LINEAR TRANSMITTANCE OF AN INTERNAL WALL FOUNDATION

1. Introduction

The heat flow through a thermal bridge caused by an internal wall foundation depends on the size of the building and on the location of the internal wall.

For identical internal wall foundation construction details:

- the heat loss is higher in case of a smaller total floor size
- the heat loss is higher nearby the perimeter compared to the centre of the building.

Therefore, it is relatively complex to derive the linear thermal transmittance of such foundation details. A 3D thermal simulation of the whole floor is required.

A simplified method is proposed and validated, using a case study.

2. Case study data

TRISCO data foundation_psi_3D_TR1.trc ; foundation_psi_3D_TR1_with_internal_walls.trc

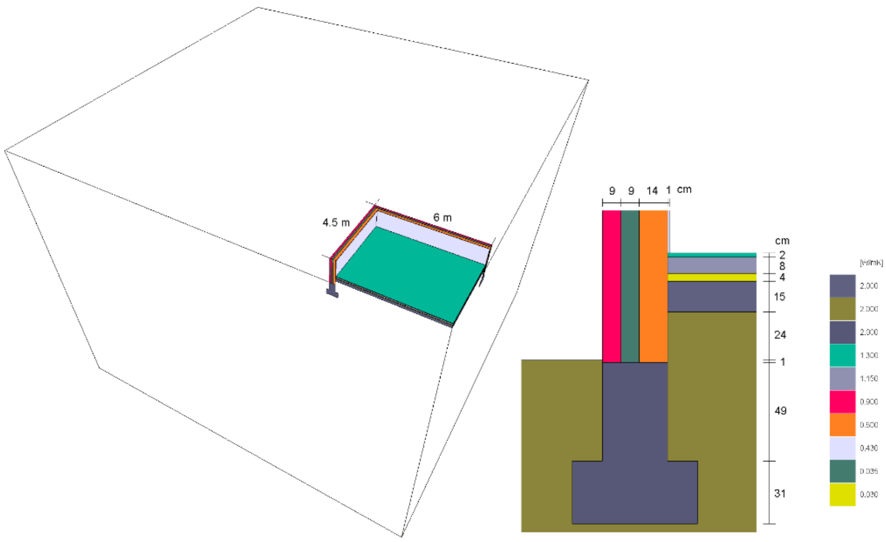

Figure 1: case study data without internal walls

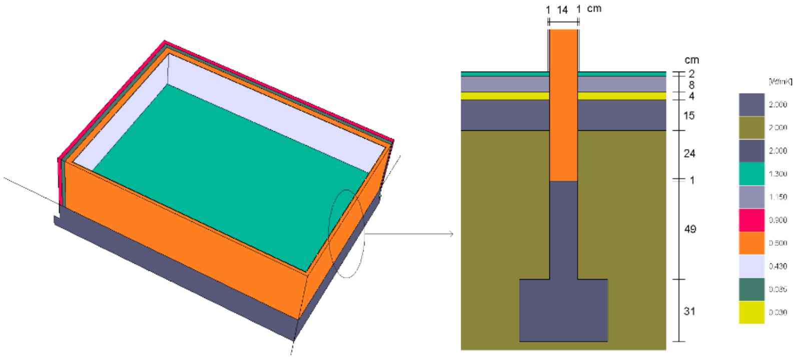

Figure 2: case study data with internal walls

The case study data is the same than for the case without internal walls presented in Figure 1 (from the document Knowledge Base B6[1]), with the addition of (half) internal walls (Figure 2).

3. Linear thermal transmittance of the internal wall foundation

TRISCO data foundation_psi_3D_TR1.trc ; foundation_psi_3D_TR1_with_internal_walls.trc

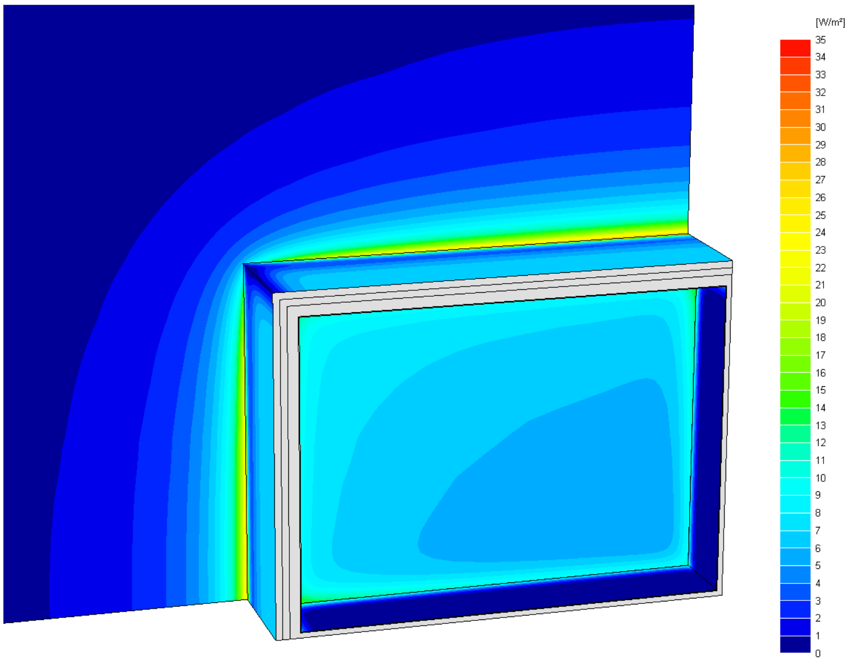

Figure 3: Heat flow density on the floor, ground and wall surfaces

The thermal bridge effect of the internal wall foundation is clear from Figure 3. The effect is larger nearby the perimeter and smaller in the building centre.

The mean linear thermal transmittance of the internal wall foundation ψ_{iw} can be derived easily from the heat loss difference between the cases with and without internal walls.

$$\psi_{iw} = 2\frac{Q_{3D,with} - Q_{3D,without}}{l\,\Delta\theta_{ie}}$$

[1] B6 - FLOOR THERMAL TRANSMITTANCE AND FOUNDATION LINEAR TRANSMITTANCE

$Q_{3D,with}$	heat loss with internal walls = 265.7 W (data [foundation_psi_3D_TR1_with_internal_walls.trc])
$Q_{3D,without}$	heat loss without internal walls = 258.9 W (data [foundation_psi_3D_TR1.trc])
l	length of the foundation = 10.5 m (external dimension system)
$\Delta\theta_{ie}$	indoors-outdoors temperature difference = 20K

ψ_{iw} = 0.064 W/mK

4. Simplified 2D method

TRISCO data foundation_psi_internal_wall.trc

The simplified method uses the following assumptions (Figure 4):

- A 2D section of the foundation is considered.
- The outdoors environment boundary condition is applied on a horizontal surface at depth d.
- The depth d is chosen in such a way that the U-value of the floor equals the real floor U-value (that depends on the floor area).
- The vertical cut-off planes are considered as adiabatic.

For the thickness of the ground layer under the foundation a value of 2.3 m was taken in order to obtain U_{floor} = 0.296 W/m^{2}K, being the U-value of the floor as derived in the document Knowledge Base B6[2]).

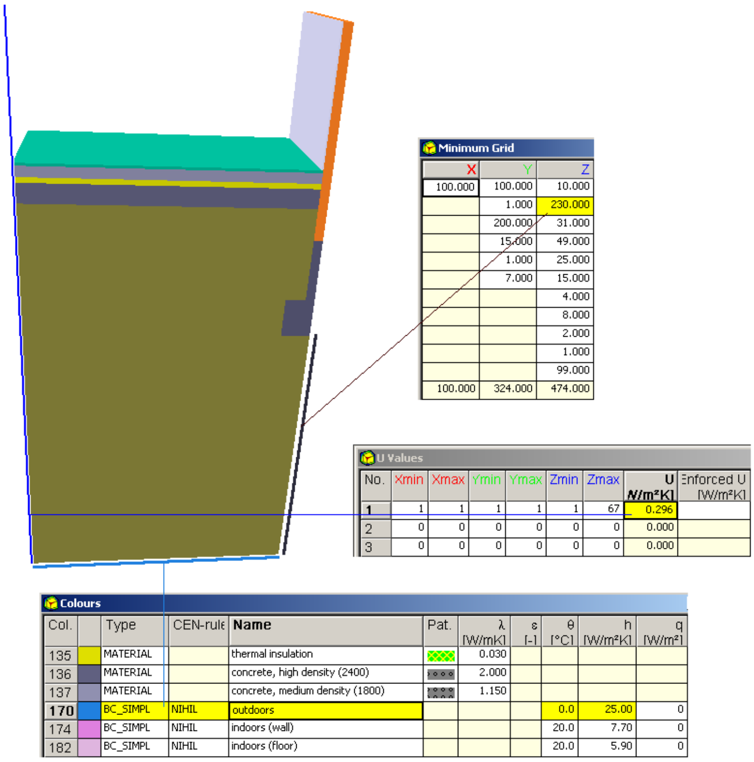

Figure 4.
Editing TRISCO data foundation_psi_internal_wall.trc

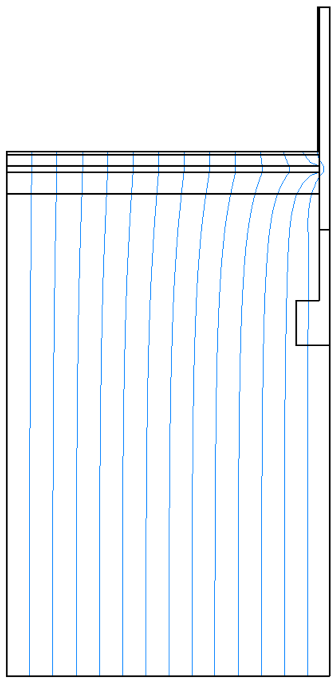

Figure 5.
Heat flow lines (increment 1 W/m)

[2] B6 - FLOOR THERMAL TRANSMITTANCE AND FOUNDATION LINEAR TRANSMITTANCE

Figure 5 shows the heat flow lines resulting from the simulation.
The linear thermal transmittance of the internal wall foundation ψ_{iw} can be derived using the formula

$$\psi_{iw} = 2\left(\frac{Q_{2D}}{\Delta\theta_{ie}} - b\ U_{floor}\right)$$

Q_{2D} total 2D heat loss = 13.94 W/m
b width of the detail considered of the foundation = 2.24 m (external dimension system)
$\Delta\theta_{ie}$ indoors-outdoors temperature difference = 20K

ψ_{iw} = 0.070 W/mK

5. Discussion

The ψ-value found by the simplified method corresponds quite well with the ψ-value from the more precise 3D method. The 3D value is somewhat lower, which can be explained by the external dimensioning system. There is indeed an 'overlap' between the thermal bridge caused by the internal wall foundation and the one caused by the external wall foundation.

The simplified 2D method can be considered as a little bit conservative.