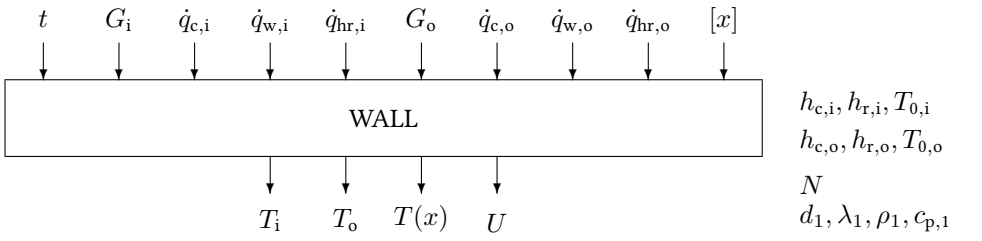
Block WALL

The WALL block solves the one-dimensional heat transfer equation for an interior wall consisting of several layers with varying thickness and heat conductivity. Shortwave irradiance, convective heat flux from the room air and longwave radiation flux from the other surfaces are given as boundary conditions.





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Inputs

1	Time / s
2	Interior solar radiation gains G_i / $\mathrm{W\,m^{-2}}$
3	Interior convective heat flux from room air $\dot{q}_\mathrm{c,i}$ / $\mathrm{W\,m^{-2}}$
4	Longwave heat flux from interior wall surfaces $\dot{q}_\mathrm{w,i}$ / $\mathrm{W\,m^{-2}}$
5	Radiative part of internal heat sources $\dot{q}_\mathrm{hr,i}$ / $\mathrm{W\,m^{-2}}$
6	Exterior solar radiation gains G_o / $\mathrm{W\,m^{-2}}$
7	Exterior convective heat flux from room air $\dot{q}_\mathrm{c,o}$ / $\mathrm{W\,m^{-2}}$
8	Longwave heat flux from exterior wall surfaces $\dot{q}_\mathrm{w,o}$ / $\mathrm{W\,m^{-2}}$
9	Radiative part of exterior heat sources $\dot{q}_\mathrm{hr,o}$ / $\mathrm{W\,m^{-2}}$
10	Distance x from inner surface / m

Outputs

1	Interior surface temperature at $t + \Delta t$
2	Exterior surface temperature at $t + \Delta t$
3	Temperature at distance x from inner surface
4	U-value / $\mathrm{W\,m^{-2}\,K^{-1}}$

Parameters

1	Interior convective heat transfer coefficient $h_{\mathrm{c,i}}$ / $\mathrm{W\,m^{-2}\,K^{-1}}$
2	Interior radiative heat transfer coefficient $h_{\mathrm{r,i}}$ / $\mathrm{W\,m^{-2}\,K^{-1}}$
3	Initial value interior air temperature $T_{0,\mathrm{i}}$ / °C
4	Exterior convective heat transfer coefficient $h_{\mathrm{c,o}}$ / $\mathrm{W\,m^{-2}\,K^{-1}}$
5	Exterior radiative heat transfer coefficient $h_{\mathrm{r,o}}$ / $\mathrm{W\,m^{-2}\,K^{-1}}$
6	Initial value exterior air temperature $T_{0,\mathrm{o}}$ / °C
7	Number of different material layers of wall $1 \leq N_{\mathrm{l}} \leq 10$
8	Thickness of material layer one / m
9	Heat conductivity of layer one / $\mathrm{W\,m^{-1}\,K^{-1}}$
10	Density of material layer one / $\mathrm{kg\,m^{-3}}$
11	Heat capacity of material layer one / $\mathrm{J\,kg^{-1}\,K^{-1}}$
12	Thickness of further material layer
13	Heat conductivity of further layer
14	Density of further material layer
15	Heat capacity of further material layer
...	etc.

Strings

None

Description

The model of the WALL block uses a finite difference scheme to solve the heat transport and temperature distribution inside the wall.

The heat flux to the two internal wall surfaces is the sum of the solar gains G, the convective heat flux from the room air on each side $\dot{q}_{\mathrm{c}}$, the long-wave radiation from the surrounding wall surfaces $\dot{q}_{\mathrm{w}}$, and the radiative part of internal heating (or cooling) gains $\dot{q}_{\mathrm{hr}}$

$$\dot{q} = G + \dot{q}_{\mathrm{c}} + \dot{q}_{\mathrm{w}} + \dot{q}_{\mathrm{hr}}$$

These heat fluxes are absorbed by the boundary layers of the wall and lead to a temperature increase of those layers. Depending on the temperature of the neighboring layers a heat flux is transferred to or from the neighboring layer by conduction. This heat flux depends only on the temperature difference between those layers and is given as

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