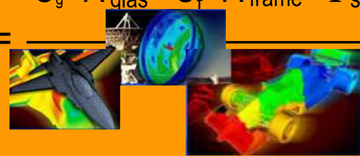
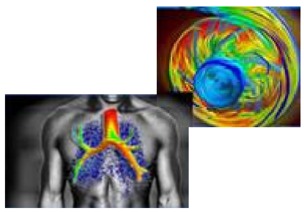
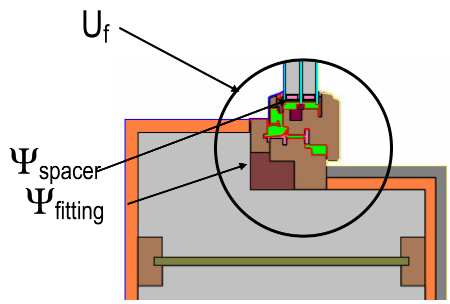
$$U_w = \frac{U_g * A_{glas} + U_f * A_{frame} + \Psi_{spacer} * L_{spacer} + \Psi_{fitting} * L_{joint\ of\ fitting}}{\ldots\text{ow}}$$

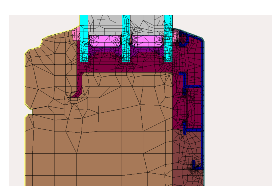




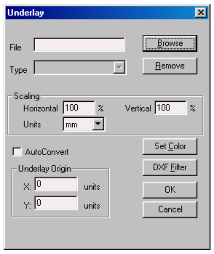


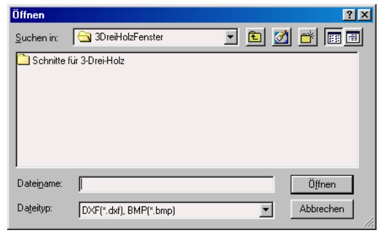
Finite Element Method

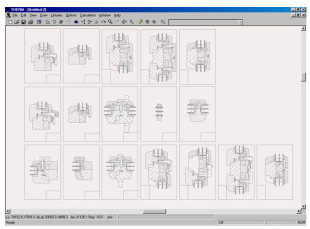
- We make a calculation model for a structural element consisting out of small elements and we know there thermal quality exact or nearly exact.
- If you lay a net over the structual element, calculate all junctions, you can conclude the thermal quality of the hole element out of the grill.

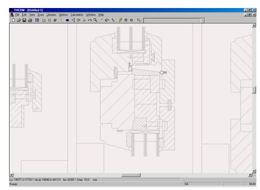


DXF File as underlay









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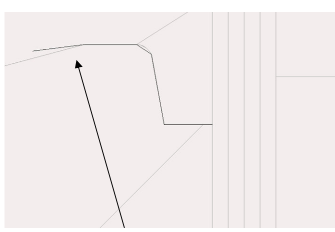
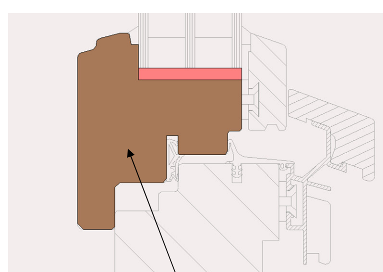
Start with drawing a contour



Redraw the contour



After the contour is finished,

define the thermal quality of the element

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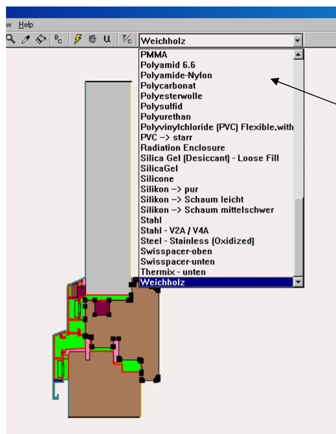
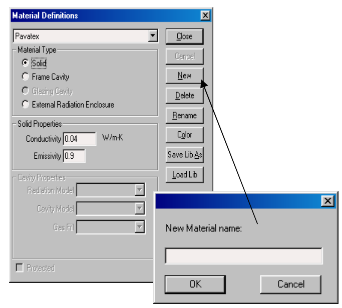
Finite element method



The thermal quality is defined

in the material library



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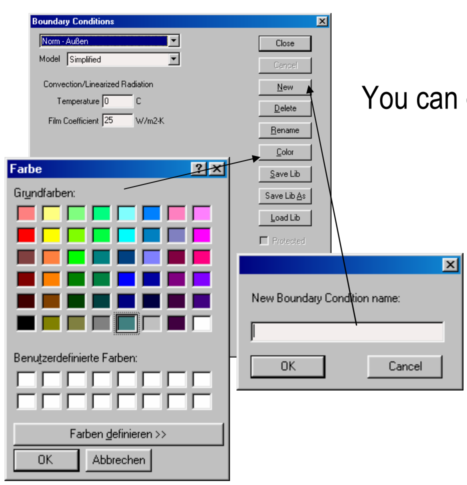
Define the boundary conditions



You can define all climate dates you need

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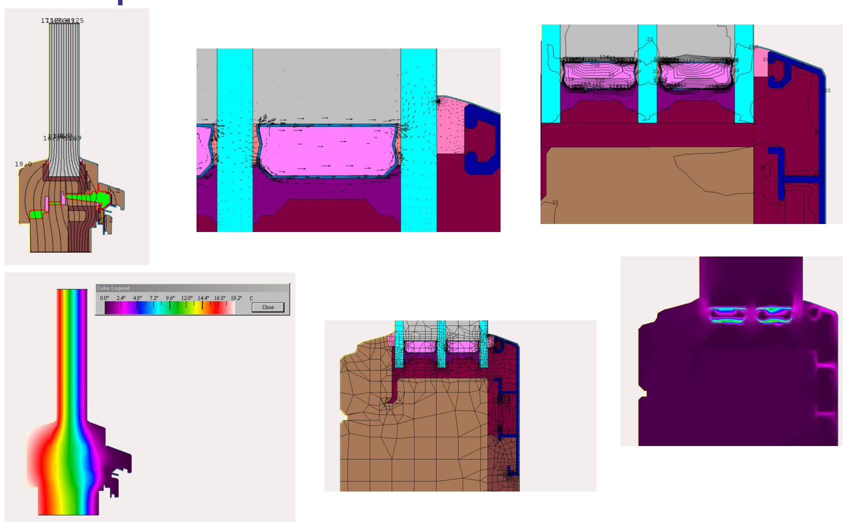
Output of the results



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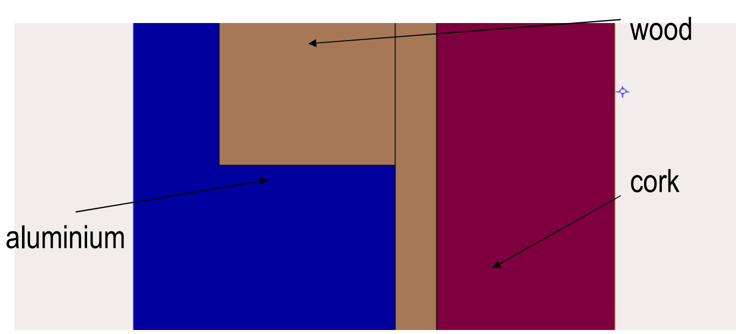
Example with different layers



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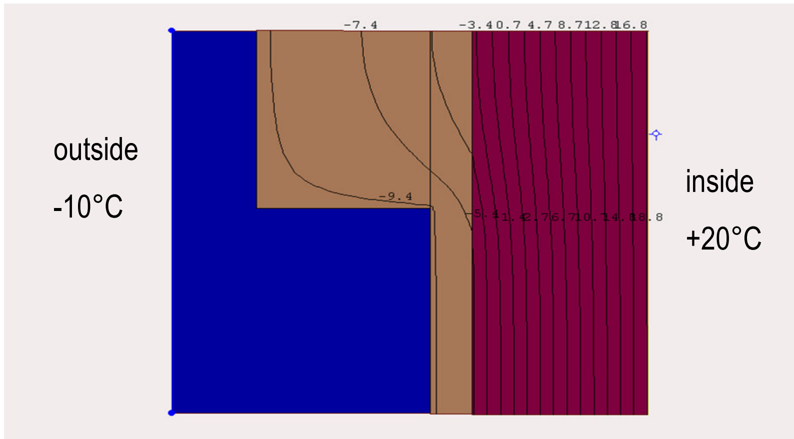
Example with different layers



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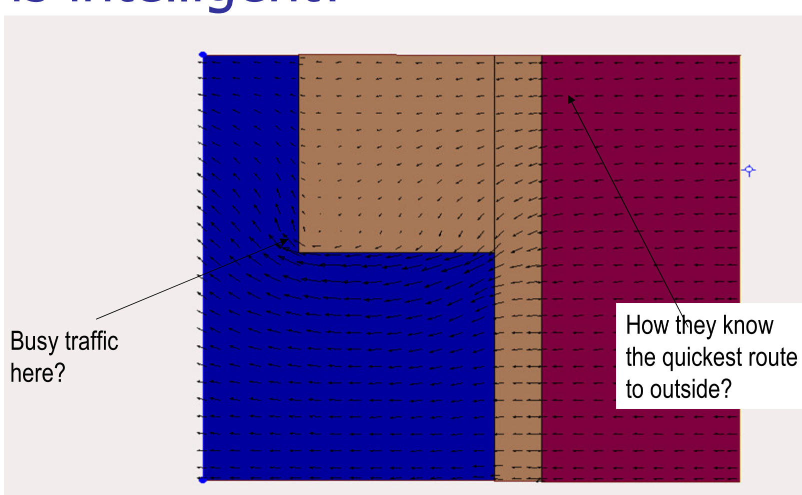
Is it possible that heat energy is intelligent?



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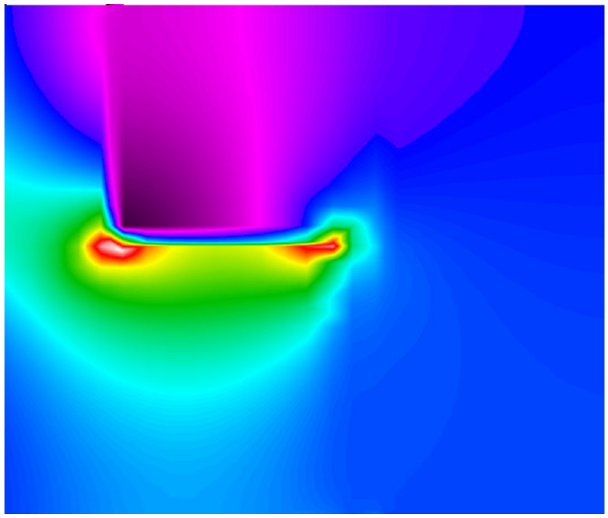
Find out the weakest places



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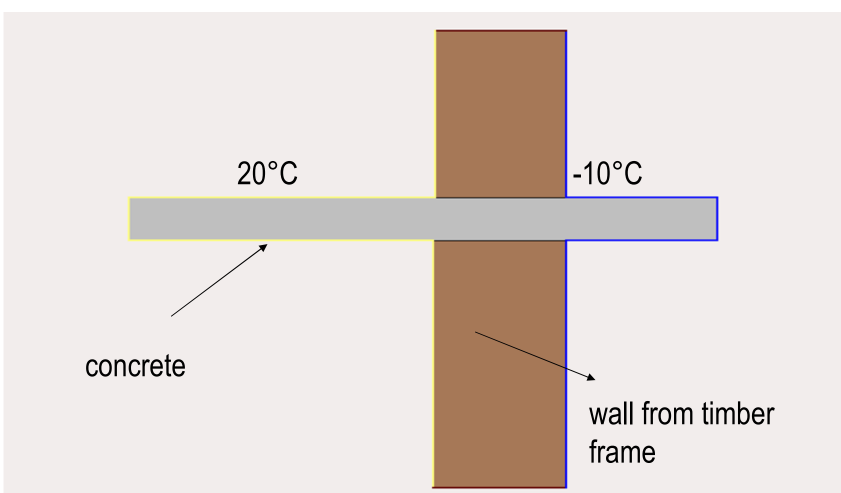
Example:thermal bridge- constructiv



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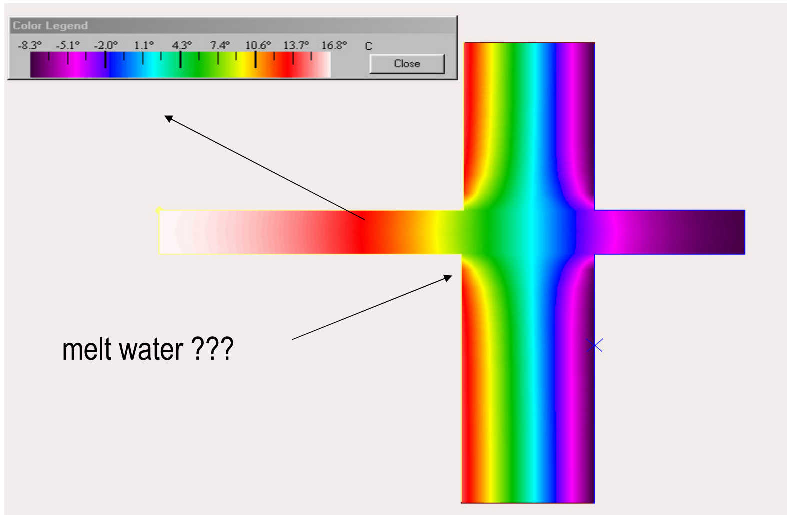
Example:thermal bridge- constructiv



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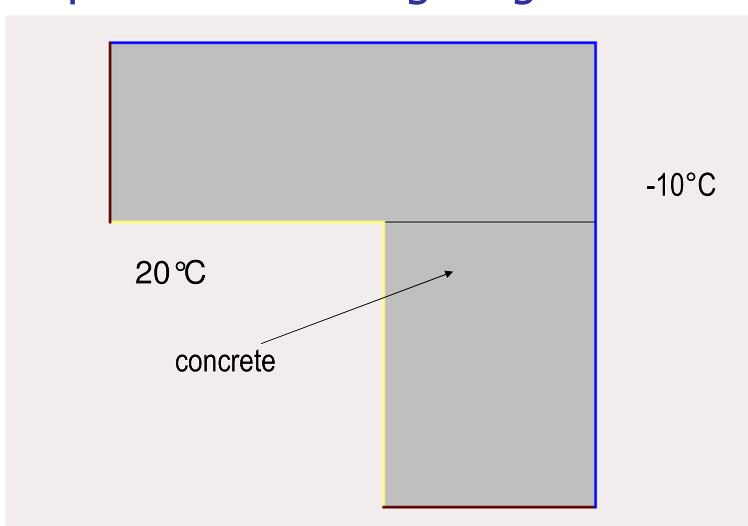
Example:thermal bridge- geometric



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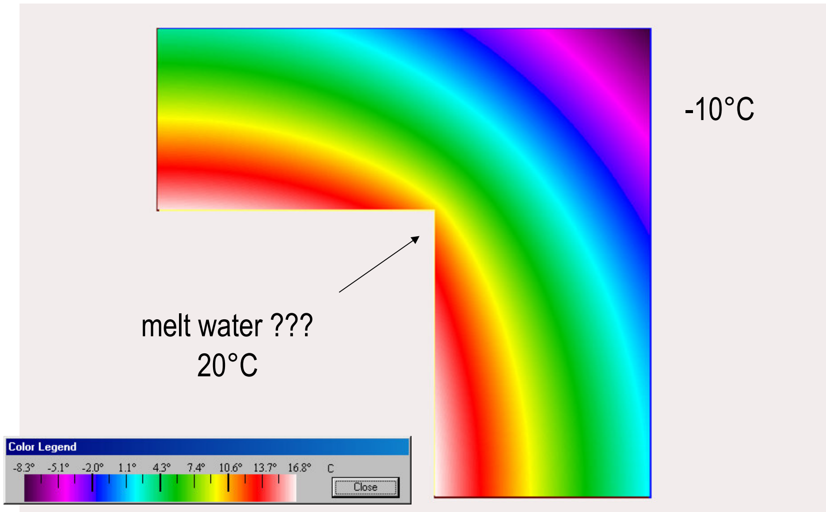
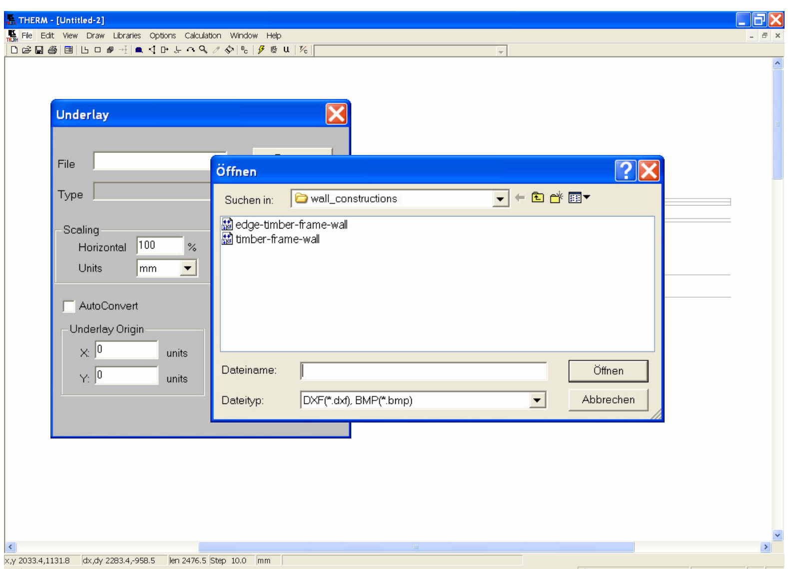
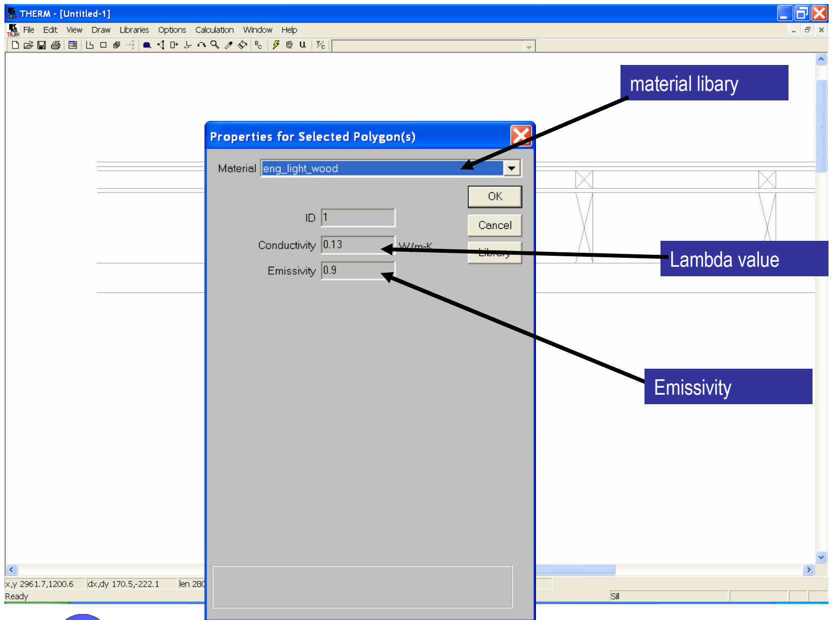
Example:thermal bridge- geometric



Now its your turn. Let´s calc a timber frame wall



Cover the construction with material



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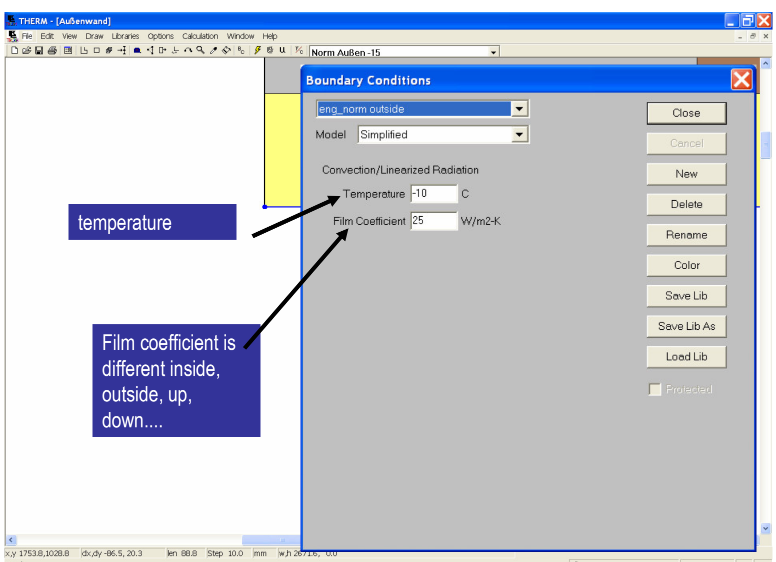
define the boundary conditions



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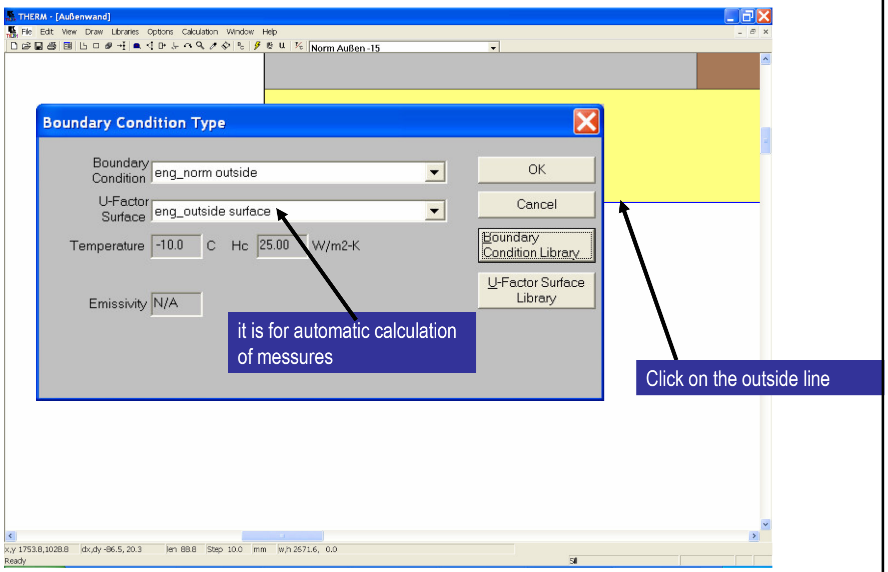
now define the U-factor surface)



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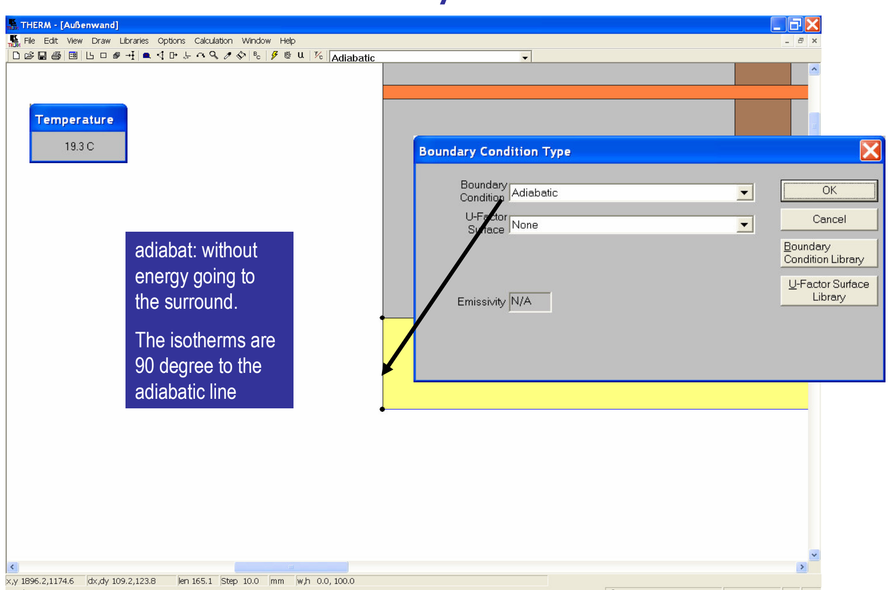
define the boundary conditions



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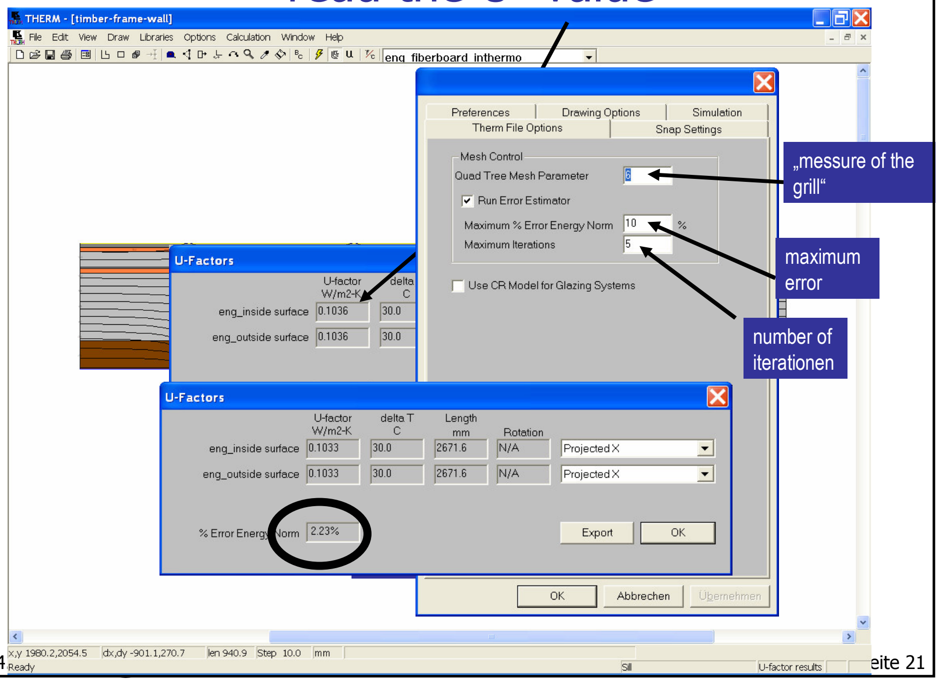
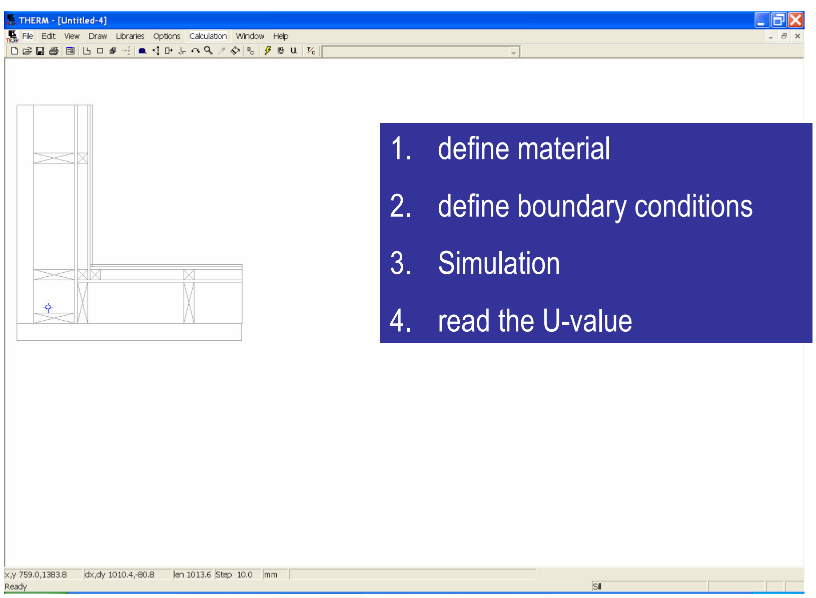
read the U- value



24 eite 21

Now we are able to calculate the Psi-value of a corner



1. define material
2. define boundary conditions
3. Simulation
4. read the U-value

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input in the exelfile linear-psi-value

Psi value		
U-Wert 1-dim	0,103	W/m2K
U-Wert 2-dim	0,084	W/m2K
length of construction	2,706	m
Q 1-dim	0,280	W/mK
Q 2-dim	0,227	W/mK
psi	-0,052	W/mK

$$\Psi = \frac{Q_{2Dim} - Q_{1Dim}}{l \times DJ}$$

simply

$Q_{1Dim} = (l_1 x h x U_1 + l_2 x h x U_2) x G_t$

$Q_{2Dim} = (l_1 x h x U_1 + l_2 x h x U_2 + h x \Psi) x G_t$

precise

l: length of the termal bridge

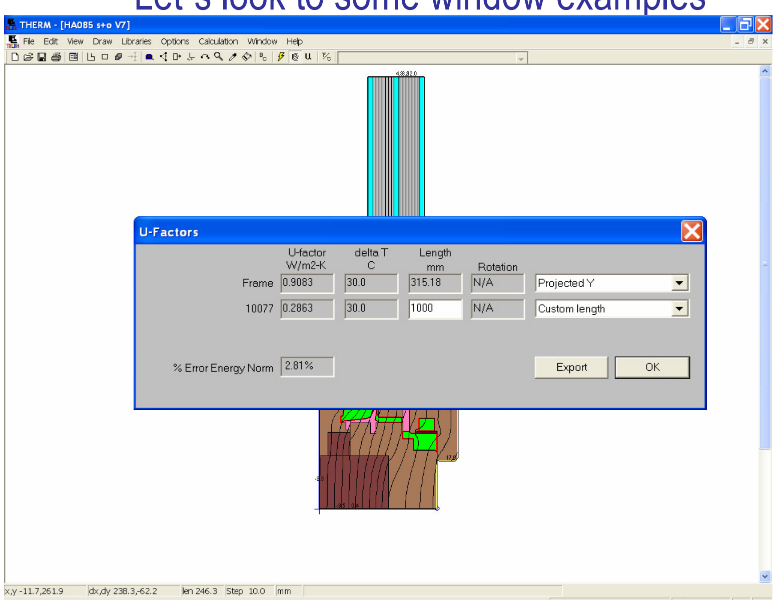
DJ: difference of temperature inside outside

Q_{2Dim}: stream of heat 2 dimensional (aus FEM)

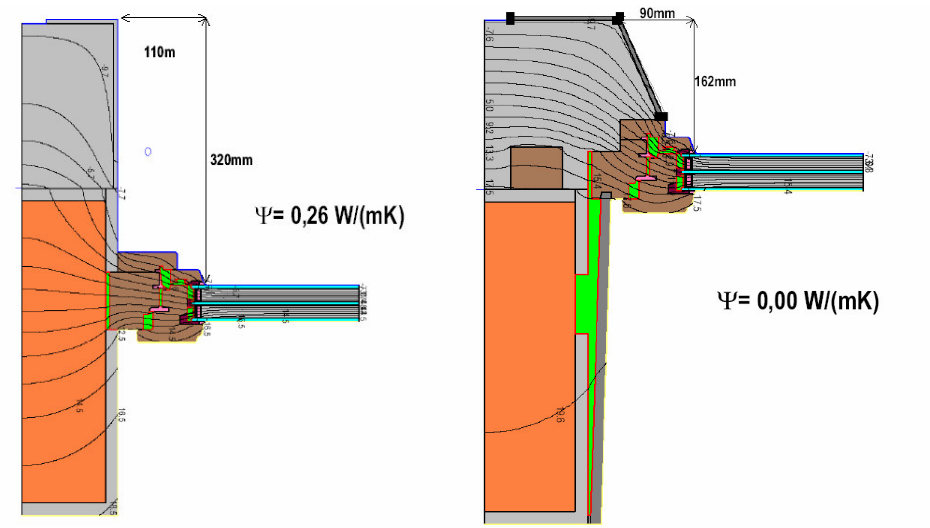
Q_{1Dim}: stream of heat 1 dimensional (at an example out of PHPP)

Ψ: psi value (linear thermal bridge)

Let´s look to some window examples



Renovation: most important for passive house windows



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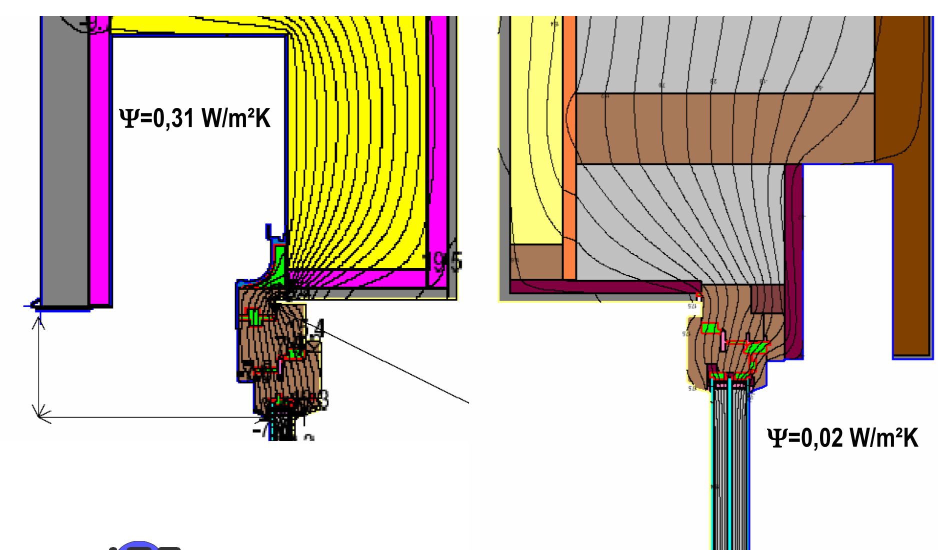
Shadowing systems



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