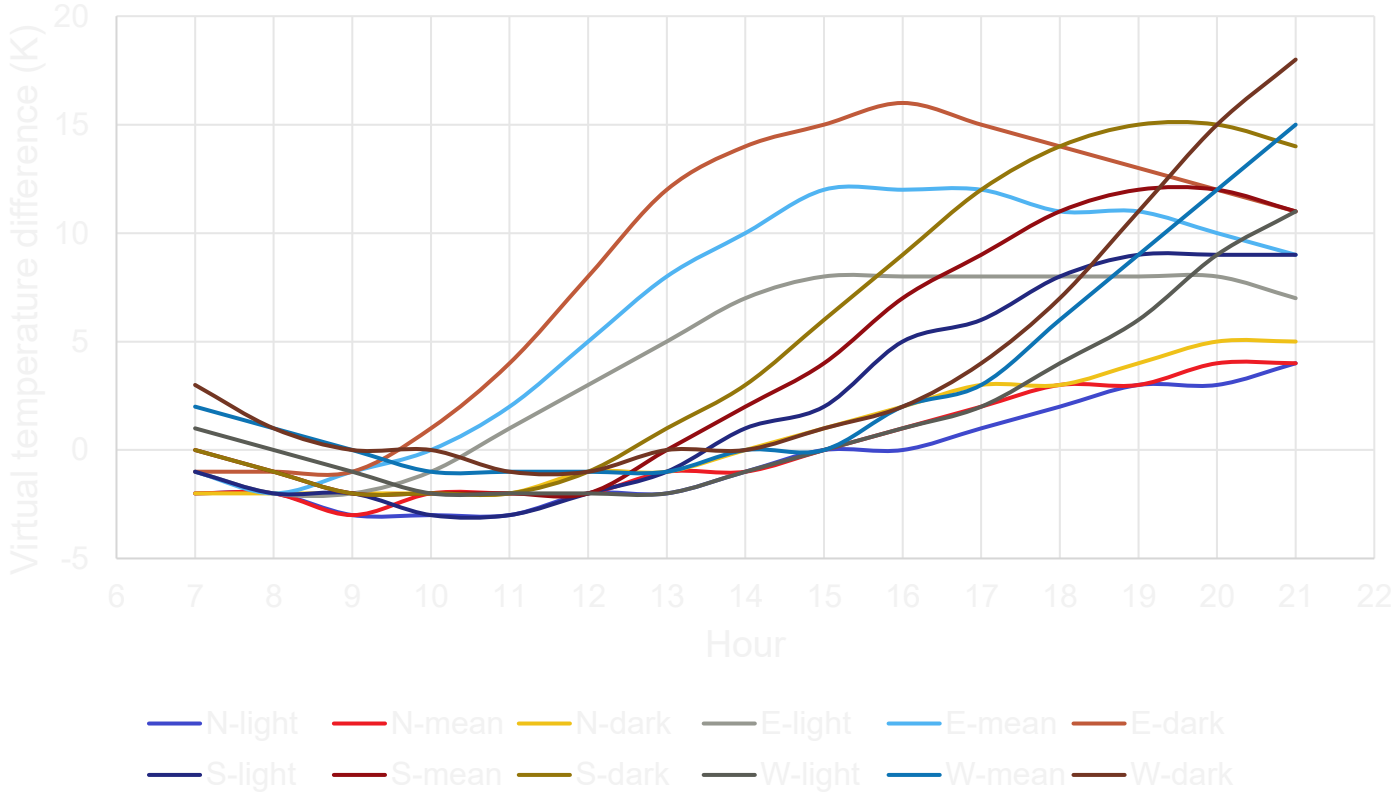
$$U = \frac{U_0}{1 + 0{,}14\ U_0}$$

$U_0\ [W/K.m^2]$: Surface thermal resistance of the wall calculated for space heating

$T_{e,v} - T_{indoor}[°C]$: Virtual temperature difference
Depending on climatic zone, hour, direction, type and color of the wall

For a classic wall in zone A

[AICVF,1999]



5. Space cooling demand

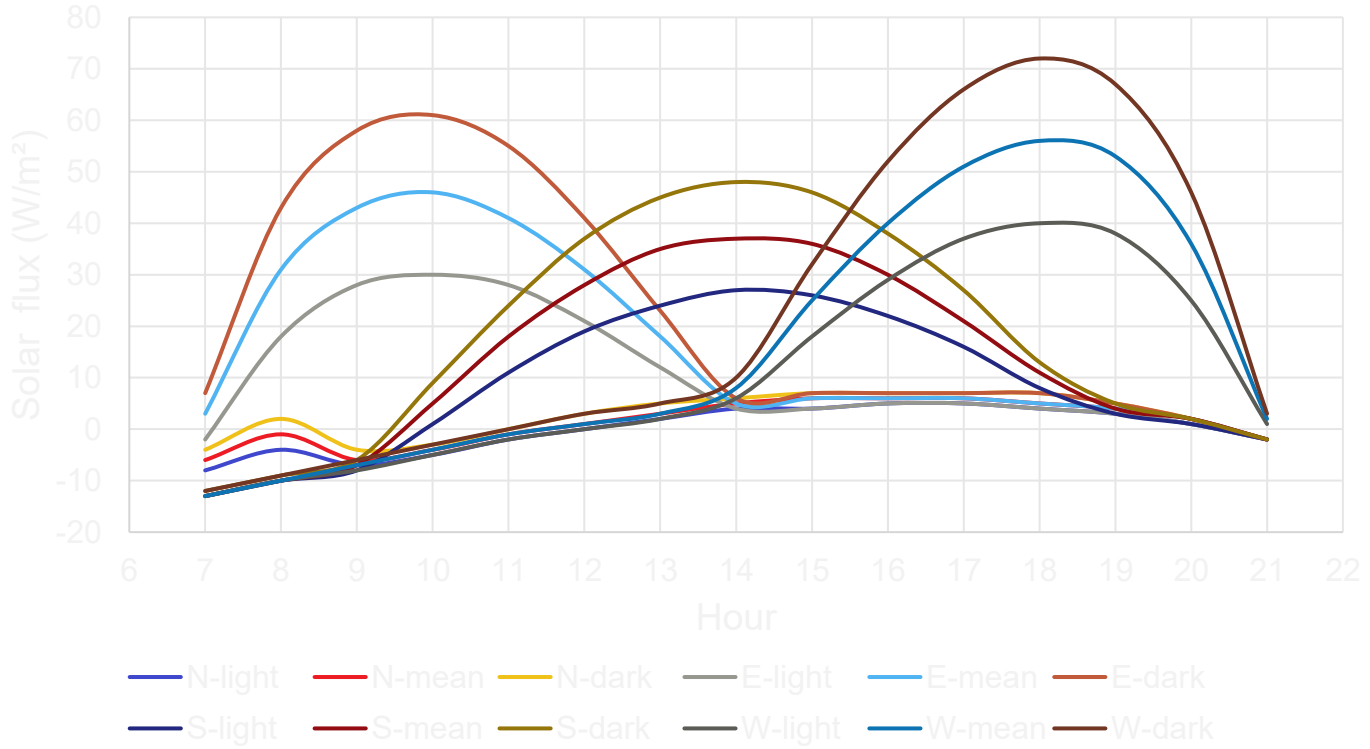
$$\dot{Q}_w = \dot{Q}_{ext,wall} + \dot{Q}_{window,frame}$$

$$\dot{Q}_{window,frame} = S \ \varphi_{window,frame}$$

$$S = S_{window} * B_v$$

Frame	Part of window surface (%)	
	Transparent (glazing)	Opaque (frame)
Metallic	75	25
Plastic	60	40
Wood	55	45

For a plastic window frame in zone B



5. Space cooling demand

$$\dot{Q}_{sc} = \dot{Q}_{gla} + \dot{Q}_v + \dot{Q}_w + \dot{Q}_i$$

Space cooling

Fan-coil unit

Cooling floor

Transmission (transparent) gains

Windows glazing

Ventilation gains

Transmission (opaque) gains

Walls

Windows frame & door

Internal gains

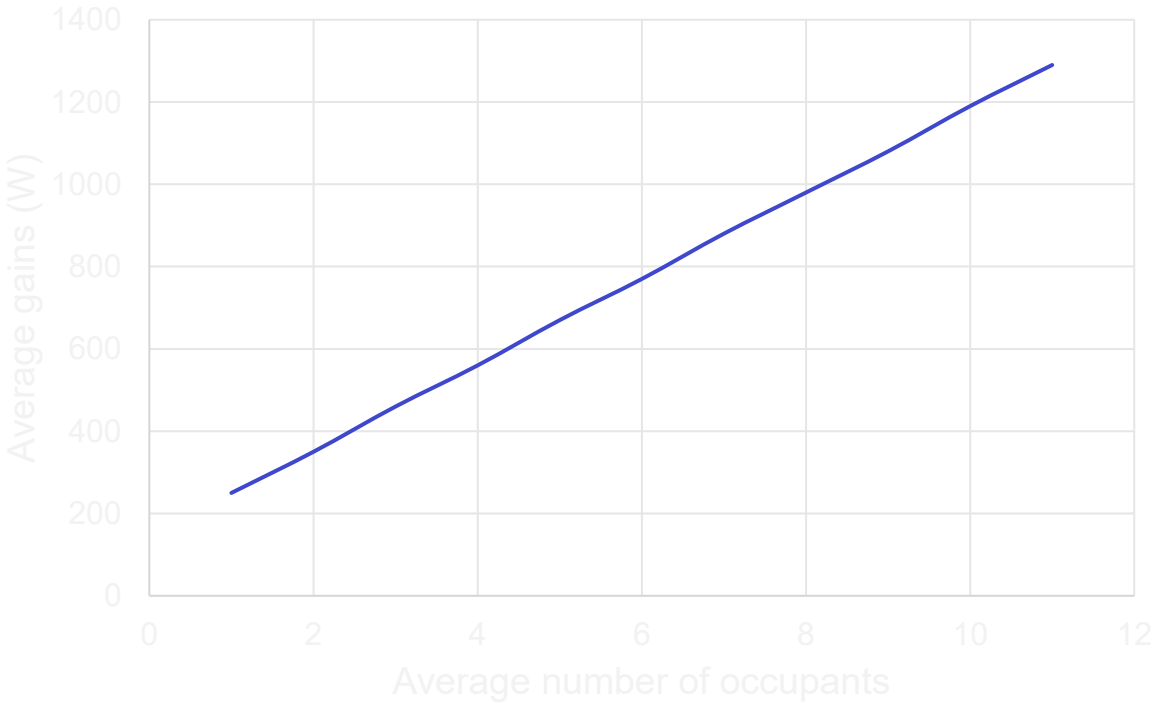
Lights

Occupants

Electric appliances

5. Space cooling demand

$$\dot{Q}_i = \sum_{Room} \dot{Q}_{nbr,occ} \frac{S_{room}}{S_{tot}}$$



Including

Internal gains

Lights

Occupants

Electric appliances

5. Space cooling demand

$$\dot{Q}_{sc} = \dot{Q}_{gla} + \dot{Q}_v + \dot{Q}_w + \dot{Q}_i$$

Space cooling

Fan-coil unit

Cooling floor

Transmission (transparent) gains

Windows glazing

Ventilation gains

Transmission (opaque) gains

Walls

Windows frame & door

Internal gains

Lights

Occupants

Electric appliances

6. Building energy simulation

Bibliography

- https://episcope.eu/building-typology/
- Energy performance of buildings – Method for calculation of the design heat load – Part 1: Space heating load, Module M3-3, EN 12831, 2017
- Ministère de la Transition écologique, Guide RE2020- Règlement environnementale des bâtiments neufs, 2024
- Conception des installations de climatisation et de conditionnement d'air, R. Casari, AICVF, 1999
- *Arrêté du 24 mars 1982 relative à l'aération des logements, https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000862344/*

SHaKE
Sharing Knowledge on Energy Communities

Thank you!

Module 2.2 - Space heating and cooling demand
SHaKE – Sharing Heat and Knowledge on Energy Communities

https://www.shakeproject-dhc.eu/

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