Tutorial

Geometrical input of a DXF file via TriscoDXF (prepared DXF file)

TRC Tutorial b

TRISCO

1. Introduction

RoofJunction.trc
RoofJunction.dxf

This tutorial discusses the calculation of a linear thermal bridge for which the geometry is defined in a DXF file (with separate layers for every material and boundary condition). The DXF file is converted to a coloured bitmap (with different colours for every material and boundary condition, chosen from the Colour database). This bitmap is imported in TRISCO, and thanks to the predefined thermal properties of the colours, further input is minimal. The areas and U values of the flanking elements are automatically initialised, and after the system calculation the linear thermal transmittance is immediately available. An automatic report including graphics can be generated into a Microsoft Word document file.

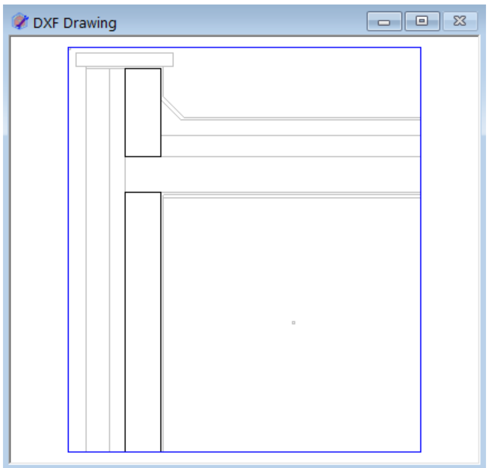
In a final step the tutorial illustrates the revolve function to get a 3D corner joint from the 2D geometry.

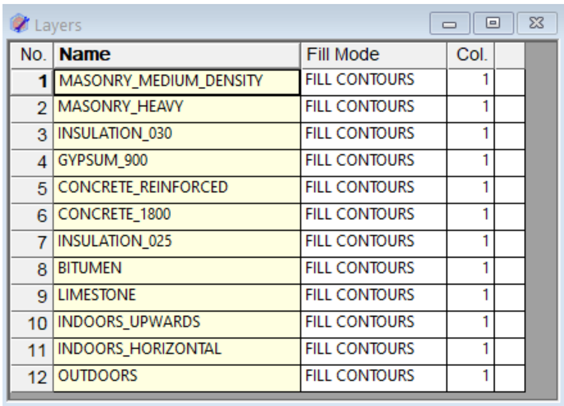
Key elements:

- Creating a geometrical model starting from a DXF file
- Using TriscoDxf to convert a DXF file to a BMP file, for input in TRISCO
- Derived thermal properties: linear thermal transmittance (ψ)
- Generating a calculation report
- Revolve function to get a 3D object from a 2D geometry

2. Input of a DXF file of a 2D drawing

- Start the TRISCO application and Load the DXF file via TriscoDxf: *File → Open DXF...* : select RoofJunction.dxf.
- A dialog box opens allowing to select layers which should not be recognised.
- Upon selecting <OK> all layers are recognised in TriscoDxf:

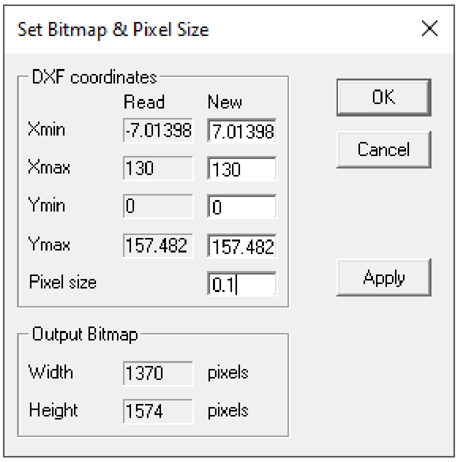




Layers

No.	Name	Fill Mode	Col.
1	MASONRY_MEDIUM_DENSITY	FILL CONTOURS	1
2	MASONRY_HEAVY	FILL CONTOURS	1
3	INSULATION_030	FILL CONTOURS	1
4	GYPSUM_900	FILL CONTOURS	1
5	CONCRETE_REINFORCED	FILL CONTOURS	1
6	CONCRETE_1800	FILL CONTOURS	1
7	INSULATION_025	FILL CONTOURS	1
8	BITUMEN	FILL CONTOURS	1
9	LIMESTONE	FILL CONTOURS	1
10	INDOORS_UPWARDS	FILL CONTOURS	1
11	INDOORS_HORIZONTAL	FILL CONTOURS	1
12	OUTDOORS	FILL CONTOURS	1

- The **DXF Drawing window** displays the corresponding lines in grey (all layers except the current layer) and black (for lines of the current layer).
  The rectangle in blue represents the border of the bitmap to be created. The left, right, top and bottom position of this border can be moved. Initially the bitmap border corresponds to the drawing extents from the DXF file header. The bitmap limits and bitmap resolution can be viewed and edited in the dialog box opened with *Bitmap → Set Bitmap & Pixel Size...* .
  The drawing unit is 1 cm (for this DXF drawing), so the proposed pixel size of 0.1 in the dialog box corresponds to 1 mm.
  The output bitmap will have a width of 1370 pixels and a height of 1574 pixels.
  Note: for a smooth import of this bitmap, the default grid unit in TRISCO can be set to mm (see later in this tutorial)



3. Edit layer definitions

- The **Layers window** sets the definitions for the bitmap colouring.
- Enter the colour numbers (between 0 and 255) for each layer corresponding to the definition in the Colour database.
- If a layer name (in the DXF file) starts with a number of 3 digits (000 up to 255), then this number is automatically copied as colour number in the colour column (e.g. 129_GYPSUM).
  Note: the Colour database can be accessed by opening a second TRISCO project and going to *File → Open Colour Database...* .
  A list of the default Colour database can be found in the Physibel Knowlegde base: “MATERIAL AND BOUNDARY CONDITIONS: EN 10077-2, EN 6946 and EN 10456.pdf”
- Also edit the fill mode per layer (double click with the left mouse button on the corresponding cell, or press <Enter> on the selected cell).
  The fill mode defines how the lines in the corresponding layer must be filled using the chosen colour. The normal fill mode to colour a closed polyline is “fill contours”, which colours the area inside the polyline. The boundary conditions (which are drawn in the DXF file as small rectangles) are filled using a “flood fill”.
- Finally the sequence of layers may be changed, which defines the priority of colouring. This can be done using the menu commands *Layers → Higher/Lower Priority* from the active **Layers window**.
  The first layer is first processed in bitmap colouring, then the second one, and so on.
- Edit the **Layers window** up to the result of the picture below.

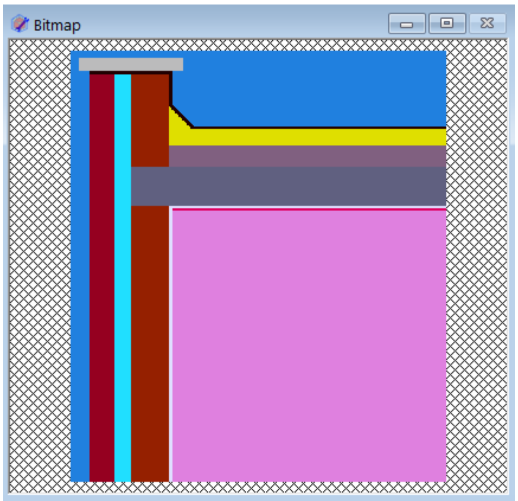
No.	Name	**Fill Mode**	Col.	
1	MASONRY_MEDIUM_DENSITY	FILL CONTOURS	148	
2	MASONRY_HEAVY	FILL CONTOURS	180	
3	INSULATION_030	FILL CONTOURS	133	
4	GYPSUM_900	FILL CONTOURS	129	
5	CONCRETE_REINFORCED	FILL CONTOURS	136	
6	CONCRETE_1800	FILL CONTOURS	72	
7	INSULATION_025	FILL CONTOURS	135	
8	BITUMEN	FILL CONTOURS	32	
9	LIMESTONE	FILL CONTOURS	17	
10	INDOORS_UPWARDS	FILL CONTOURS	190	
11	INDOORS_HORIZONTAL	FLOOD FILL	174	
12	OUTDOORS	FLOOD FILL	170	

- The technical details of the different fill modes are explained in detail in the manual.
- Similar to the predefined colours, it is also possible to add the fill mode info to the DXF layer names for automatically recognication by TriscoDxf. The prefix in the layer name is then XXX_Y in which the first three digits define the colour and Y the fill mode (FILL CONTOUR = 1, FLOOD FILL = 2). For the example in this tutorial this corresonds to following layer names (RoofJunction_prepared.dxf):

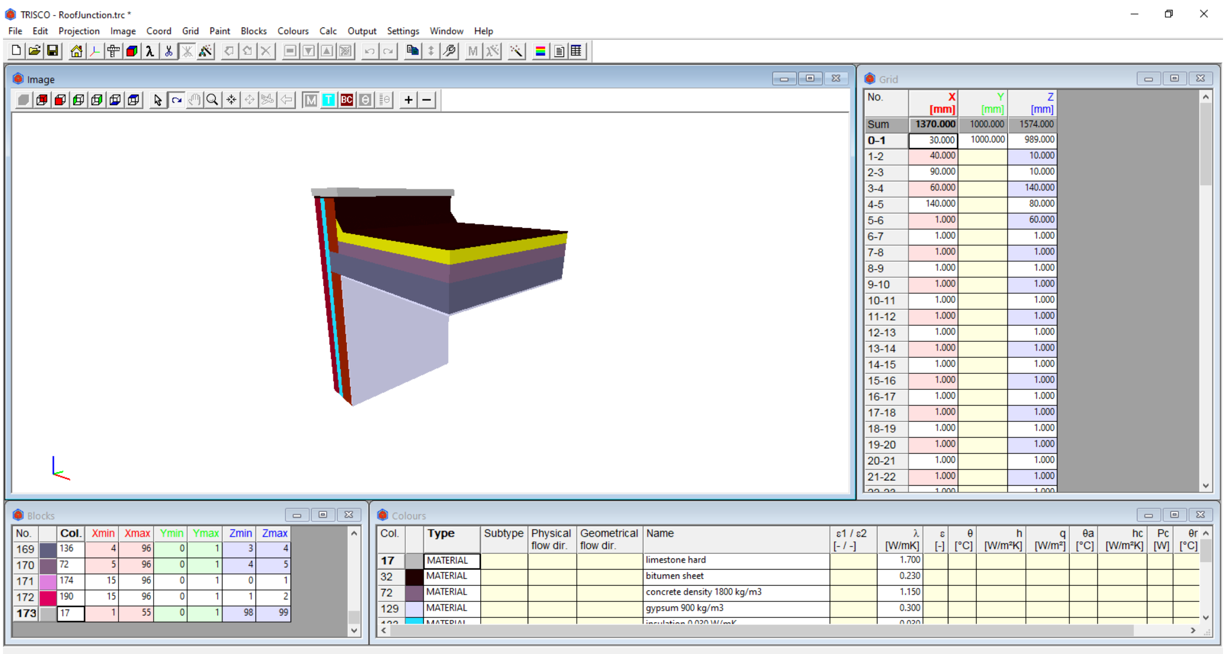
	017_1_LIMESTONE
	032_1_BITUMEN
	072_1_CONCRETE_1800
	129_1_GYPSUM_900
	133_1_INSULATION_030
	135_1_INSULATION_025
	136_1_CONCRETE_REINFORCED
	148_1_MASONRY_MEDIUM_DENSITY
	170_2_OUTDOORS
	174_2_INDOORS_HORIZONTAL
	180_1_MASONRY_HEAVY
	190_1_INDOORS_UPWARDS

4. Conversion to BITMAP and import in TRISCO

- After definition of the bitmap extent, pixel resolution and colouring scheme, the bitmap is created using the command *Calc → Calc Bitmap* or by clicking the magic wand.  The **DXF Drawing window** is modified into the **Bitmap window**, showing the result.

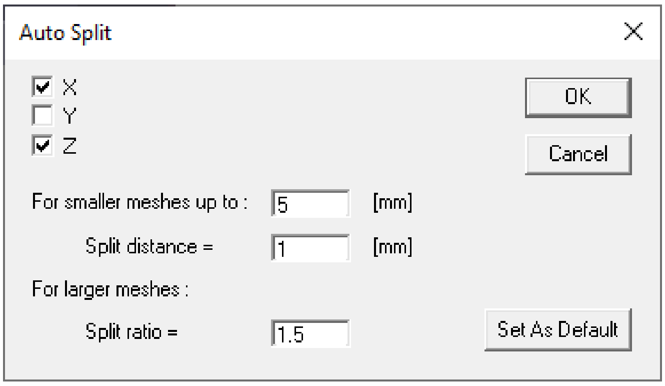


- Save the generated bitmap.
- Close TriscoDxf to load the generated bitmap directly in TRISCO.
  Note: Together with saving the BMP file, the file "RoofJunction.lay" is written, which contains the used layer definitions. When other DXF files must be converted to BMP files, the same layer definitions can be reloaded (using *Layers → Load Layer Definitions…*) or installed as default layer definitions (*Layers → Save as Default Layer Definitions* (which copies into TriscoDxf.lay in AppData)).
- A dialog box opens allowing to select the block arrangements.
- Upon selecting <YES> a second dialog box will ask to select the position and depth of the 2D image: select "XZ" and define a Depth of "1 m". In addition, the grid unit (pixel size of the bitmap) can be defined. Set the grid unit to 0.001 m, as the pixel size of the imported bitmap was 1 mm.
- The 2D geometry and boundary conditions are automatically loaded in TRISCO
- Save the TRISCO file: *File → Save as…*



5. Set-up the calculation grid and run the simulation

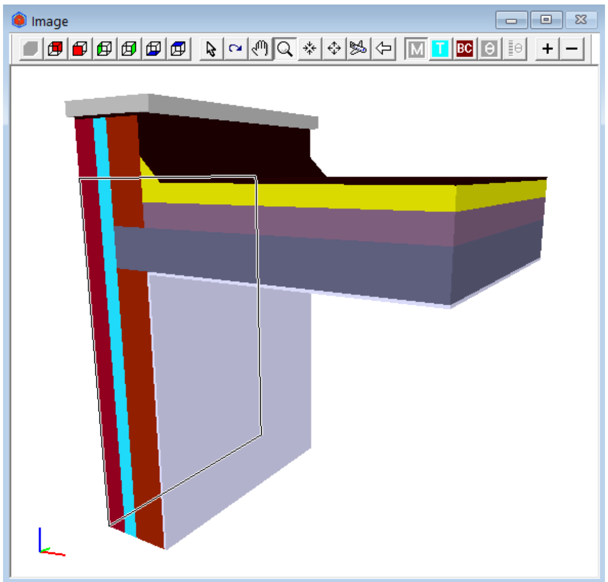
- The component can still be scaled if necessary. Following example is under the assumption that the grid unit is in m:
    - Choose *Grid* → *Grid Unit...*, set grid unit = 0.001 m, answer the prompt "Transform grid widths ?" with No.
    - Modify the extrusion width of the bitmap (cell Y, no. 0-1) to 1000 mm (= 1 m).
- To define the calculation grid: Choose *Grid* → *Auto Split...*, and accept the settings of the dialog box.

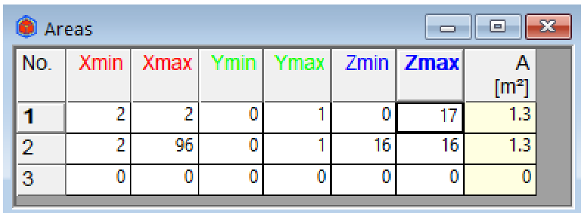


- The grid is automatically subdivided. Smaller meshes (up to 5 mm) are subdivided into equal meshes of 1 mm. Larger meshes are split into a geometric sequence with split ratio 1.5.
- Calculate the system (*Calc* → *Calc System*)

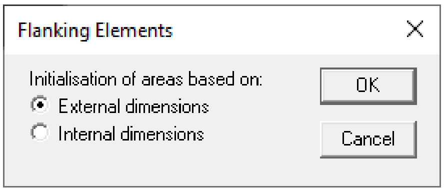
6. Prepare calculation of linear thermal transmittance

- The flanking elements of the linear thermal bridge are automatically detected.
- The reference areas can be viewed (and edited) in the **Areas window** (*Edit* → *Areas*), and are based on either external or internal dimensions (cf. *Settings* → *Flanking Elements...*).

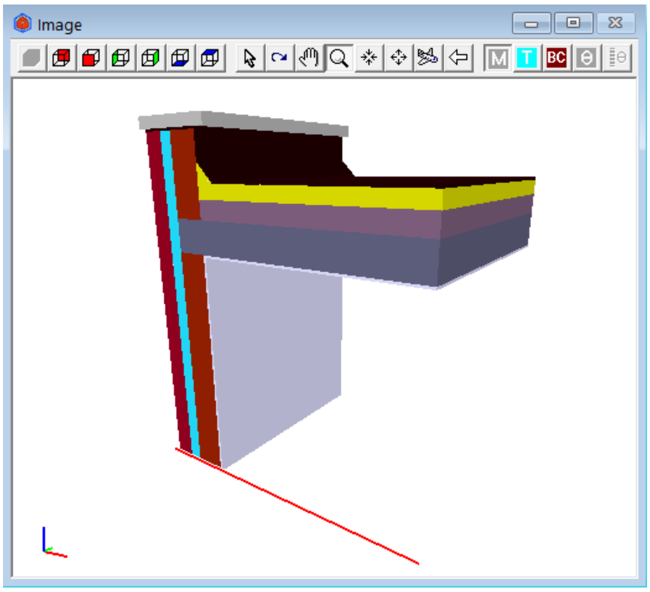


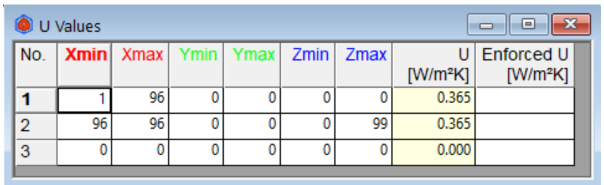


No.	Xmin	Xmax	Ymin	Ymax	Zmin	Zmax	A [m²]
1	2	2	0	1	0	17	1.3
2	2	96	0	1	16	16	1.3
3	0	0	0	0	0	0	0



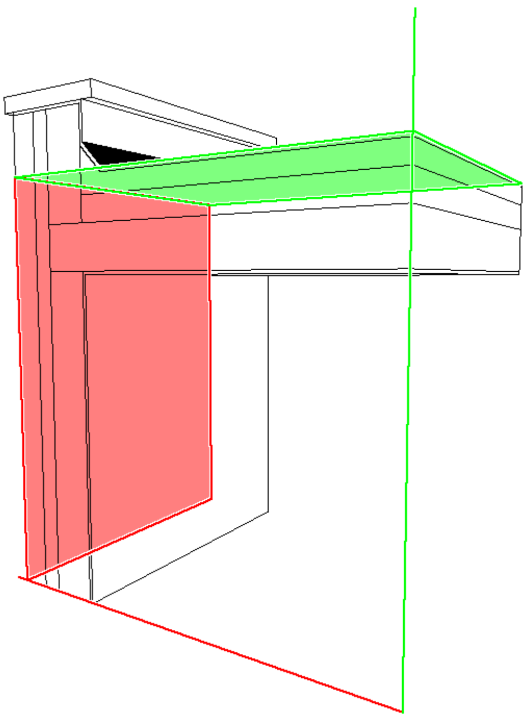
- The thermal transmittances of the flanking elements can be viewed in the **U Values window** (*Edit* → *U Values*). The line between the points (Xmin,Ymin,Zmin) and (Xmax,Ymax,Zmax), along which the U value is calculated, is represented in the **Image window** as a thick line (in red, green or blue, correspondent to its position parallel to the X, Y or Z axis).



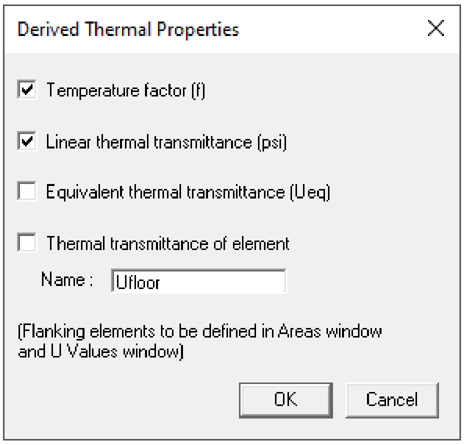


No.	Xmin	Xmax	Ymin	Ymax	Zmin	Zmax	U [W/m²K]	Enforced U [W/m²K]
1	1	96	0	0	0	0	0.365	
2	96	96	0	0	0	99	0.365	
3	0	0	0	0	0	0	0.000	

- The areas and U values can be viewed together in the **Graphics Output window**, using the view option *View → Fill Areas*.

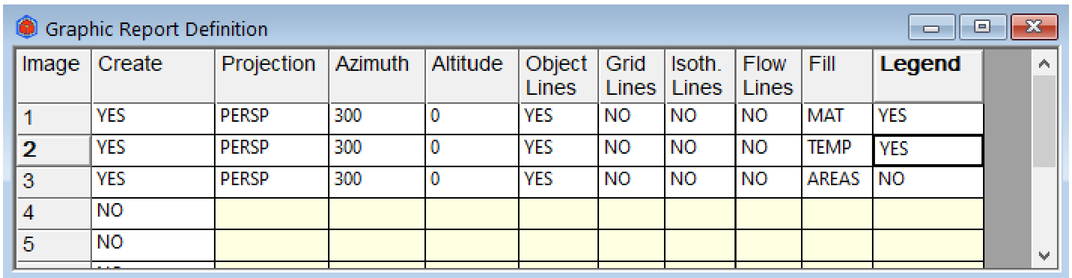


- Quit the **Graphics Output window** (*File → Exit*).
- In the Derived Thermal Properties dialog box (*Edit → Derived Thermal Properties...*), check the temperature factor and linear thermal transmittance as wanted calculation results output.



7. Automatic report generation

- Open the **Graphic Report Definition window** (*Edit → Graphic Report Definition*).
- Define three images as wanted output in a calculation report. The parameters are conform to the view options in the **Graphic Output window**. The view angles (azimuth and altitude) are initialised as the view angles of the current view in the **Image window**, but can be changed freely.
- All other parameters (image size, line styles, temperature range, heat flow increments) are as defined in the Settings menu of the **Graphic Output window**.
- Enter the parameters as in the picture below.



Graphic Report Definition

Image	Create	Projection	Azimuth	Altitude	Object Lines	Grid Lines	Isoth. Lines	Flow Lines	Fill	Legend
1	YES	PERSP	300	0	YES	NO	NO	NO	MAT	YES
2	YES	PERSP	300	0	YES	NO	NO	NO	TEMP	YES
3	YES	PERSP	300	0	YES	NO	NO	NO	AREAS	NO
4	NO									
5	NO									

The function *Output → Make Report* creates a set of output data files (text and graphics) and automatically copies and opens the template report (RoofJunction_report.doc) into which the generated data can be imported.

> Note: The report in Microsoft Word is copied from the personal folder ../Documents/Physibel/TRISCO/TriscoReportTemplate.doc.
> This template report can be modified (e.g. adding company logo or deleting irrelavant report items) at this location.

- The automatically opened report document (DOC file) contains a toolbar button to import all wanted report items.
  - Choose: Enable macros.
    (The security level in Microsoft Word or Microsoft Office should be medium or low to allow enabling macros)
  - The document contains predefined bookmarks, which mark the insertion points for the TRISCO output files (created with *Output → Make Report*).
  - Click the toolbar button *Add-ins → TRISCO Load* and select the file "RoofJunction.trx" (TRISCO report index file for RoofJunction, which was created using the TRISCO function *Output → Make Report).*
  - All report items are imported.
  - Save the report (*File → Save*)

REPORT SAMPLE

GRAPHICS

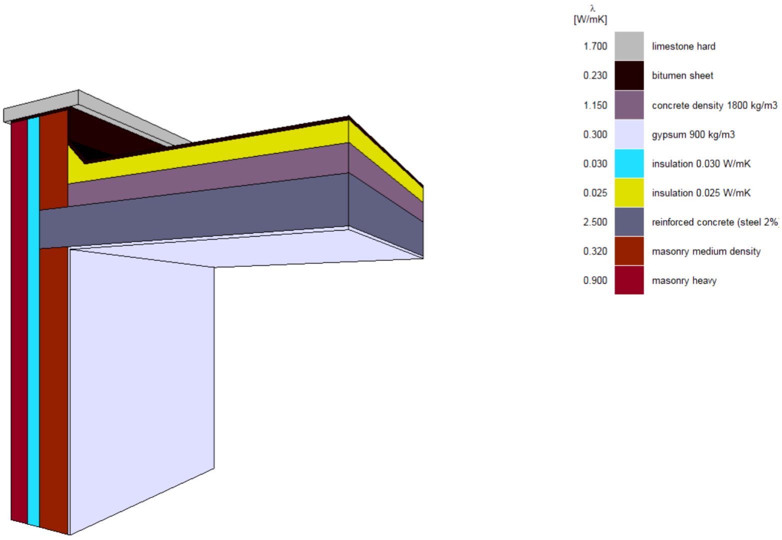


Figure 1. Material geometry.

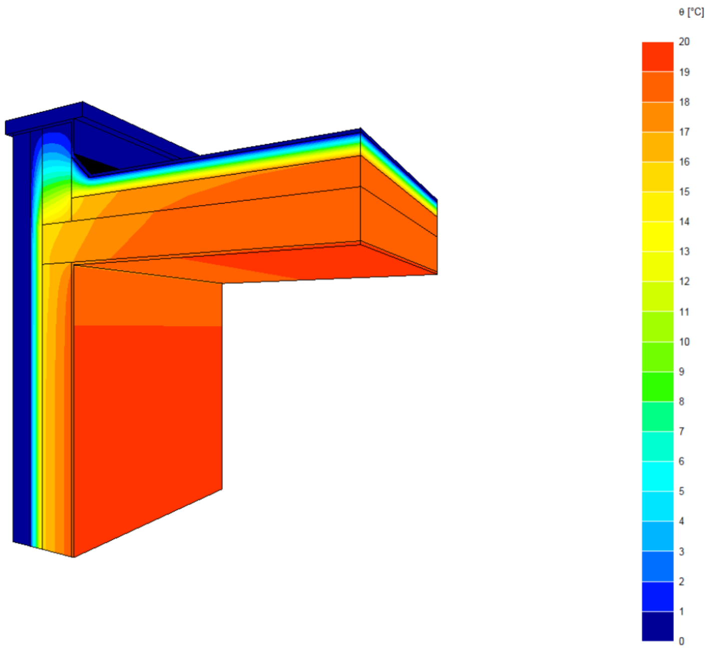


Figure 2. Isotherms (colour increment of 1°C, line increment of 5°C).

TRISCO DATA SUMMARY

TRISCO data file	RoofJunction_prepared.trc
Number of nodes	**45802**

Material properties table

Col.	Name	lambda [W/mK]	eps [-]
17	limestone_hard	1.700	
32	bitumen_sheet_	0.230	
72	concrete_density_1800_kg/	1.150	
129	gypsum_900_kg/m3	0.300	
133	insulation_0.030_W/mK_	0.030	
135	insulation_0.025_W/mK_	0.025	
136	reinforced_concrete_(stee	2.500	
148	masonry_medium_density	0.320	
180	masonry_heavy	0.900	

Boundary condition table

Col.	Name	t [°C]	h [W/m²K]	q [W/m²]	ta [°C]	tr [°C]	hc [W/m²K]	Pc [W]
170	exterior	0.0	25.00	0				
174	interior_(normal)_horizon	20.0	7.70	0				
190	indoors;_upwards_heat_flo	20.0	10.00	0				

TRISCO MAIN RESULTS

Temperature factor	**0.887**
Linear thermal transmittance	**-0.011 W/(m.K)**
U-value of flanking element 1	**0.365 W/(m^2.K)**
Area of flanking element 1	**1.3 m^2**
U-value of flanking element 2	**0.365 W/(m^2.K)**
Area of flanking element 2	**1.3 m^2**

Temperature factor (EN ISO 10211) = 0.887

hi = 10.00 W/(m^2.K)
Rsi = 0.10 m^2.K/W
Surface condensation if RH > 87 % (at 20.00°C)

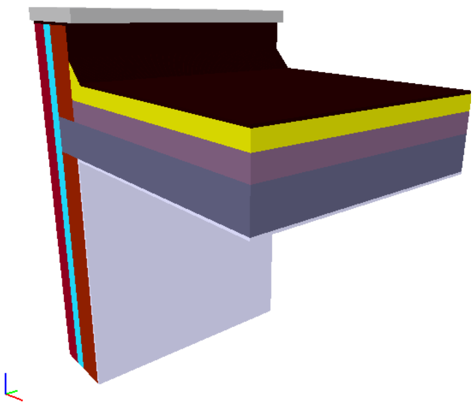
Linear thermal transmittance (EN ISO 10211)

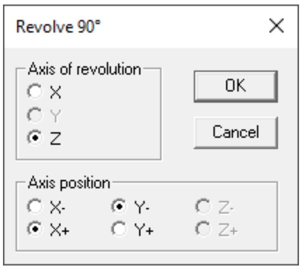
psi = (Q/(ti-te) - U1*A1 - U2*A2)/l = -0.011 W/(m.K)
Q = 18.752 W
ti = 20.00°C
te = 0.00°C
U1 = 0.365 W/(m^2.K)
Xmin=1 Xmax=167 Ymin=0 Ymax=0 Zmin=0 Zmax=0
A1 = 1.3 m^2
Xmin=13 Xmax=13 Ymin=0 Ymax=1 Zmin=0 Zmax=91
U2 = 0.365 W/(m^2.K)
Xmin=167 Xmax=167 Ymin=0 Ymax=0 Zmin=0 Zmax=210
A2 = 1.3 m^2
Xmin=13 Xmax=167 Ymin=0 Ymax=1 Zmin=90 Zmax=90
l = 1 m

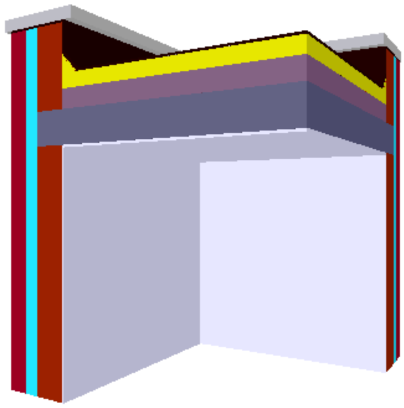
8. Revolve function

RoofJunction_3D.trc

- Open the file "RoofJunction.trc".
- From this 2D section a 3D corner joint can be created by using the revolve function.
- Choose *Blocks → Revolve 90°….*
- Set the parameters as in the picture above middle.
- The 2D section is revolved around the Z axis positioned at the right end of X (= X+) and the front end of Y (= Y-). The picture above right shows the result.







- The system has more than 4 million nodes, which is very high. A simpler grid can be used starting from the minimum grid (*Grid → Create Minimum Grid…)* to reduce the number of nodes.