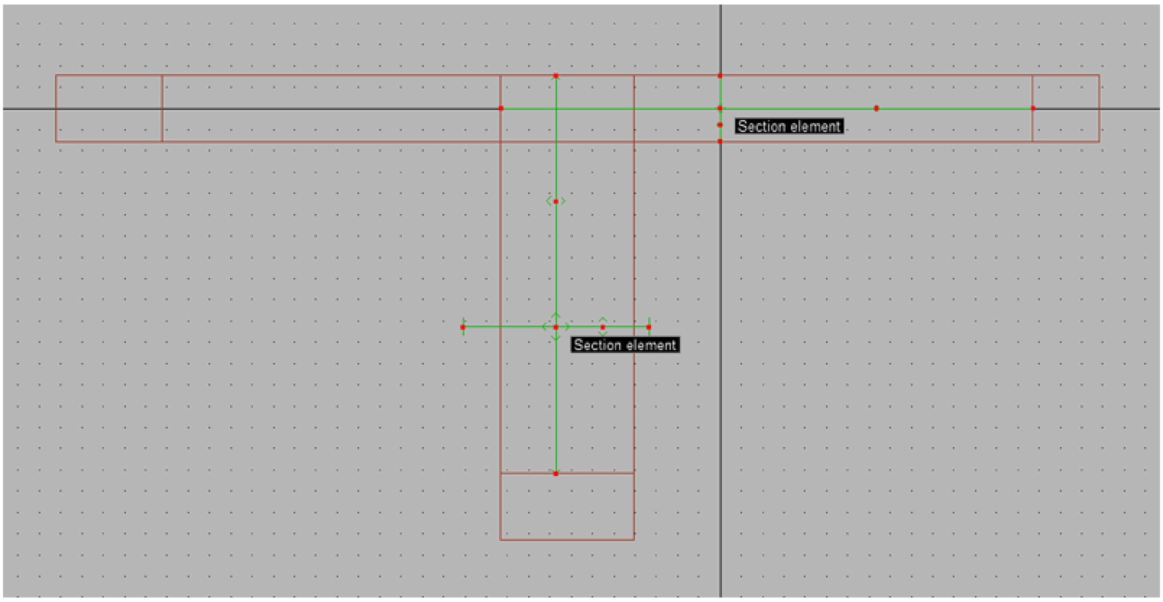
Mold Simulator - Tutorial 3

Analysis of a therms bridge with three environments

Linear thermal transmittance of a thermal bridge placed between three environments will be computed in the following paragraphs. “example9.mos” sample file will be used in order to understand fundamental aspects of this analysis.

1- Introduction
The presence of three boundary conditions makes it impossible to uniquely identify L2D and ψ values; they're depending on analysis point of view.
Coupling coefficients are instead always valid and they can be viewed clicking on “Advanced results” button on “Simulation tab”.

2- Section elements
Please open “example9.mos” file, contained in documentation's “samples” folder.



You'll notice two section elements:

- horizontal section element, representing structure's floor;
- vertical section element, representing wall dividing internal environment and stairwell.

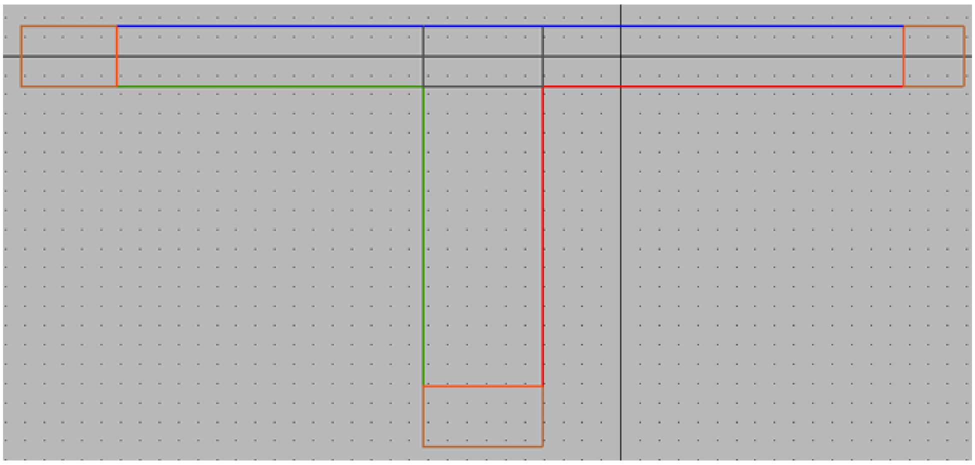
Section elements' transmittance will be automatically computed by Mold Simulator, since they're simple homogeneous layers.

3- Boundary conditions
Please note that boundary grouping is off; this will make sure that Mold Simulator won't try to group environments in case they have the same temperature.
Three boundary conditions have been used:
1- internal environment, with 20°C air temperature;
2- external environment, with 0°C air temperature;
3- stairwell, with temperature that its difference with internal environment is half of the difference between internal and external environments.
The reason why this particular conficuration has been used for condition 3 is because of ψ definition with three environments:

ψ = Lie – lie*Uie + (Lis – lis*Uis) * ((Ti – Ts) / (Ti – Te))

With:
Lie: internal/external coupling coefficient;
lie: length of section element between internal and external enviroments;
Uie: transmittance of section element between internal and external enviroments;
Lis: internal/stairwell enviroment coupling coefficient;
lis: length of section element between internal and stairwell enviroments;
Uis: transmittance of section element between internal and stairwell enviroments;
Ti: internal environment's temperature;
Ts: stairwell environment's temperature;
Te: external environment's temperature;

It can be noticed that ψ depends on factor (Ti – Ts) / (Ti – Te); configuration of condition 3 sets this factor exactly to 0.5, so it's independent on internal and external temperature.
In order to make this technique work it's necessary to tell Mold Simulator which is the "internal environment" / "external enviroment" couple: this detail can be set through "Internal/external couple" choice on "Boundary" tab.



As stated in EN 10211 norm, simulation's fundamental values are environment's coupling coefficients; they can be viewed through "Advanced results" button on "Simulation" tab. On the same window there are also heat flows between environments, that are simply coupling coefficients times temperature difference. It's also possible to define an "average" L2D, supposing that internal and external environments can be clearly identified (in our case, 1 and 2 conditions respectively):

L2D = (Fie + Fis) / ΔTie
Where:
Fie: heat flow between internal and external environments;
Fis: heat flow between internal and stairwell environments;
ΔTie: temperature difference between internal and external environments.