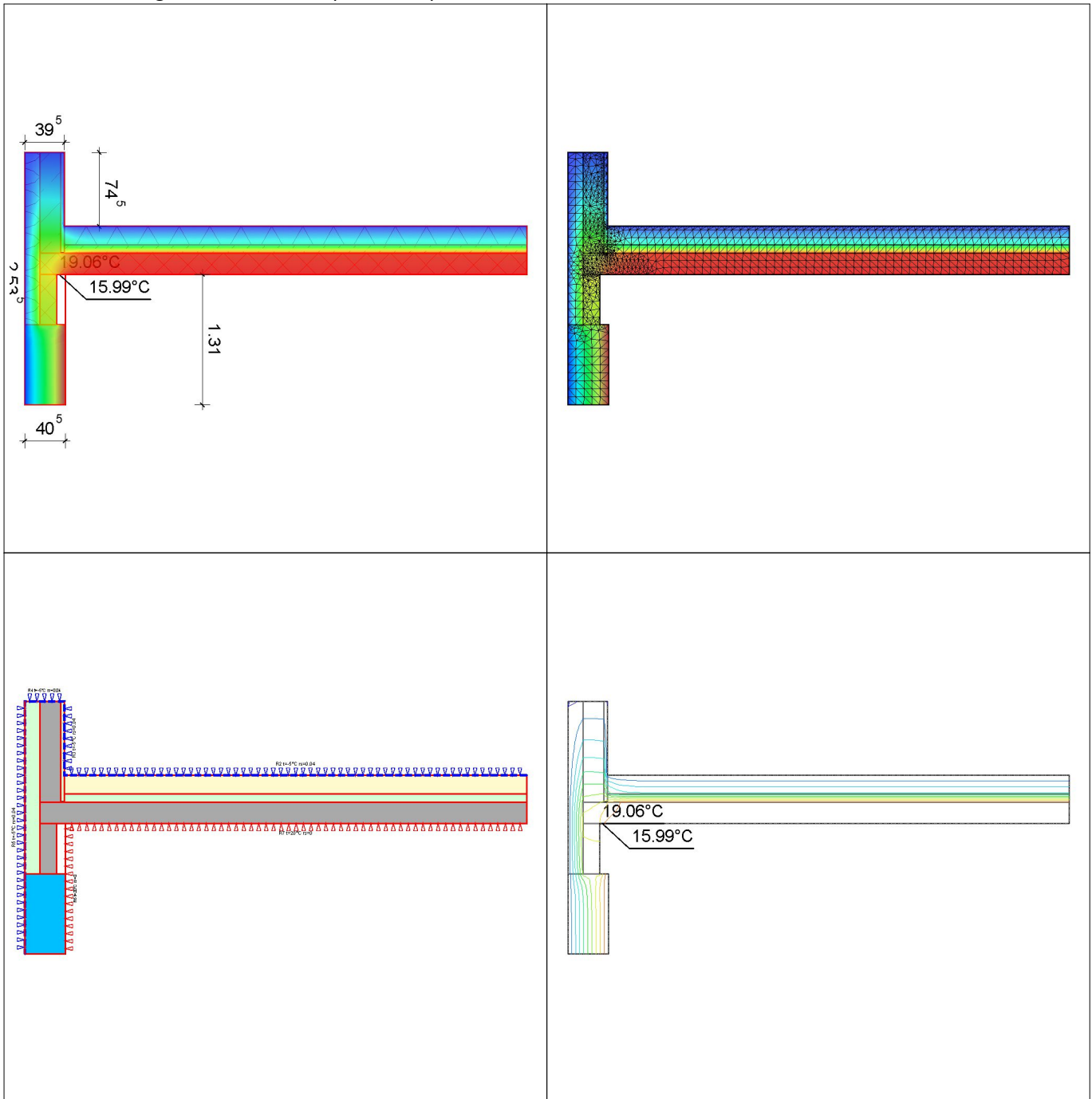


## Thermal bridges calculation ( $\Psi$ -Value)



## Thermal bridges calculation

$$\Psi = +0,000 \text{ W/(mK)}$$

## Materials list:

	Description	Lambda
	Aerated concrete plan stones 450	0,160 W/(mK)
	DIN window with UW 1.4 [W/(mK)] = (d = 7 cm)	0,129 W/(mK)
	Extruder polystyrene foam (WLG 035)	0,035 W/(mK)
	Mineral and vegetable fiber insulation products (WLG 040)	0,040 W/(mK)
	Normal concrete (2400)	2,100 W/(mK)


## Boundary conditions and Flow of heat:


Nr	Temp	Rsi/Rse	Length	Flow of heat
R 1	--	--	1,63 m	--
R 2	-5,00 °C	0,04	4,64 m	-31,898 W/m
R 3	-5,00 °C	0,04	0,74 m	-3,677 W/m
R 4	-5,00 °C	0,04	0,40 m	-4,454 W/m
R 5	-5,00 °C	0,04	2,54 m	-11,869 W/m
R 6	20,00 °C	0,01	0,80 m	6,353 W/m
R 7	20,00 °C	0,01	4,65 m	45,574 W/m


## Calculation of the thermal conductivity L2D temperature for 2 conditions


Conductance L2D	+0,00000 W/mK
Psi-value	+0,00000 W/mK


## Input data - material regions

		Description	Lambda	
	M1	Extruder polystyrene foam (WLG 035)	0,035 W/(mK)	
Description		Nr	X	Y
Contour		1	+3,62 m	+4,80 m
		2	-1,02 m	+4,80 m
		3	-1,02 m	+4,72 m
		4	+3,62 m	+4,72 m
Contour		1	-1,02 m	+5,73 m
		2	-1,06 m	+5,73 m
		3	-1,06 m	+4,72 m
		4	-1,02 m	+4,72 m

		Description	Lambda	
	M2	Mineral and vegetable fiber insulation products (WLG 040)	0,040 W/(mK)	
Description		Nr	X	Y
Contour		1	-1,27 m	+5,73 m
		2	-1,42 m	+5,73 m
		3	-1,42 m	+4,00 m
		4	-1,27 m	+4,00 m

		Description	Lambda	
	M3	Normal concrete (2400)	2,100 W/(mK)	
Description		Nr	X	Y
Contour		1	-1,06 m	+5,73 m
		2	-1,27 m	+5,73 m
		3	-1,27 m	+4,72 m
		4	-1,06 m	+4,72 m
Contour		1	+3,62 m	+4,72 m
		2	-1,27 m	+4,72 m
		3	-1,27 m	+4,51 m
		4	+3,62 m	+4,51 m
Contour		1	-1,10 m	+4,51 m
		2	-1,27 m	+4,51 m
		3	-1,27 m	+4,00 m
		4	-1,10 m	+4,00 m

		Description	Lambda	
	M4	DIN window with UW 1.4 [W/(mK)] = (d = 7 cm)	0,129 W/(mK)	
Description		Nr	X	Y
Contour		1	-1,01 m	+4,00 m
		2	-1,42 m	+4,00 m
		3	-1,42 m	+3,20 m
		4	-1,01 m	+3,20 m

		Description	Lambda	
	M5	Aerated concrete plan stones 450	0,160 W/(mK)	
Description		Nr	X	Y
Contour		1	+3,62 m	+4,99 m
		2	-1,02 m	+4,99 m

Description	Nr	X	Y
	3	-1,02 m	+4,80 m
	4	+3,62 m	+4,80 m

Input data - border areas

	Description	Temperature	Rsi/Rse	Length
R2	Außenwand, Dach, Wärmestrom horizontal und vertikal	-5,00 °C	0,04	4,64 m
		X	Y	
Starting point		+3,62 m	+4,99 m	
Endpoint		-1,02 m	+4,99 m	

	Description	Temperature	Rsi/Rse	Length
R3	Außenwand, Dach, Wärmestrom horizontal und vertikal	-5,00 °C	0,04	0,74 m
		X	Y	
Starting point		-1,02 m	+4,99 m	
Endpoint		-1,02 m	+5,73 m	

	Description	Temperature	Rsi/Rse	Length
R4	Außenwand, Dach, Wärmestrom horizontal und vertikal	-5,00 °C	0,04	0,40 m
		X	Y	
Starting point		-1,02 m	+5,73 m	
Endpoint		-1,42 m	+5,73 m	

	Description	Temperature	Rsi/Rse	Length
R5	Außenwand, Dach, Wärmestrom horizontal und vertikal	-5,00 °C	0,04	2,54 m
		X	Y	
Starting point		-1,42 m	+5,73 m	
Endpoint		-1,42 m	+3,20 m	

	Description	Temperature	Rsi/Rse	Length
R6	Interior free input	+20,00 °C	0,00	1,31 m
		X	Y	
Starting point		-1,01 m	+3,20 m	
Endpoint		-1,01 m	+4,51 m	

	Description	Temperature	Rsi/Rse	Length
R7	Interior free input	+20,00 °C	0,00	4,63 m
		X	Y	
Starting point		-1,01 m	+4,51 m	
Endpoint		+3,62 m	+4,51 m	



```

*****
PSI - VALUE CALCULATION
*****
NETWORK GENERATION
Combining the thermal bridge areas... ready
Generation of the element cells
  There were : 836 Element cells produced.
Topology optimization... ready
END : NETWORK GENERATION
Assembling the finite element structure... ready
  Number of elements____:1309
  Number of nodes_____:784
START : FINITE ELEMENT CALCULATION
Initialize matrices...Number of nodes 784
Assembling the stiffness matrix and load vector... ready
Solve equations:
  Begin the iteration. According to the method of conjugate gradient:
... Finished, the system of equations was solved.
  Number of iterations 89
  The temperatures in the network nodes are calculated.
END : FINITE ELEMENT CALCULATION
*****
*** CONVERGENCE TEST *****
*** To DIN10211:2008-04, A.2 *****
  Convergence - structure... ready
  Number of elements____:5236
  Number of nodes_____:2877
START : FINITE ELEMENT CALCULATION
Initialize matrices...Number of nodes 2877
Assembling the stiffness matrix and load vector... ready
Solve equations:
  Begin the iteration. According to the method of conjugate gradient:
... Finished, the system of equations was solved.
  Number of iterations 188
  The temperatures in the network nodes are calculated.
END : FINITE ELEMENT CALCULATION
Sum of absolute values of all penetrating heat flows:
  from the baseline [W/m]:52.244
  from the convergence calculation [W/m]:51.84
Convergence [%] 0.8 <= 1
=====
=== Optimise element network =====
=== Iteration 1 =====
Topology optimization... ready
Assembling the finite element structure... ready
  Number of elements____:2036
  Number of nodes_____:1149
START : FINITE ELEMENT CALCULATION
Initialize matrices...Number of nodes 1149
Assembling the stiffness matrix and load vector... ready
Solve equations:
  Begin the iteration. According to the method of conjugate gradient:
... Finished, the system of equations was solved.
  Number of iterations 147
  The temperatures in the network nodes are calculated.

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END : FINITE ELEMENT CALCULATION
=== Iteration 1 Convergence 0.167
=== CONVERGENCE - TEST after automatic mesh refinement
START : FINITE ELEMENT CALCULATION
Initialize matrices...Number of nodes 4334
Assembling the stiffness matrix and load vector... ready
Solve equations:
  Begin the iteration. According to the method of conjugate gradient:
... Finished, the system of equations was solved.
  Number of iterations 346
  The temperatures in the network nodes are calculated.
END : FINITE ELEMENT CALCULATION
Sum of absolute values of all penetrating heat flows:
  from the baseline [W/m]:51.927
  from the convergence calculation [W/m]:51.727
Convergence [%] 0.4 <= 1
=====
Calculation of heat flows
Boundary condition Type Heat flow Length Temperature Rs(i,e)
q [W/m] [m] [m2K/W]
1 Neumann 0.000 1.630 -- --
2 Robin -31.898 4.642 -5.000 0.040
3 Robin -3.677 0.744 -5.000 0.040
4 Robin -4.454 0.397 -5.000 0.040
5 Robin -11.869 2.536 -5.000 0.040
6 Robin 6.353 0.803 20.000 0.000
7 Robin 45.574 4.647 20.000 0.000
Total: 0.02957
Total heat flow (positive) Q+ = 51.92685 [W/m]
Total heat flow (from interior outwards) Q = 0.00000 [W/m]
=====
Psi-value calculation:
=====
The number of undisturbed U-values is zero. The Psi-value can not be calculated!
*****
*** END of CALCULATION ***
*****

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