

1. Introduction

[Roofjunction_1.tr2](#)

[Roofjunction_1.dxf](#)

This tutorial explains how to model the linear thermal transmittance of a roof junction.

Key elements:

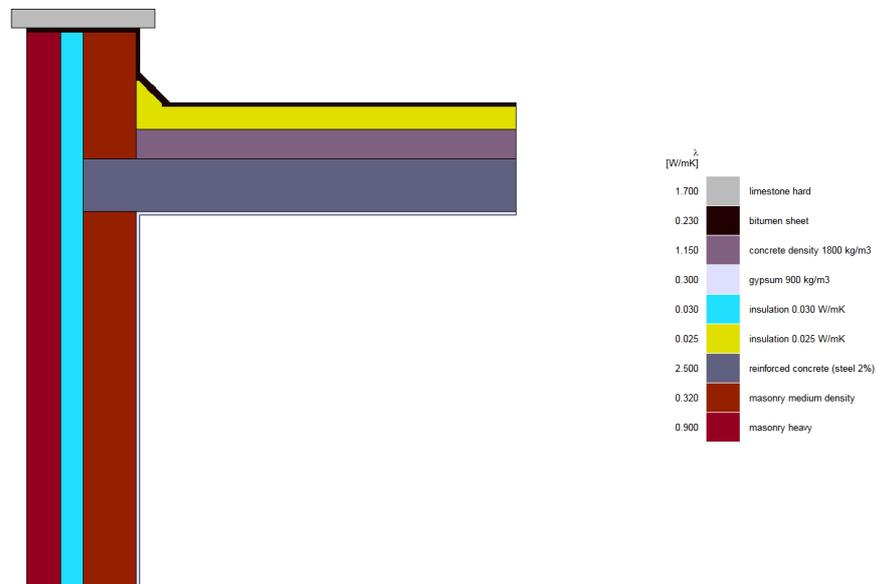
- Creating a geometrical model starting from a .dxf file
- Drawing sloped elements
- Derived thermal properties: linear thermal transmittance (Ψ)

Note: this tutorial is partly assembled from:

- How to create the design grid for a geometrical model from scratch or with a .dxf underlayer?
- How to add materials and boundary conditions to a geometrical model?
- How to create sloped elements
- How to generate a linear and an equivalent thermal transmittance?

2. Case study data

The configuration is a junction between a masonry wall and an insulated concrete roof structure:



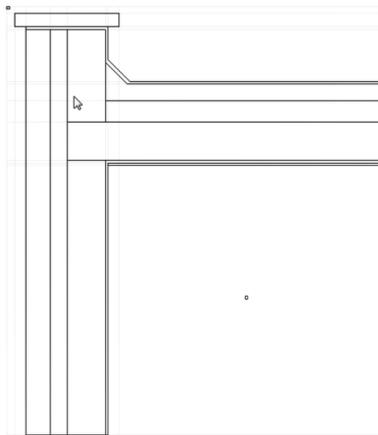
The boundary conditions imposed by EN ISO 10211 are:

- Outdoors: temperature $\theta_e = 0$ °C, surface heat transfer coefficient = 25 W/m²K,
- Indoors: temperature $\theta_i = 20$ °C, wall surface heat transfer coefficient = 7.7 W/m²K, roof surface heat transfer coefficient = 10 W/m²K.

3. Creating the design grid (= minimum grid) from a .dxf file

- Load the .dxf underlayer: *File* → *Import DXF*: select "Roofjunction_1.dxf"
- In the Create DXF underlayer dialog box:
 - o Define the DXF unit.
Note: by pressing <tab> the dialog box is updated with the entered unit.
 - o Select "create horizontal and vertical object grid line based on DXF".
 - o If needed, select DXF layers which should not be recognised.
- The design grid lines to create the model geometry are now automatically recognised and drawn.

Note that no grid lines are drawn in Trisco2D at the endpoints of the sloped lines (see further in this tutorial on how to deal with the sloped elements).



No.	ΔX [cm]	ΔY [cm]
0-1	3.000	2.500
1-2	4.000	5.000
2-3	9.000	1.000
3-4	6.000	19.000
4-5	14.000	1.000
5-6	1.000	6.000
6-7	4.000	8.000
7-8	96.000	14.000
8-9		1.000
9-10		1.000
10-11		99.000
Sum	137.000	157.500

4. Adding material properties and boundary conditions

- Select *Colours* → *List Defined*
- Materials and boundary conditions can be added to the model by first selecting the desired colour in the **Colours window** and then pick the desired grid cells with  ("Draw") or select a desired zone  ("Fill").
 - o To colour multiple grid cells with the "Draw" function: hold the left mouse button down while moving the cursor over the model.
 - o To colour a line of grid meshes with the "Draw" function: select the starting grid cell with the left mouse button and hold down <Shift> while selecting the end point grid cell with the left mouse button.

- To select a colour already used in the model: click with the right mouse button in this coloured zone in the model.

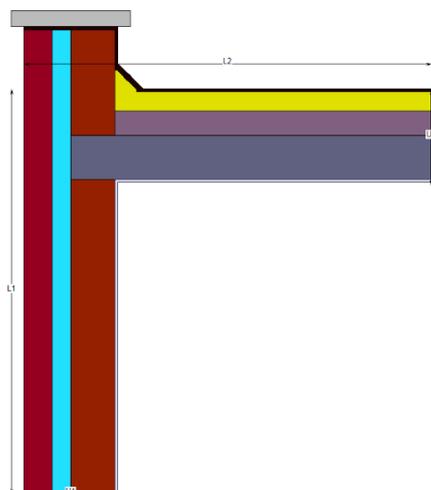
Note: when selecting materials with the "Draw" option the number of blocks can increase rapidly. To reduce the number of blocks it is advisable to intermediately optimise the number of blocks by *Blocks* → *Optimise Blocks*.

- Trisco2D is designed for rectangular geometries. As a consequence the sloped parts of the roof insulation need a special procedure for colouring:
 - o Create first additional grid lines at the starting and end points of the sloped lines in the underlayer by snapping to these points   ("set vertical grid line" or "set horizontal grid line").
 - o Discretise the mesh over the area of the sloped part of the insulation:
 - Select the corresponding grid mesh in the **Grid window** by clicking with the left mouse.
 - Refine these meshes: *Grid* → *Split...* (or by pressing <Ctrl+I>).

- Select the split method in the Split selected Mesh(es) dialog box “Maximum”.
 - Define the mesh width in the Split selected Mesh(es) dialog box: “0.2 cm”.
 - Colour the sloped lines of grid cells with the “Draw” function  : select the starting grid cell with the left mouse button and hold down <Shift> while selecting the end point grid cell with the left mouse button.
 - Colour the zone within these sloped lines with the “Fill” function 
 - During colouring: an already used colour can be picked from the model by clicking in the corresponding zone with the right mouse button.
- The .dxf underlayer can now be removed from the **Image window**: *Image* → *Hide Dxf Underlayer*.

5. Calculation of the linear thermal transmittance

- *Edit* → *Derived Thermal Properties...* and check “Linear thermal transmittance” 
- The **Lengths of flanking elements window** and **U-values of flanking elements window** open automatically.
- The flanking element lengths can be defined with the mouse cursor:
 - Activate the desired row in the **Lengths of flanking elements window** by clicking with the left mouse button.
 - Select with the left mouse button the starting point in the grid.
 - Hold the left mouse button down and select the end point in the grid.
 - The mouse wheel can be used to zoom in/out during this action.
- Within the **U-value of flanking elements window** the line along which the 1D U-value should be calculated can be defined with the same procedure.
- Run the simulation by clicking the magic wand 
- Before the simulation starts an automatic grid discretisation is proposed: click “yes”.
- A grid base size of 1 cm is proposed by the software (based on the dimensions of the model) which is fine for this model.
- The simulation automatically starts and the model then shows the temperature field.
- Within the **Image window** the user can switch to:
 - Show Materials 
 - Show Temperatures 
 - (Adjust)Temperature Range 
 - Show (discretisation) Grid 
- See the results in the **Graphic Output window**  or in the **Text Output window** 



$$\psi = Q / (\theta_{e0} - U_1 \cdot L_1 - U_2 \cdot L_2)$$

$$Q = 18.812 \text{ W/m}$$

$$\theta_e = 20^\circ\text{C}$$

$$\theta_{e0} = 0^\circ\text{C}$$

$$U_1 = 0.365 \text{ W/(m}^2\text{K)}$$

$$L_1 = 1.3 \text{ m}$$

$$U_2 = 0.365 \text{ W/(m}^2\text{K)}$$

$$L_2 = 1.3 \text{ m}$$

$$\psi = -0.008 \text{ W/(m.K)}$$

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Number of nodes = 8100
Heat flow divergence for total object = 0.000751811 %
Heat flow divergence for worst node = 0.0207898 %
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Col.	Type	Name	tmin [°C]	X	Y	tmax [°C]	X	Y
17	MATERIAL	limestone_hard	0.01	1	1	0.29	20	6
32	MATERIAL	biviumum_sheer	0.02	5	6	2.73	25	25
72	MATERIAL	concrete_densit	14.52	25	62	18.52	76	68
129	MATERIAL	gypsum_900_kg/m	16.94	25	76	19.22	76	77
133	MATERIAL	insulation_0.03	0.11	11	7	15.82	17	74
136	MATERIAL	insulation_0.02	0.45	69	42	18.02	76	62
136	MATERIAL	reinforced_conc	15.28	17	68	18.95	76	76
148	MATERIAL	masonry_medium	0.19	25	7	18.81	25	88
170	BC_SIMPL	exterior	0.01	1	1	0.84	26	15
174	BC_SIMPL	interior_(norma	18.16	26	78	19.05	26	88
180	MATERIAL	masonry_heavy	0.03	5	7	1.02	11	88
190	BC_SIMPL	indoors,_upward	17.73	26	77	19.22	76	77

Col.	Type	Name	Flow in [W]	Flow out [W]
170	BC_SIMPL	exterior	0.00	18.81
174	BC_SIMPL	interior_(norma	7.72	0.00
190	BC_SIMPL	indoors,_upward	11.09	0.00

Linear thermal transmittance (EN ISO 10211)
 $\psi_{si} = Q / (t_{ci} - t_{ce}) - U_1 \cdot L_1 - U_2 \cdot L_2 = -0.008 \text{ W/(m.K)}$
 $Q = 18.812 \text{ W/m}$
 $t_i = 20^\circ\text{C}$
 $t_e = 0^\circ\text{C}$
 $U_1 = 0.365 \text{ W/(m}^2\text{K)}$
 $X1=5 \ Y1=88 \ X2=26 \ Y2=88$
 $L_1 = 1.3 \text{ m}$
 $X1=1 \ Y1=88 \ X2=1 \ Y2=55$
 $U_2 = 0.365 \text{ W/(m}^2\text{K)}$
 $X1=76 \ Y1=78 \ X2=76 \ Y2=55$
 $L_2 = 1.3 \text{ m}$
 $X1=5 \ Y1=15 \ X2=76 \ Y2=15$