

Guideline for the calculation of gravel roofs

Date: April 2017

The hygrothermal material properties of a gravel layer could be adapted by recalculations of field tests and measurements which were performed on gravel roofs in Holzkirchen, Gräfelfing (both Southern Germany) and Milan (Italy). In the gravel layer there is no capillary transport – the rainwater which runs through the gravel layer has to be modelled by a moisture source. The moisture source is spread over the whole layer with the exception of the outermost element – by adding the moisture source in the outermost element numerical problems and differences in the balances can be caused.

Assembly:

- generic gravel in required thickness
(material data set: „generic gravel.xml“)

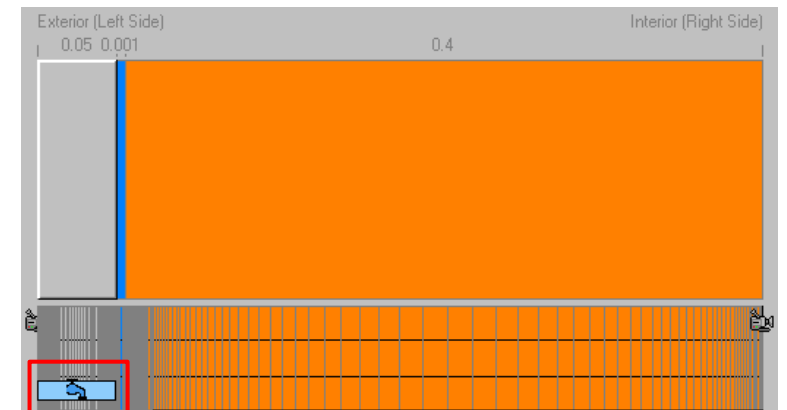
Material directly available in WUFI®

→ Source: Fraunhofer-IBP, Catalog: Green and Gravel Roofs

Moisture source:

In the whole gravel layer with the exception of the outermost element:

- spread area: several elements
example: 5 cm thick gravel layer
start depth in layer: 0.0005 m / end depth in layer: 0.05 m
- source type: fraction of driving rain
- fraction: 40 %
- clipping of the source term to free water saturation



Moisture Source

Name: Source in gravel layer

Spread Area:

- One Element
- Several Elements
- Whole Layer

Start Depth in Layer [m]: 0.0005

End Depth in Layer [m]: 0.05

Source Type:

- Transient from File
- Fraction of Driving Rain
- Air Infiltration model IBP
- Constant Monthly Moisture Load

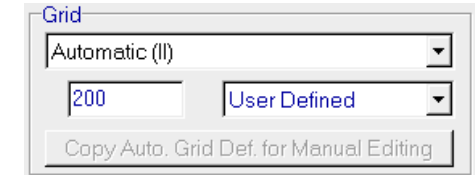
Source Term Clipping [kg/m³]:

- No Clipping
- Clipping to max. Water Content
- Clipping to Free Water Saturation
- User Defined

Fraction [%]: 40

Suggested grid:

Automatic (II) with 200 elements



Grid

Automatic (II)

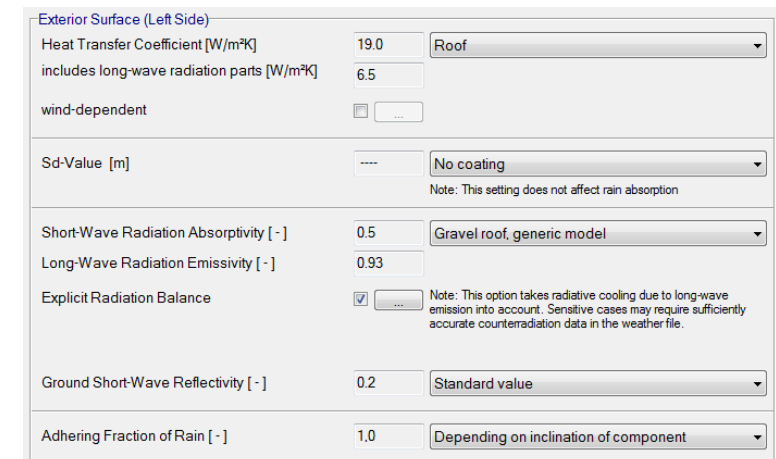
200

User Defined

Copy Auto. Grid Def. for Manual Editing

Surface transfer parameters on the exterior surface:

- heat transfer coefficient: 19 W/m²K
resp. heat resistance: 0.0526 m²K/W
(depending on the settings in WUFI®)
- short-wave radiation absorptivity:
Gravel roof, generic model
($a = 0.5$, for medium grey gravel)
- long-wave radiation emissivity:
Gravel roof, generic model ($\varepsilon = 0.93$)
- explicit radiation balance: used



Exterior Surface (Left Side)

Heat Transfer Coefficient [W/m²K] 19.0 Roof

includes long-wave radiation parts [W/m²K] 6.5

wind-dependent ...

Sd-Value [m] --- No coating
Note: This setting does not affect rain absorption

Short-Wave Radiation Absorptivity [-] 0.5 Gravel roof, generic model

Long-Wave Radiation Emissivity [-] 0.93

Explicit Radiation Balance ...
Note: This option takes radiative cooling due to long-wave emission into account. Sensitive cases may require sufficiently accurate counter-radiation data in the weather file.

Ground Short-Wave Reflectivity [-] 0.2 Standard value

Adhering Fraction of Rain [-] 1.0 Depending on inclination of component

Exterior climate data set:

Necessary climate data for the calculation:

- temperature
- relative humidity
- global radiation (resp. diffuse and direct radiation for pitched roofs)
- atmospheric counter radiation
- precipitation