KaLiBat

User’s manual

References : -	Date : July 15th, 2009	Revision : 1.02

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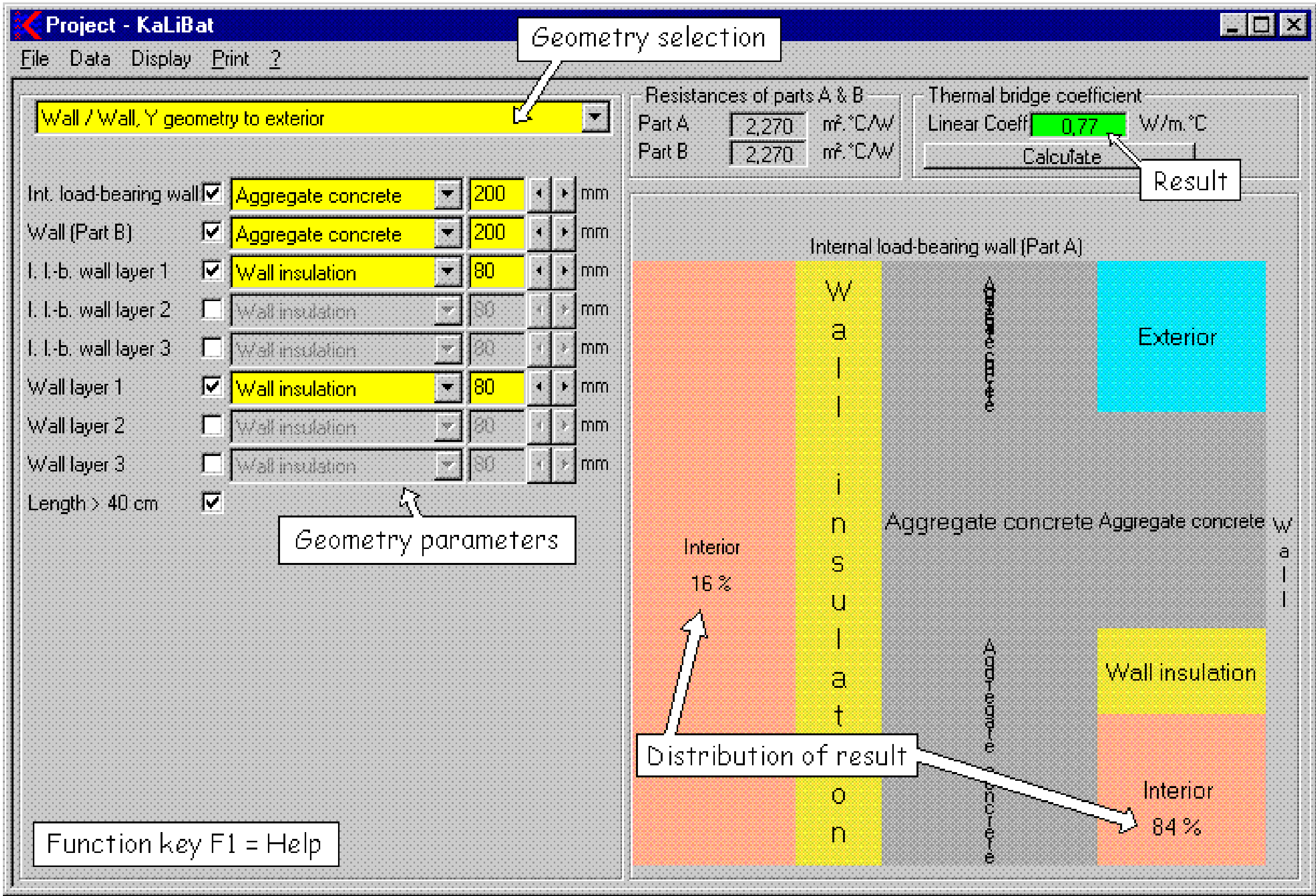
I – QUICK TOUR OF THE SOFTWARE

KaLiBat is a « calculator » that may be used to determine the **linear heat loss coefficient of a 2D thermal bridge**, which measures the heat loss intensity by unit of length (W/m.°C).

KaLiBat is very easy to use. On the main screen :

1. Define **geometry data** (materials and dimensions).
2. Click on « calculate » button.
3. Note the value of the linear heat loss coefficient which is displayed in the green zone.



1. The resistances of the parts of the walls facing the exterior are displayed on the top and on the right of the screen. After calculation the value of the linear heat loss coefficient is displayed in the green zone. In some cases, the distribution of the coefficient is given on the drawing (expressed as percentage).
2. To link a room type with the geometry, locate the mouse on a name (for example "Interior"), click with the right button and select a type among the values listed in the context menu. A click on the geometry displays the conductivity of the selected material.
3. The "data" menu gives access to the lists of materials, surface resistances, room types and parameters, and to references (project name, author, etc., which appears in report printing).
4. The « display » menu makes it possible to modify display options like geometry real size, material names or cut plans of the thermal bridge (on screen drawing or on report print).

II – THE STRONG POINTS OF THE SOFTWARE

KaLiBat makes it possible to treat a great number of cases by allowing for the modification of materials, dimensions, surface resistances and the "b" coefficient of linked spaces (continuous variation of the temperature from an inside value to an outside value).

References : calculation is carried out according to the European standards **EN10211 and EN13370**.

Quick calculation : the calculation time is within an order of magnitude of one to two minutes for slab-on-grade floor and of ten seconds for other configurations.

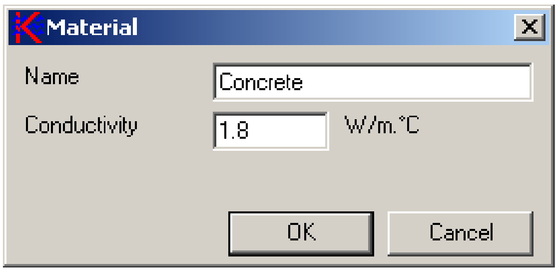
Accuracy : many comparisons evaluate the accuracy of KaLibat to values lower than 30 % for slab-on-grade floors, and lower than 12 % for other configurations (until 15 / 20 % if a screed is taken into account).

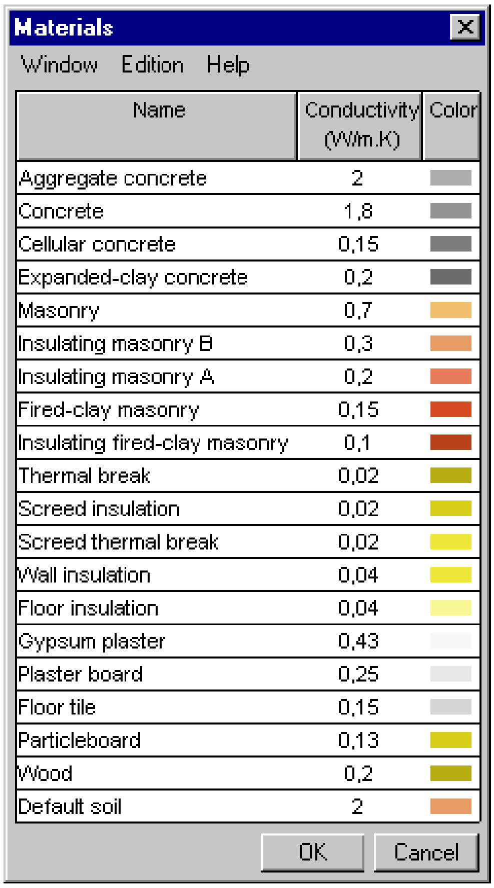
Validation : many comparisons have been carried out in cases supplied with the French Thermal Building Standard (RT2000), see the report provided with the software.

III – DATA OF THE SOFTWARE

III – 1 - MATERIALS

The list of materials is displayed by the menu "Data\Materials list", while editing is possible with a double-click on the row of the material. The number of materials can't be modified.



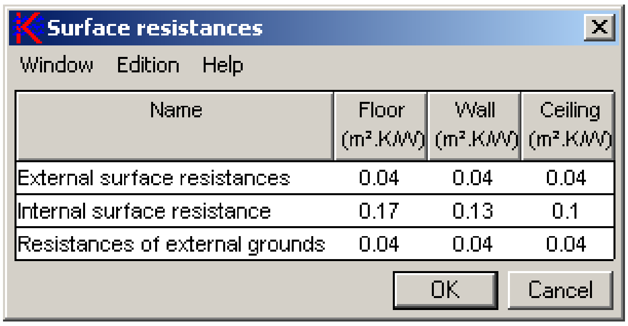


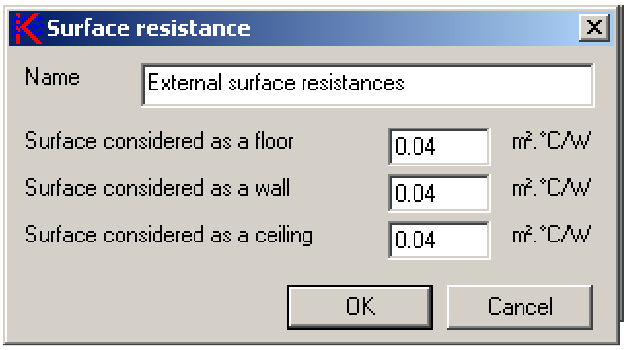
Name	Conductivity (W/m.K)	Color
Aggregate concrete	2	
Concrete	1,8	
Cellular concrete	0,15	
Expanded-clay concrete	0,2	
Masonry	0,7	
Insulating masonry B	0,3	
Insulating masonry A	0,2	
Fired-clay masonry	0,15	
Insulating fired-clay masonry	0,1	
Thermal break	0,02	
Screed insulation	0,02	
Screed thermal break	0,02	
Wall insulation	0,04	
Floor insulation	0,04	
Gypsum plaster	0,43	
Plaster board	0,25	
Floor tile	0,15	
Particleboard	0,13	
Wood	0,2	
Default soil	2	

III – 2 - THE SURFACE RESISTANCES

A surface resistance is made up of three resistances : one for the floor, one for the vertical surface and one for the ceiling.

The list of the surface resistances is displayed by the menu "Data\Surface resistances list" (figure on the left), while editing is possible with a double-click on the row of the resistance (figure on the right). The number of surface resistances can't be modified.

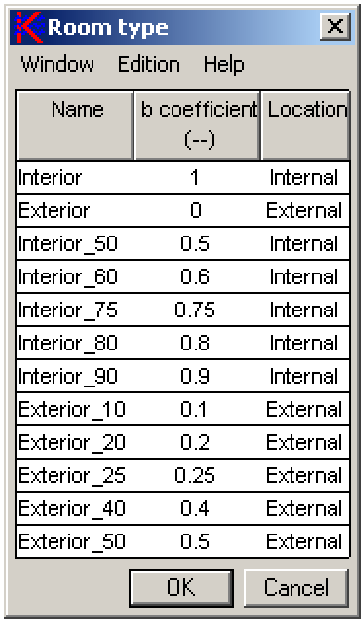


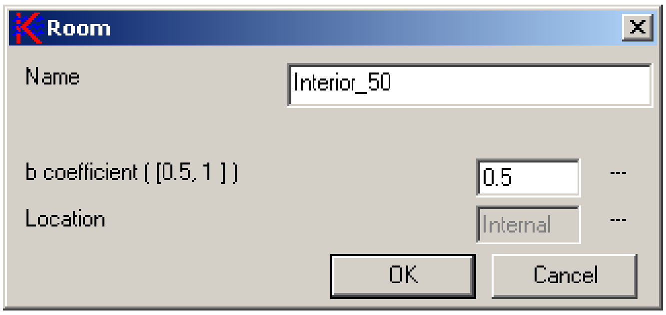


III – 3 – THE ROOM TYPES

A **room type** characterizes a space (room or exterior) linked to the thermal bridge through the **b coefficient** (see VI-1).

The list of room types is displayed by the menu "Data\Rooms list", while editing is possible with a double-click on the row of the room type. The number of room types can't be modified.

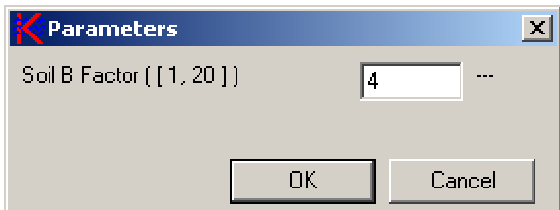




The **b coefficient** makes it possible to define rooms whose temperature is intermediary between those of the interior (b=1) and exterior (b=0).

III – 4 – PARAMETERS

A single parameter is displayed on the Parameters screen: the B' coefficient, which is the characteristic dimension of the floor.



$$B' = \frac{A}{1/2 * P} \text{ where } \begin{cases} A & \text{Floor area} \\ P & \text{Perimeter of the floor} \end{cases}$$

IV – REFERENCE OF DATA AND PARAMETERS USED IN THE SOFTWRE

IV – 1 - PARAMETERS FROM STANDARDS

IV – 1 - 1 – SLAB-ON-GRADE FLOORS

The parameters or characteristics for the ground are :

The **B' coefficient** (see standard [EN13370], Chap. 7.1) :

$$B' = \frac{A}{1/2 * P} \text{ where } \begin{cases} A & \text{Floor area} \\ P & \text{Perimeter of the floor} \end{cases}$$

Default **thermal conductivity of the ground** : 2 W/m.K ([EN13370], Chap. 4.1)

IV – 1 - 1 - 1 – BOUNDS OF THE GEOMETRY

Location of the cut plans (see standard [EN13370], Annex A.1.2) :

Location of the cut plans	Location of the plan
In the horizontal direction inside the building	0.5 * B'
In the horizontal direction outside the building	2.5 * B'
In the vertical direction over the ground level	2.5 * B'

Boundary conditions (see standard [EN13370], Annex A.1.2):

Location of the cut plan	Condition
In the horizontal direction inside the building, vertical plan	Adiabatic bound
In the horizontal direction outside the building, vertical plan	Adiabatic bound
In the vertical direction over the ground level, horizontal plan	Adiabatic bound

IV – 1 - 1 - 2 – LINEAR HEAT LOSS COEFF. AT THE JUNCTION WALL/FLOOR

The calculation rules respect the standard [EN13370] (Annex A.2) :

1. First, the complete element is modeled, including part of the wall up to a certain height, and then the heat flux is calculated. The heat flux is divided by the difference in temperature between the interior and exterior.
2. Next, all materials located above ground level are replaced by ground material, leaving the insulation unchanged. The part of the wall located above ground level is eliminated. Adiabatic boundaries are placed where the wall used to be in contact with the slab or ground.
3. The linear heat loss is obtained by finding the difference between the two previous values. The value found for the linear heat loss must then be decreased due to the influence of the upper part of the wall.

IV – 1 - 2 – THERMAL BRIDGES OTHER THAN ON SLAB-ON-GRADE FLOORS

IV – 1 - 2 - 1 – SURFACE RESISTANCES

The surface resistances are those by default (see V-1).

IV – 1 - 2 - 2 – LOCATON OF CUT PLANS

The lengths are the internal lengths. If a screed is present, the internal length goes to the screed.

Cut plans are located at more than a 1 meter of the thermal bridge

V – DEFAULT PARAMETERS OF THE SOFTWARE

V- 1 - SURFACE RESISTANCES

Surface resistances are those of the standard [EN13370] (Chap. 4.3) :

	Floor (m².°C/W)	**Vertical** (m².°C/W)	**Ceiling** (m².°C/W)
External surface	0.04	0.04	0.04
Internal surface	0.17	0.13	0.1
Ground	0.04	0.04	0.04

V- 2 - MATERIALS

V - 2 - 1 – MATERIALS OF THE WALLS

Materials used in the comparisons (CSTB, THERMIQ) are :

Material	**Conductivity** (W/m.°C)	**Capacity** (J/kg.K)	**Density** (kg/m^3)	**ρ . C** (10^{+6} J /m^3.K)	**Reference**
Concrete	1.8	1000	2200	2.2	[Th-U 2/5]
Aggregate concrete	2	1000	2450	2.45	[Th-U 2/5]
Cellular concrete	0.15	1000	400	0.4	[Th-U 2/5]
Masonry	0.7				[Th-U 5/5] Chap. 1.2a
Insulating masonry A	0.2				[Th-U 5/5] Chap. 1.2a
Insulating masonry B	0.3				[Th-U 5/5] Chap. 1.2a
Fired-clay masonry	0.15	1000	1700	1.7	[Th-U 2/5]
Insulating fired-clay masonry	0.1				
Wall insulation	0.04				
Screed thermal break	0.02				
Screed insulation	0.02				
Floor insulation	0.04				
Break insulation	0.02				

Other materials :

Material	**Conductivity** (W/m.°C)	**Capacity** (J/kg.K)	**Density** (kg/m^3)	**ρ . C** (10^{+6} J /m^3.K)	**Reference**
Expanded-clay concrete	0.2	1000	600	600	
Clay	1.5	1875	1600	3	[EN13370] Annex G
Sand and gravel	2	1100	1800	2	[EN13370] Annex G
Roche	3.5	800	2500	2	[EN13370] Annex G
Plaster	0.43	1000	1200	1.2	[Th-U 2/5]
Plasterboard	0.25	1000	825	0.825	[Th-U 2/5]
Particleboard	0.12	1700	400	0.68	[Th-U 2/5]
Wood	0.2	1600	750	1.2	[Th-U 2/5]

V - 2 - 2 – MATERIAL OF SCREED USED IN TESTS

Screed used by CSTB	**Screed used by KaLiBat**
Screed on insulation (Rsc>=1 m².K/W) and thermal break >= 0.5 m².K/W	Width of the screed insulation (λ=0.02 W/m.K) of 2 cm Concrete screed (λ=0.02 W/m.K) of 5 cm Thermal break (λ=0.02 W/m.K) de 1 cm

V - 2 - 3 - MATERIAL OF THERMAL BRIDGE USED IN TESTS

Thermal break used by CSTB	**Thermal break used by KaLiBat**
Thermal break Rc >= 0.5 m².K/W	Thermal break (λ=0.02 W/m.K), width 1 cm

VI – CALCULATION METHODS

VI - 1 - DEFINITION OF THE B COEFFICIENT OF A ROOM

The b coefficient is defined by the temperature T_p of the room p and by the two reference temperatures Tmin and Tmax (external and internal temperatures) :

$$b_p = \frac{T_p - T_{MIN}}{T_{MAX} - T_{MIN}}$$

VI - 2 – CALCULATION OF THE GLOBAL LINEAR HEAT LOSS COEFFICIENT

The global coefficient Ψ is calculated by the formula :

$$\Psi = \frac{\text{Calculated\_Flux(Interior->Exterior)} - \sum_{\text{Int/Ext Surfaces}} K \,.\, L_{Int} .(T_p - T_{Ext/p})}{\underset{\text{Internal spaces pi}}{\text{Max}} [T_{pi}] - \underset{\text{External spaces pe}}{\text{Min}} [T_{pe}]}$$

$$\Psi = \frac{\dfrac{\text{Calculated\_Flux(Interior->Exterior)}}{T_{MAX} - T_{MIN}} - \sum_{\text{Int/Ext Surfaces}} K \,.\, L_{Int} .(b_p - b_{Ext/p})}{\underset{\text{Internal spaces pi}}{\text{Max}} [b_{pi}] - \underset{\text{External spaces pe}}{\text{Min}} [b_{pe}]}$$

VI - 3 - CALCULATION OF THE GLOBAL LINEAR HEAT LOSS COEFFICIENT OF A ROOM

$$\Psi_p = \frac{\sum_{\substack{\text{Int. Surf.}\\ \text{of p}}} \text{Calculed\_Flux(S)} - \sum_{\substack{\text{Int./Ext.}\\ \text{Surf.}}} K_{Ext/p} . L_{\substack{\text{Int p/}\\ \text{Ext}}} .(T_p - T_{Ext/p}) - \sum_{\substack{\text{Surf. S}\\ \text{Int./Int.}}} K_{Int/Int} . L_{\substack{\text{Int p/}\\ \text{Int S}}} .(T_p - T_{Int/p})}{\underset{\text{Internal spaces pi}}{\text{Max}} [T_{pi}] - \underset{\text{External spaces pe}}{\text{Min}} [T_{pe}]}$$

With :

$L_{interior/Exterior}$ = Internal Length

$L_{interior/Interior}$ = Smallest internal length of the wall

Which gives :

$$\Psi_p = \frac{\dfrac{\sum_{\substack{\text{Int. Surf.}\\ \text{of p}}} \text{Calculated\_Flux(S)}}{T_{MAX} - T_{MIN}} - \sum_{\substack{\text{Surf.}\\ \text{Int./Ext.}}} K_{Ext/p} . L_{\substack{\text{Int p/}\\ \text{Ext}}} .(b_p - b_{Ext/p}) - \sum_{\substack{\text{Surf. S}\\ \text{Int./Int.}}} K_{Int/Int} . L_{\substack{\text{Int p/}\\ \text{Int S}}} .(b_p - b_{Int/p})}{\underset{\text{Internal spaces pi}}{\text{Max}} [b_{pi}] - \underset{\text{External spaces pe}}{\text{Min}} [b_{pe}]}$$

VII - REFERENCES

[EN13370] Norme Européenne EN ISO 13370 (février 1998)
Performance thermique des bâtiments - Transfert de chaleur par le sol - Méthodes de calcul

[Th-U 2/5] Fascicule 2/5 de la RT2000 sur les matériaux

[Th-U 5/5] Fascicule 5/5 de la RT2000 sur les matériaux

[RT1] LA REGLEMENTATION THERMIQUE FRANCAISE
"Matériaux", Tome 2, Règles THK 77
Chap. 4.124 p. 70 && Chap. 4.126 p. 74 && Chap. 4.13 p. 78-80

[RT2] LA REGLEMENTATION THERMIQUE FRANCAISE RT2000
Règles Th-U, Fascicule 2/5, Matériaux, Fascicule 5/5, Ponts thermiques

[THERMIQ] Logiciel de calculs de thermique 2D par éléments finis de l'auteur.