LINEAR THERMAL TRANSMITTANCE OF A WOODEN FRAME CORNER

1. Introduction

The calculation of the linear thermal transmittance of a wooden frame corner is discussed. This thermal bridge effect is quantified using the programs BISCO and TRISCO.

2. Wooden frame corner

TRISCO data wooden_frame_corner.trc
BISCO data wooden_frame_corner_bsc.bsc

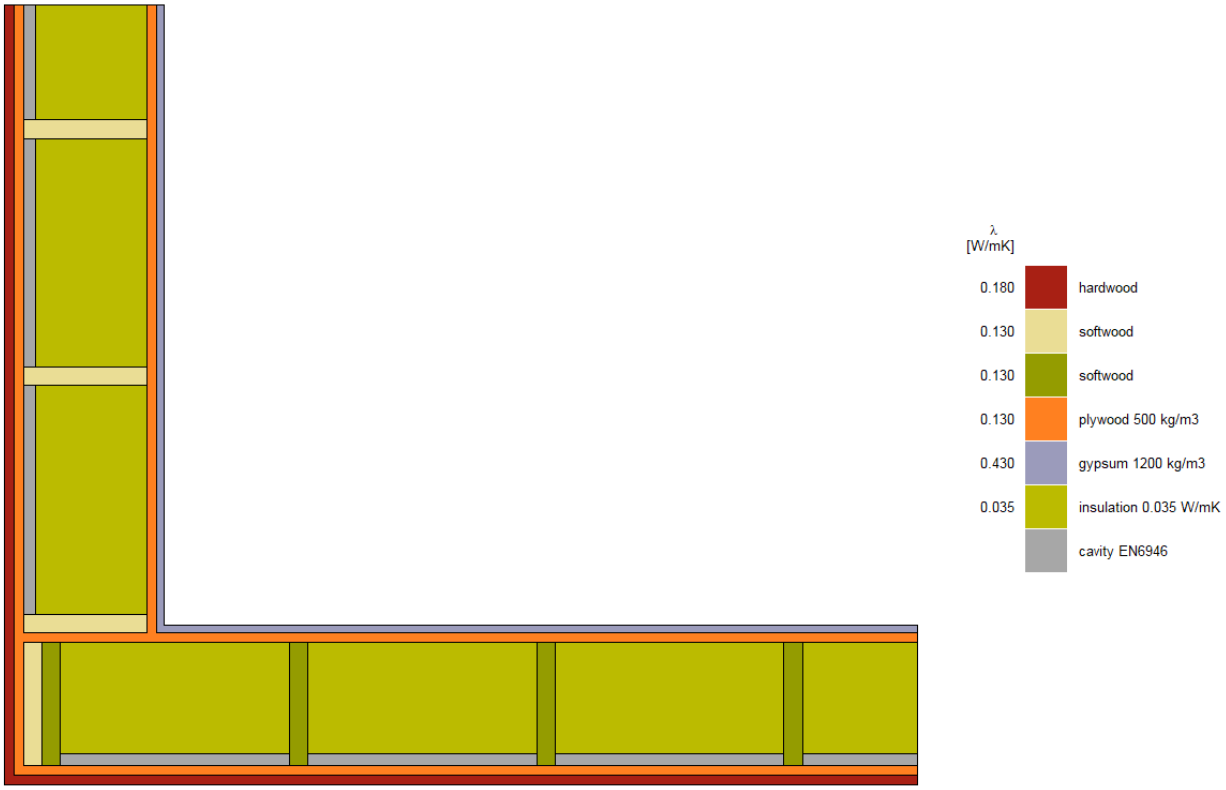

Figure 1: horizontal section of a wooden frame corner

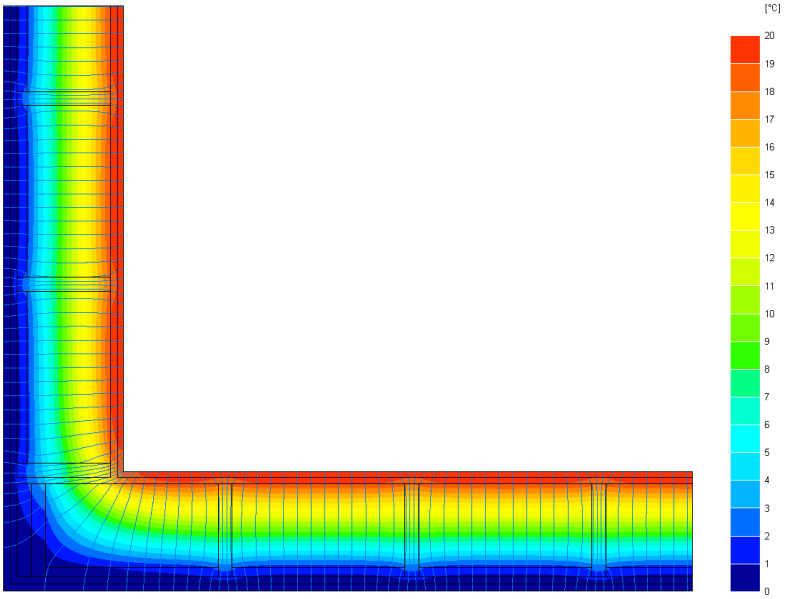

Figure 2: isotherms and heat flow lines (increment 0.1 W/m)

Figure 1 shows the data of the wooden frame corner. Figure 2 shows the isotherms and heat flow lines obtained by TRISCO or BISCO. The wooden studs cause some thermal bridge effect. The calculation of the linear thermal transmittance of the corner requires vigilance:

- The wooden studs in the wall are repetitive thermal bridges, and their effect needs to be taken into account in the wall mean thermal transmittance.
- The calculation results (Figure 2) consider both the wall thermal bridges and the corner thermal bridge.

2 methods are discussed to derive the linear thermal transmittance of the corner.

3. Corner linear thermal transmittance – Method 1

TRISCO data wooden_frame_wall.trc
wooden_frame_corner_psi_M1.trc
BISCO data wooden_frame_wall_bsc.bsc
wooden_frame_corner_bsc_M1.bsc

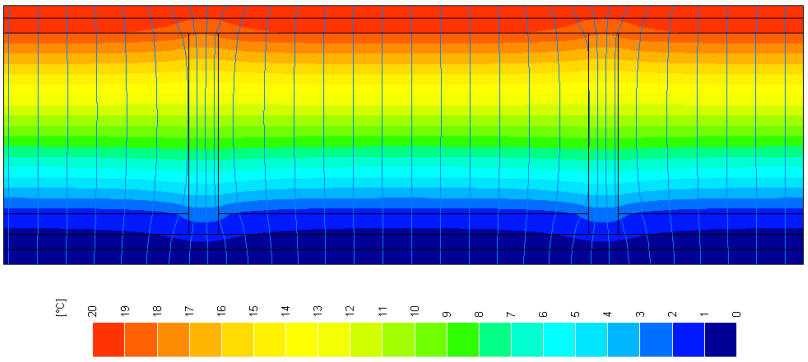

Figure 3: wall section - isotherms and heat flow lines (increment 0.1 W/m)

First the wall U-value with a wooden stud each 400 mm is derived from a 2D simulation (Figure 3).

$$U_{wall} = \frac{L^{2D}}{b} \qquad L^{2D} = \frac{Q^{2D}}{\Delta\theta ie} \qquad \boldsymbol{U_{wall} = 0.199\ W/m^2K}$$

U_{wall}	effective thermal transmittance of the wall [W/m^{2}K]
L^{2D}	thermal coupling coefficient [W/mK]
b	width of the considered wall part [m] = 0.8 m
Q^{2D}	total simulated heat loss [W/m] = 3.178 W/m (from BISCO or TRISCO)
$\Delta\theta_{ie}$	indoor-outdoor temperature difference [K] = 20 K

Secondly, the corner ψ-value is derived using the value U_{wall} for the flanking elements. In BISCO and TRISCO this value is entered as an enforced U-value.

$$\psi = L^{2D} - U_{wall}b_1 - U_{wall}b_2 \qquad \boldsymbol{\psi = -0.067\ W/mK}$$

ψ	linear thermal transmittance [W/mK]
L^{2D}	thermal coupling coefficient [W/mK] = 9.542 / 20 W/mK (from BISCO or TRISCO)
U_{wall}	thermal transmittance of the wall (including studs) [W/m^{2}K]
b_1 , b_2	widths of the flanking elements[1] [m] : b_1 = 1.26 m b_2 = 1.475 m

The ψ-value is negative because of the external dimension system used.

[1] External dimensions are used. The method is also applicable for internal dimensions.

4. Corner linear thermal transmittance – Method 2

TRISCO data wooden_frame_corner_psi_M2.trc
BISCO data wooden_frame_corner_bsc_M2.bsc

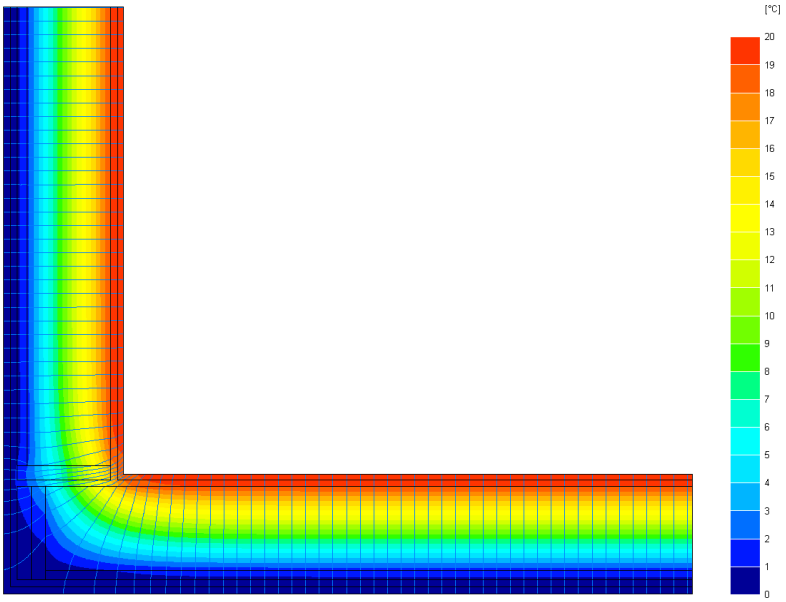

Figure 4: wall section without wall studs - isotherms and heat flow lines (increment 0.1 W/m)

It can be seen in Figure 2 that the wall studs do not affect the 2D heat transfer in the corner. Therefore the corner linear thermal transmittance can be evaluated from a simulation omitting the wall studs (Figure 4).

The corner ψ-value is derived using the undisturbed U-value of the flanking elements. In BISCO and TRISCO no enforced U-value need to be applied.

$$\psi = L^{2D} - U_0 b_1 - U_0 b_2 \qquad \boldsymbol{\psi = -0.046\ W/mK}$$

ψ	linear thermal transmittance [W/mK]
L^{2D}	thermal coupling coefficient [W/mK] = 8.447 / 20 W/mK
U_0	thermal transmittance of the wall without the studs [W/m²K] = 0.171 W/m²K
b_1 , b_2	widths of the flanking elements[2] [m] : b_1 = 1.26 m b_2 = 1.475 m

5. Discussion

There is a little difference between the linear transmittance values obtained by both methods. Practically it isn't relevant. The difference is related to the exact position of the first (viewed from the corner) studs. The method 1 ψ-value depends on that position; the method 1 ψ-value doesn't. If the exact position of the studs is known, method 1 is preferable.

[2] External dimensions are used. The method is also applicable for internal dimensions.