

Outputs in DELPHIN 6.1

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1. Overview

The aim of a DELPHIN simulation is to achieve results that can be evaluated in accordance with the problem definition. For this purpose, DELPHIN produces outputs. These are always output files that contain time-dependent values. Two main types can be distinguished:

- **Value outputs** - one value per time point
- **Field outputs** - several values per time point

Value outputs are generated by assigning the output to only one element or by summarising in the case of several elements (mean value, sum, maximum, minimum).

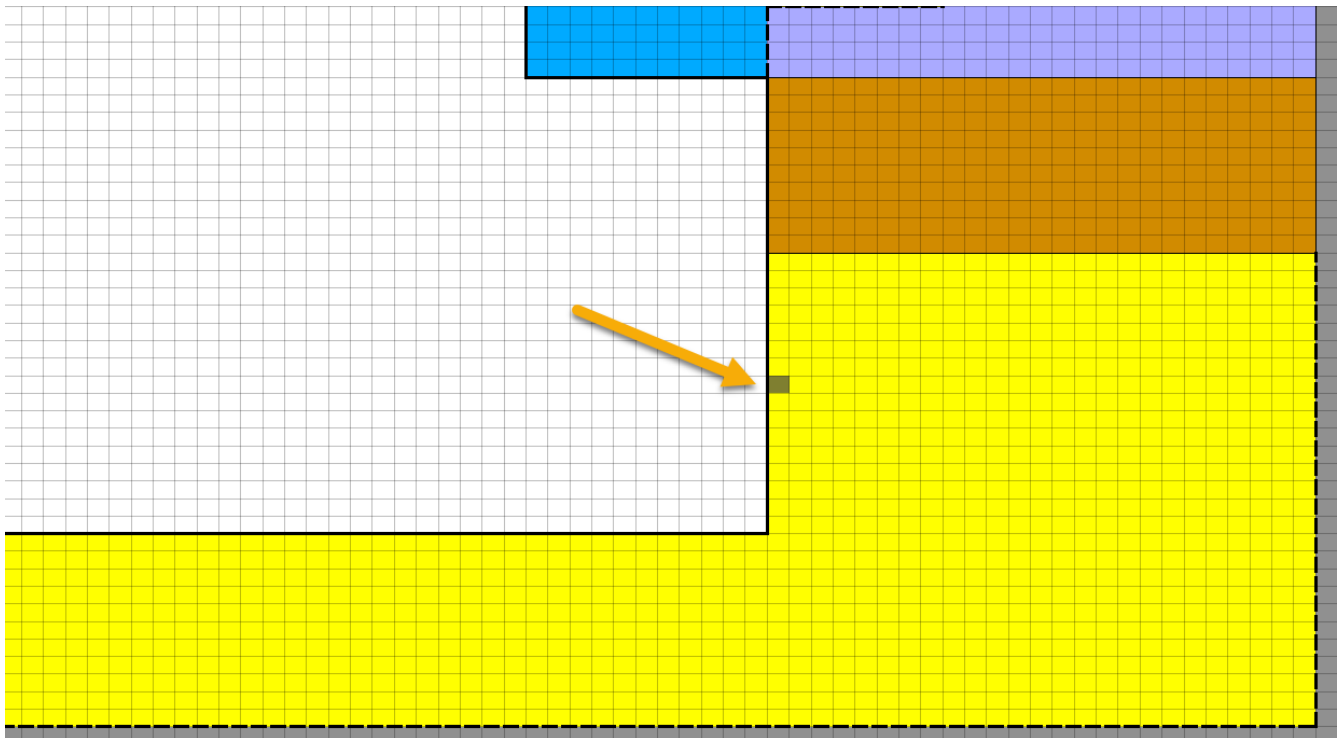


Image 1. Selection of an element in a 2D construction

With **field outputs**, in addition to time and value, there are one to three coordinate axes for assigning the values to the construction. Several elements must always be selected.

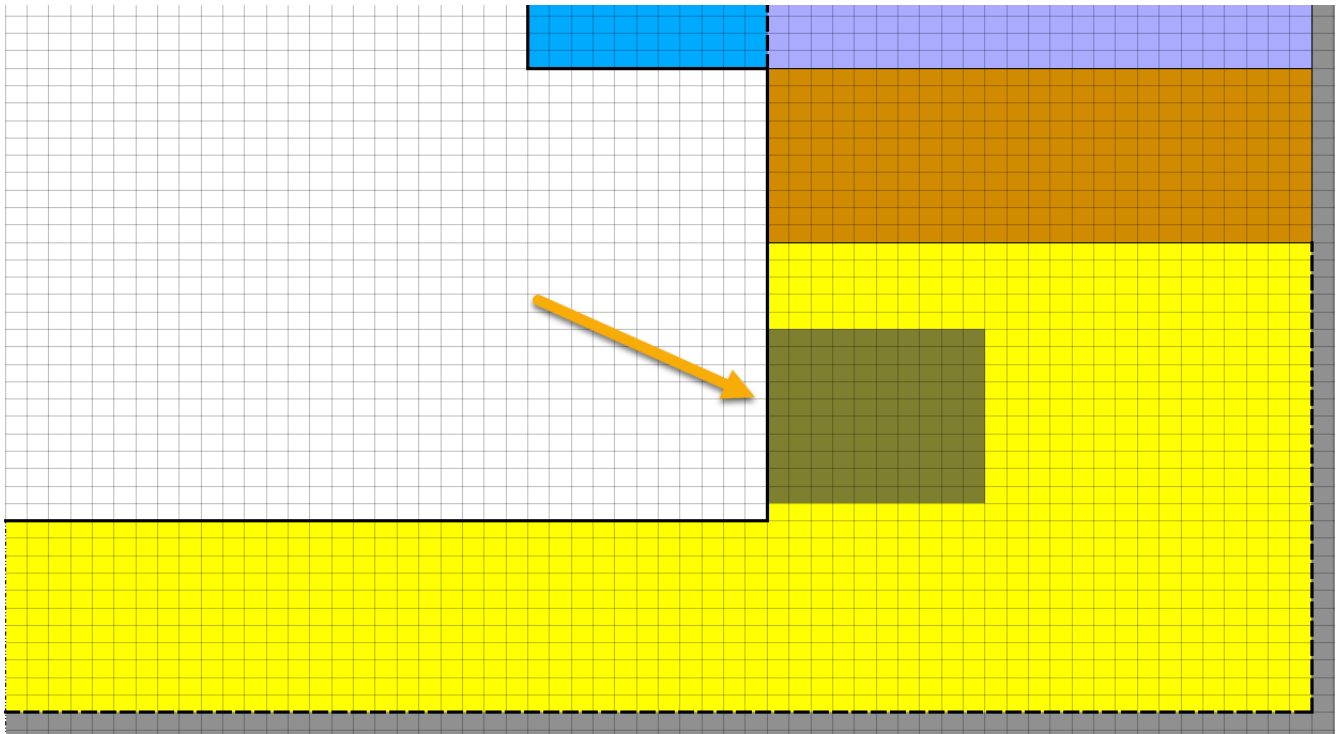


Image 2. Selection of several elements (area) in a 2D construction

In the post-processing (PostProc 2) of DELPHIN, the following terminology is used here:

- 2D - value and time
- 3D - value, time and one coordinate
- 4D - value, time and two coordinates (from 2D simulations)
- 5D - value, time and three coordinates (3D simulations only)

3D outputs are sometimes called **profiles** because they can represent time-dependent profiles of quantities. By variables we mean the physical parameters that can be output in DELPHIN. We distinguish 3 main categories here:

- Element outputs
 - State variables
 - Derived quantities
 - Material parameters
 - Mean fluxes
- Fluxes
 - Boundary fluxes
 - Field fluxes
- Outputs from sources/sinks

State variables are the physical quantities that are balanced and thus represent the state of the system.

- Heat transport - internal energy
- Moisture transport - moisture mass density
- Air transport - air mass density

Various other variables can be derived from these state variables, such as the temperature from the internal energy. All these variables are always related to the corresponding volume elements. In this case, one also speaks of the representative elementary volume (REV). All outputs are assigned to certain transport processes, state variables or source models. They are only present if these processes are also present in the current project. The tables in the section [Possible output quantities](#) show all outputs sorted by type and associated process.

2. Formatting

The formatting of output data in DELPHIN is divided in two subsections:

- Data description
- Schedule

Here, each data description is linked to a schedule and thus forms an output data record.

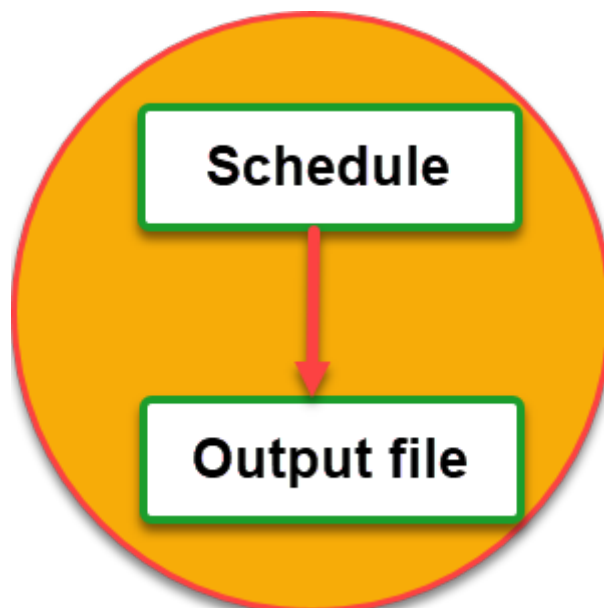


Image 3. Output as a combination of data description and schedule

2.1. Data description (formatting)

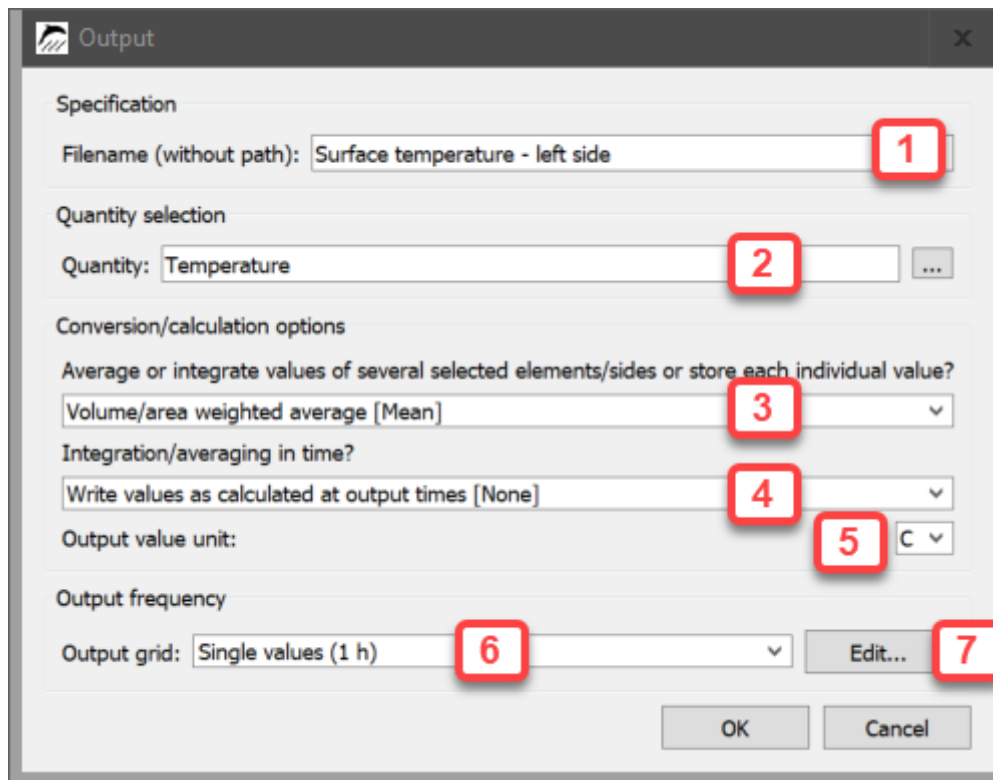


Image 4. Dialogue for setting the data description of an output

The data description contains the following information:

- File name (1)
- Physical quantity (2)
- Calculation in space (3)
- Calculation in time (4)
- Output unit (5)
- Schedule used (6,7)

The **file name** (1) can in principle be freely defined. However, the specifications of the operating system should be adhered to. In order to avoid problems when distributing or editing data files, special characters should not be used in the name. Spaces, minus or underscores should be used to separate individual words. The name should reflect the output quantity, position and formatting. This facilitates the selection for later use in post-processing.

Clicking on the button to the right of the input field for the **physical quantity** (2) opens a selection dialogue.

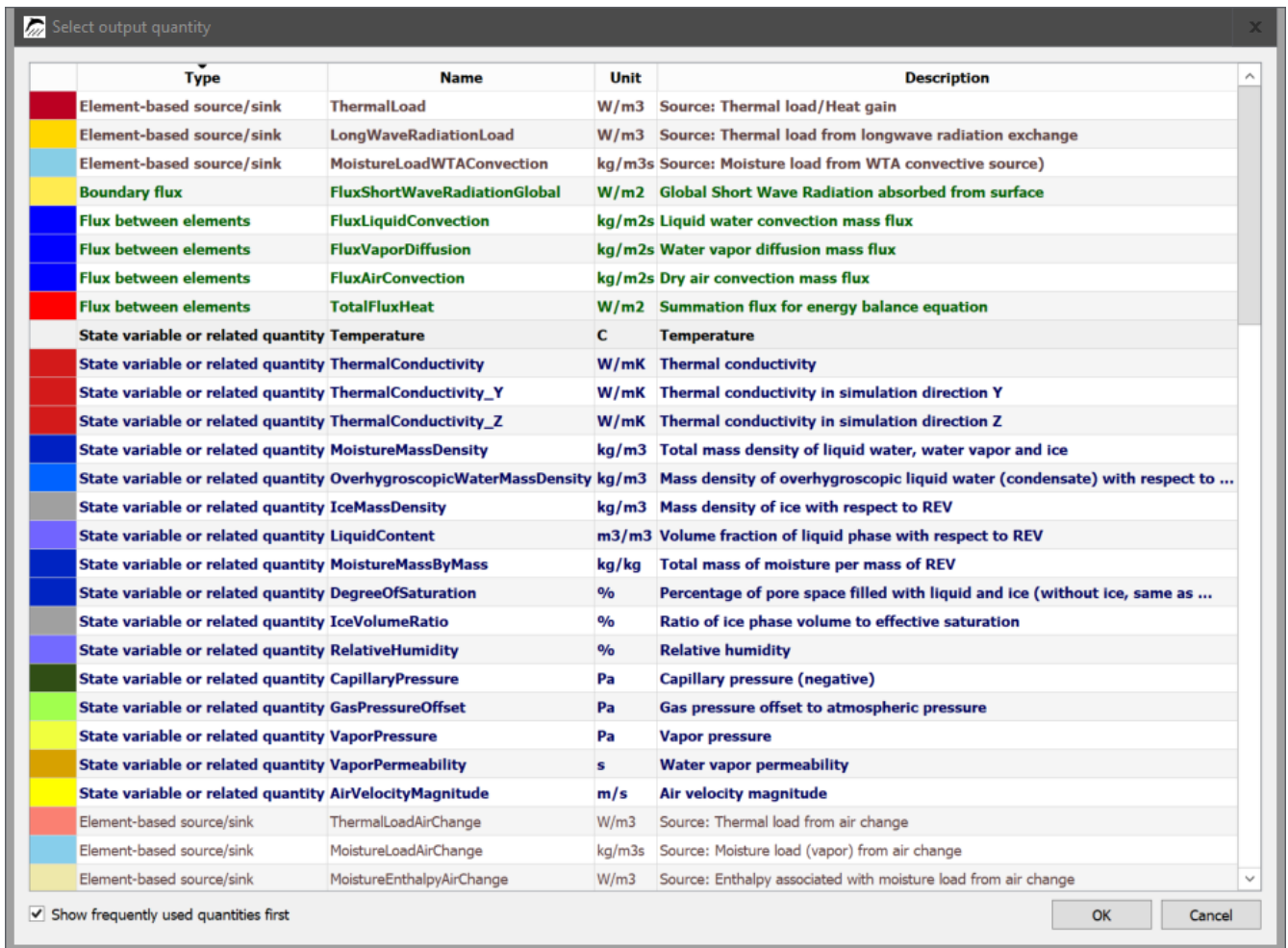


Image 5. Selection dialogue for the physical quantity

The dialogue lists all possible physical quantities, regardless of whether they are available in the concrete calculation. The type is shown in the first column. The classification is as shown in the [overview](#). The second column contains the name of the quantity. This is a keyword in DELPHIN. An explanation of the quantity can be found in the last column and in the chapter 'Possible output quantities'. To facilitate the selection, DELPHIN remembers the last selected quantities and displays them in **bold font** at the top of the list if necessary. This behaviour can be set by using the checkbox at the bottom left of the dialogue.

In the section '*Conversion and calculation options*' there are two selection boxes. The first (3) determines how the output value is calculated when assigned to several elements. The following options are available here:

1. Individual values of each selected element or side - Single
2. Volume/area weighted average - Mean
3. Volume/area weighted integral - Integral
4. Minimum value in range - Min
5. Maximum value in range - Max

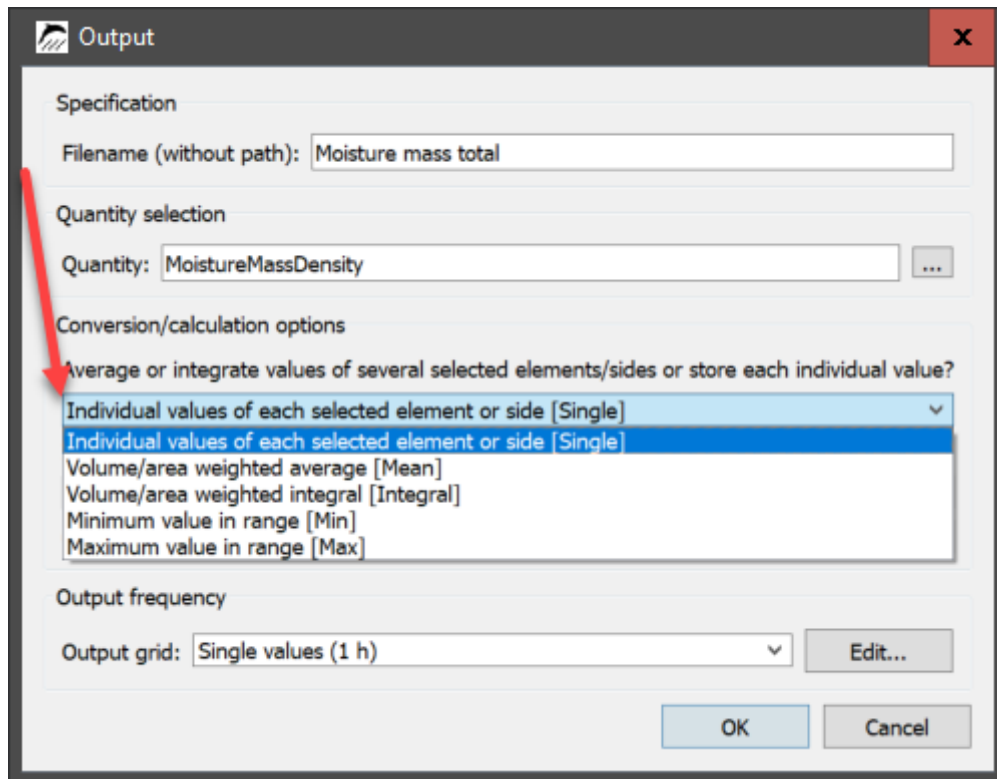


Image 6. Selection of calculation options for the space

With the first option (Single), there is always a [field output](#) when assigned to several elements. This means that the values of all assigned elements are output at any time. This allows the output of spatial distributions or profiles. The type of possible charts in postprocessing depends on the number of elements selected and the type of simulation (1D or 2D). If only one element is selected, a value output will also be generated as with options 2 to 5. It is recommended to always select option 2 (mean value) for single value outputs.

If several elements have been selected, the following representations can be selected in postprocessing:

1D - Simulation

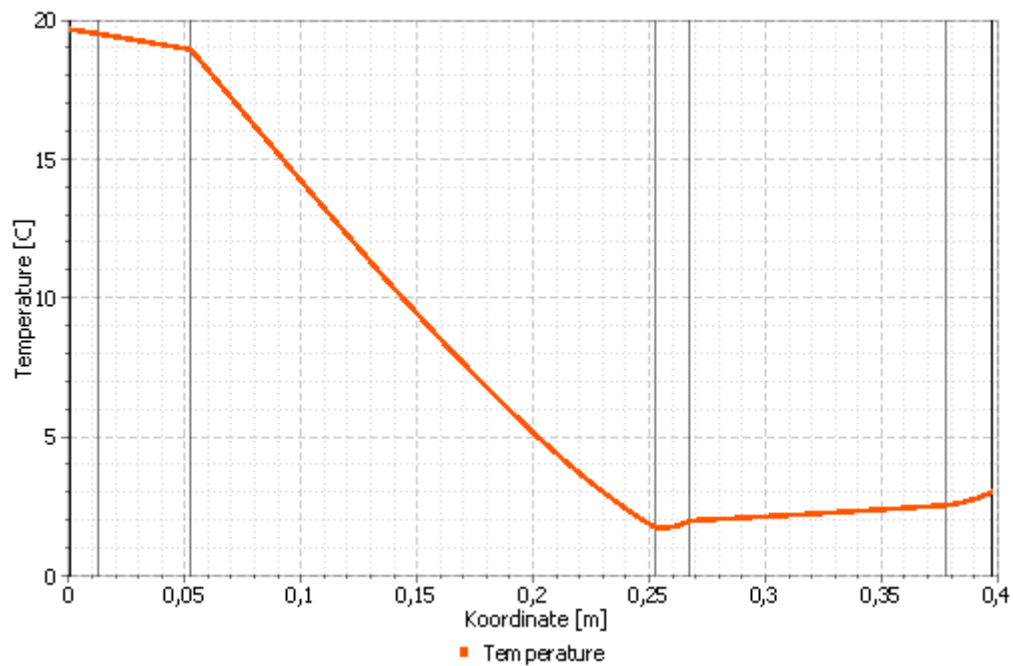


Image 7. Profile chart

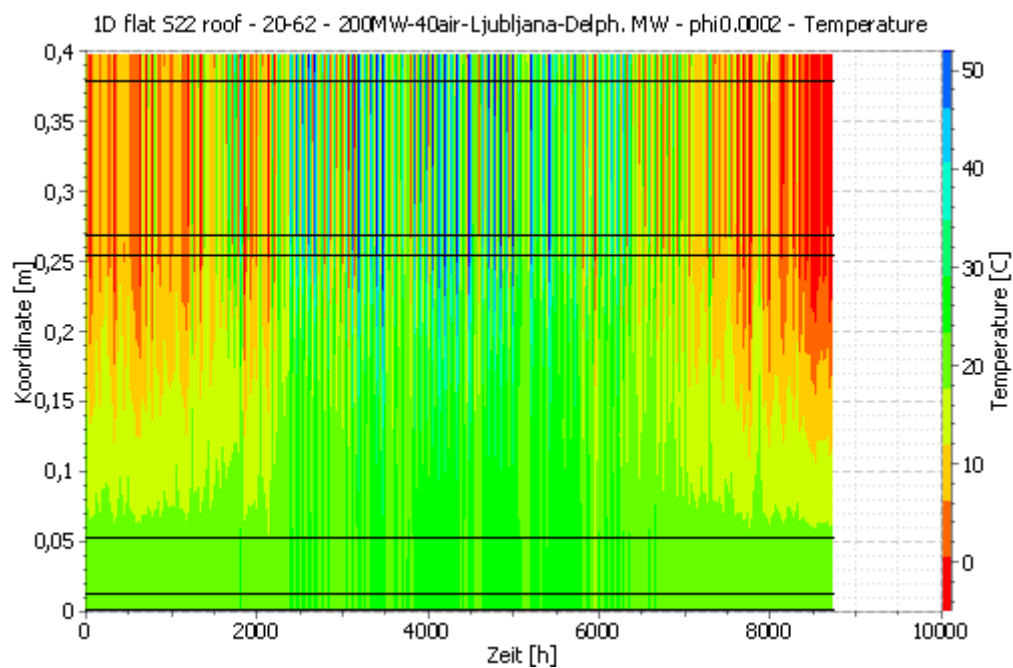


Image 8. Color map chart with time on the x-axis

The two charts above represent the same data in two different ways.

2D simulation

In 2D simulations, the data can be represented directly only as a colour gradient at a point in time.

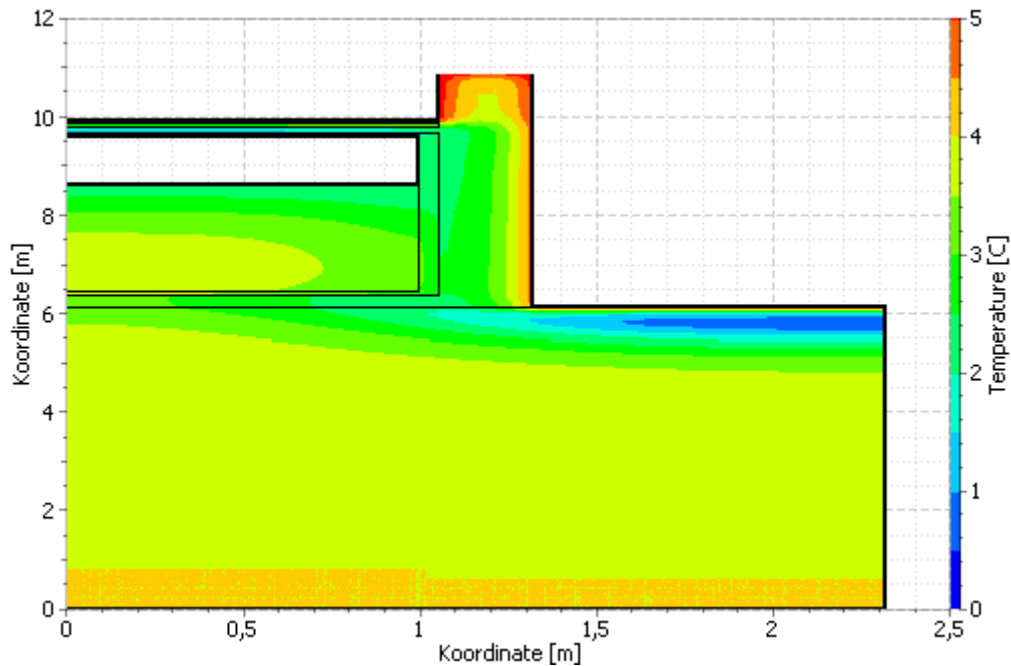


Image 9. Distribution of the value at a certain time point as a color map plot

Post-processing allows even more sectional representations. More information is available in the help:

<https://www.bauklimatik-dresden.de/postproc/help/de/index.html>

Options 2 to 5 always produce value outputs with one value per time point. These can be displayed as line diagrams (see figure below) and are well suited to show changes over time.

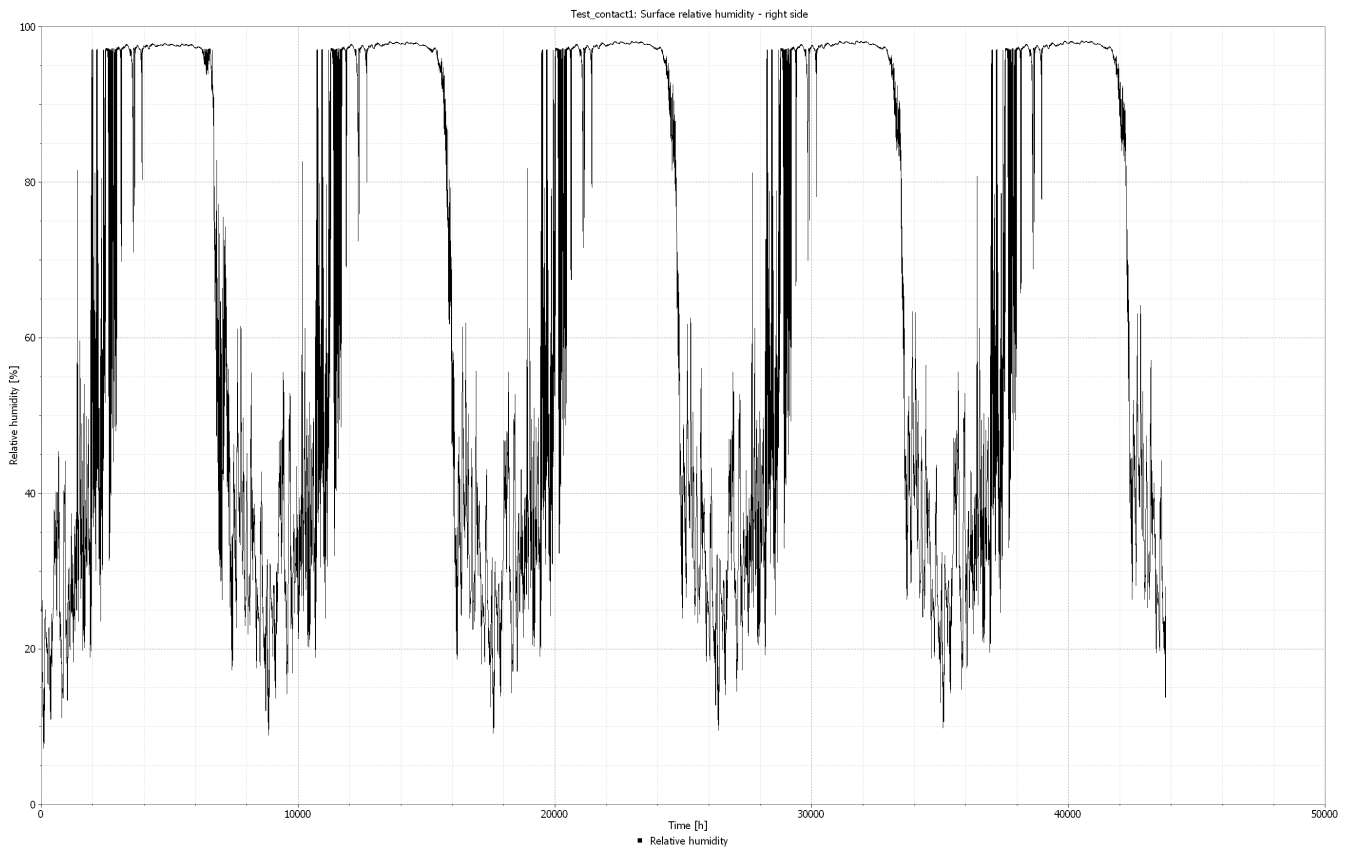


Image 10. Example of a line chart

Such outputs are also needed for the damage models contained in the post-processing.

Option 3 is a special case here, because here the sum of the physical quantity is formed over all selected elements. Of course, this is only possible for summable quantities, such as masses. For non-summable quantities, such as temperature, this option is not offered. The unit of the output variable is then also adapted. E.g. the unit of the water mass density would be kg/m^3 . If a spatial integral is selected here, it becomes the water mass in the unit kg for the assigned area.

Options 4 and 5 provide the minimum and maximum values of the assigned area. This can be particularly interesting for damage modelling for worst-case analyses.

The second selection box (4) determines the calculation options for the time course. The following variants can be selected:

1. Write values as calculated at output times - None
2. Averaging values in time - Mean
3. Integrating values in time - Integral
4. Minimum value within simulation interval - Min
5. Maximum value within simulation interval - Max

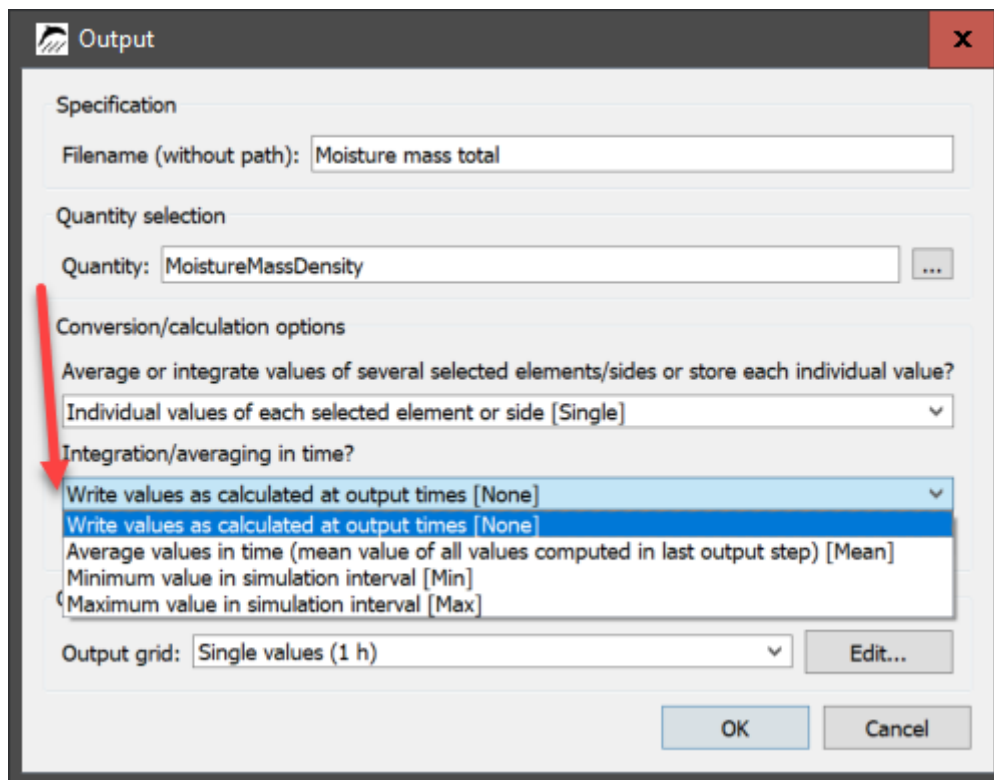


Image 11. Selection of calculation options for time

When creating new outputs, variant 1 is always used by default.

With variant 2, an average value is formed over the time steps set in the schedule. The values for the internal time steps of the solver are used for this. Variants 4 and 5 are calculated similarly. Here, the respective minimum or maximum value is output over the time step. With small output step widths ($\leq 1h$), there is usually hardly any difference to the normal output.

Time integration is only available for flow outputs. Here, the values are also added up to the internal solver time steps and divided by the time step length. The unit is adjusted in the process. E.g. for an output of the heat flux density, W/m^2 changes to J/m^2 .

The one-page setting (5) only affects the unit of the physical quantity. The time unit is set in DELPHIN in the model options.

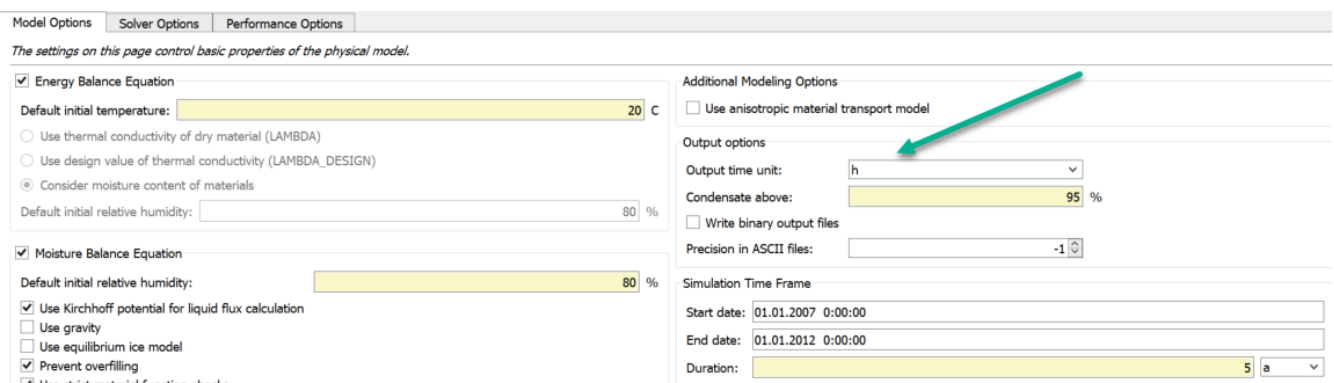


Image 12. Setting the time unit for the outputs

A time schedule (output grid) must be assigned to each data description. Selection field 6 allows a choice of an existing schedule or the creation of a new one. To create, select '*Select or create new...*' from the list.

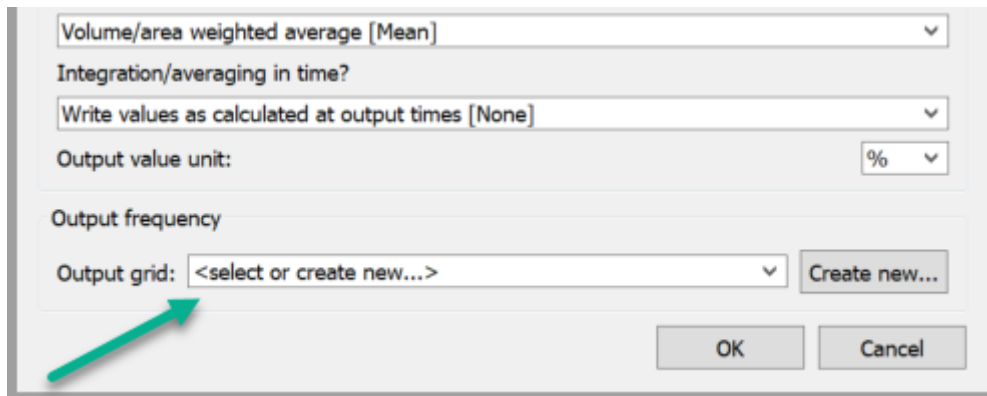


Image 13. Create a new output schedule

Then the label of the button to the right of the selection field changes to '*Create New...*'. Clicking on the button '*Edit*' or '*Create new...*' opens the dialogue for editing the schedule.

2.2. Schedules / Output grids

Any number of output grids can be created. However, only two are recommended for most simulations.

- a coarse grid for field outputs (several outputs per time) - e.g. 1.5 d
- a fine grid for value outputs (one value per time) - e.g. 1 h

For the coarse grid, always take a time step that contains a 12h value (0.5d, 1.5d, 2.5d) in order to avoid that the output always came at 00:00. The 12h section then always alternates the output at midnight and noon. The output grid shown above is also used in the project wizard for the [standard outputs](#).

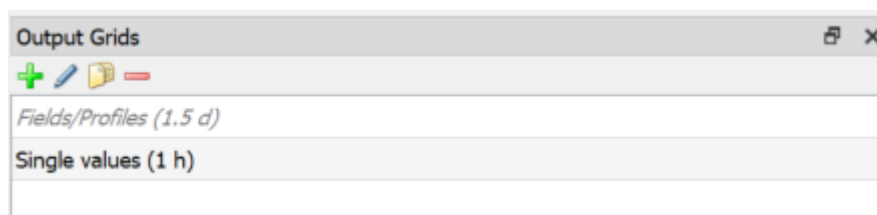


Image 14. List of output grids in a project

The above image shows the list of output grids available in a project. Click on the green plus sign to create a new grid. Then the dialogue shown in the following picture opens.

Edit output grid

Specification

Name: 1

Number of intervals: 2

Output time intervals and their associated output step sizes

Definition of intervals

Format: Enter time offsets or intervals as "<value> <unit>" strings.
 Note: A duration of 0 in the last interval will let this interval run forever.

Interval #1	
Start time	0 d
Duration	0 a
End time	
Step size	1 h

3

Interval #1	
Start time	0 d
Duration	infinite
End time	---
Step size	1 h

4

Image 15. Dialogue for editing an output schedule

The dialogue shown above allows the setting of an output schedule. This can consist of several intervals. Each interval is identified by the start, the duration and the time grid.

The name is defined in input line 1. This can be any name, but should reflect the time grid to make the selection easier. The output grid shown above has the name '1h' because it has hourly time steps.

In field 2 you specify the number of intervals present. One-interval grids are usually used.

Then there are two list elements in the dialogue. The first (green frame - 3) is for entering the interval parameters. In the lower area (blue frame - 4) the intervals are only displayed.

In the input area one can set the following parameters (always number - space - unit):

- Start time - start of the interval
- Simulation duration or end time
 - only one of the two values must be entered
 - If 0 (any unit) is entered for the simulation duration, there is no end time point. The

interval always goes to the end of the simulation.

- Step size

The output grid shown in the picture above has the following properties:

- an interval
- starts at the beginning of the simulation
- goes to the end of the simulation
- outputs are made every hour

Output grids with multiple intervals are useful for very long simulations to reduce the amount of output data. The following figure shows an example:

The screenshot shows a dialog box titled "Edit output grid" with a close button (X) in the top right corner. The dialog is divided into several sections:

- Specification:**
 - Name:** Multi schedule
 - Number of intervals:** 3
- Output time intervals and their associated output step sizes**
- Definition of intervals:**
 - Format: Enter time offsets or intervals as "<value> <unit>" strings.
 - Note: A duration of 0 in the last interval will let this interval run forever.
- Interval Definition Table:**

	Interval #1	Interval #2	Interval #3
Start time	0 d		
Duration	1 a	10 a	1 a
End time			
Step size	1 h	25 d	1 h

- Computed intervals (computed time offsets are converted to the unit of the start time offset)**
- Computed Interval Table:**

	Interval #1	Interval #2	Interval #3
Start time	0 d	365 d	4015 d
Duration	1 a	10 a	1 a
End time	365 d	4015 d	4380 d
Step size	1 h	25 d	1 h

At the bottom right of the dialog are "OK" and "Cancel" buttons.

Image 16. Output grid with multiple intervals

This output grid is intended for simulations with more than 12 years. In the first year there is a finer output (every hour). In the next 10 years, outputs are only written every 25 days. At the end it goes back to hourly values. From interval 2 onwards, no more starting points are set to ensure that the entire simulation period is covered. You should always enter 0 as the duration

in the last interval to avoid missing outputs at the end. The calculated start and end times are then shown in the lower list field for checking.

3. Create and assign

In versions up to 6.1.2, help for creating outputs is only available in the wizard for a new project. Otherwise, outputs can be created individually in the project.

3.1. Creation with the project wizard

When a new project is created in DELPHIN, the project assistant opens first. It guides the user to the new project in several steps. Step 5 allows the selection of predefined outputs. The display is different for 1D and 2D simulations. The following section deals with a 1D simulation.

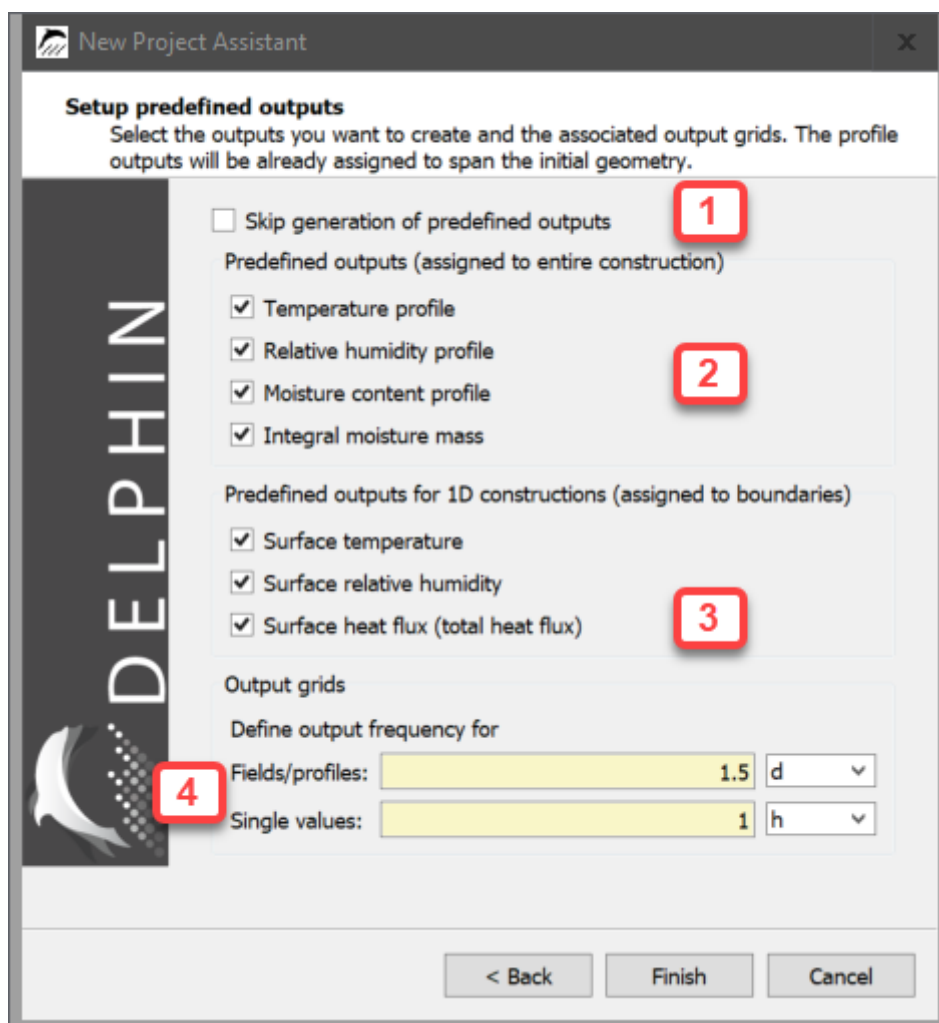


Image 17. Section for outputs in the project wizard for a 1D construction

Setting 1 allows to skip the creation of predefined outputs.

Section 2 creates outputs that affect the entire structure. There are 3 profiles (or fields) for

temperature, relative humidity and moisture content as well as an integral moisture content (total moisture content). The integral moisture content represents the sum of the moisture contents of all elements of the construction (water, vapor, ice). These 4 outputs should exist in every DELPHIN simulation. Especially the integral moisture content is important to represent the long-term behaviour of the construction. Does the moisture increase more and more or does the moisture content level off at a certain level after a few years?

Area 3 allows the creation of outputs for the surfaces (inside and outside). The temperature and relative humidity on the surface and the heat flux density over the boundaries are offered here. Especially important here is usually temperature and relative humidity at the inner surface. These data can be used e.g. for dynamic mould models to prove the minimum thermal insulation. The transmission heat loss can be derived from the heat flux density (preferably also inside). After confirming this dialogue, one continues with the project wizard. After completion, the new project is displayed in DELPHIN. The output data are usually shown in the upper right corner of the window.

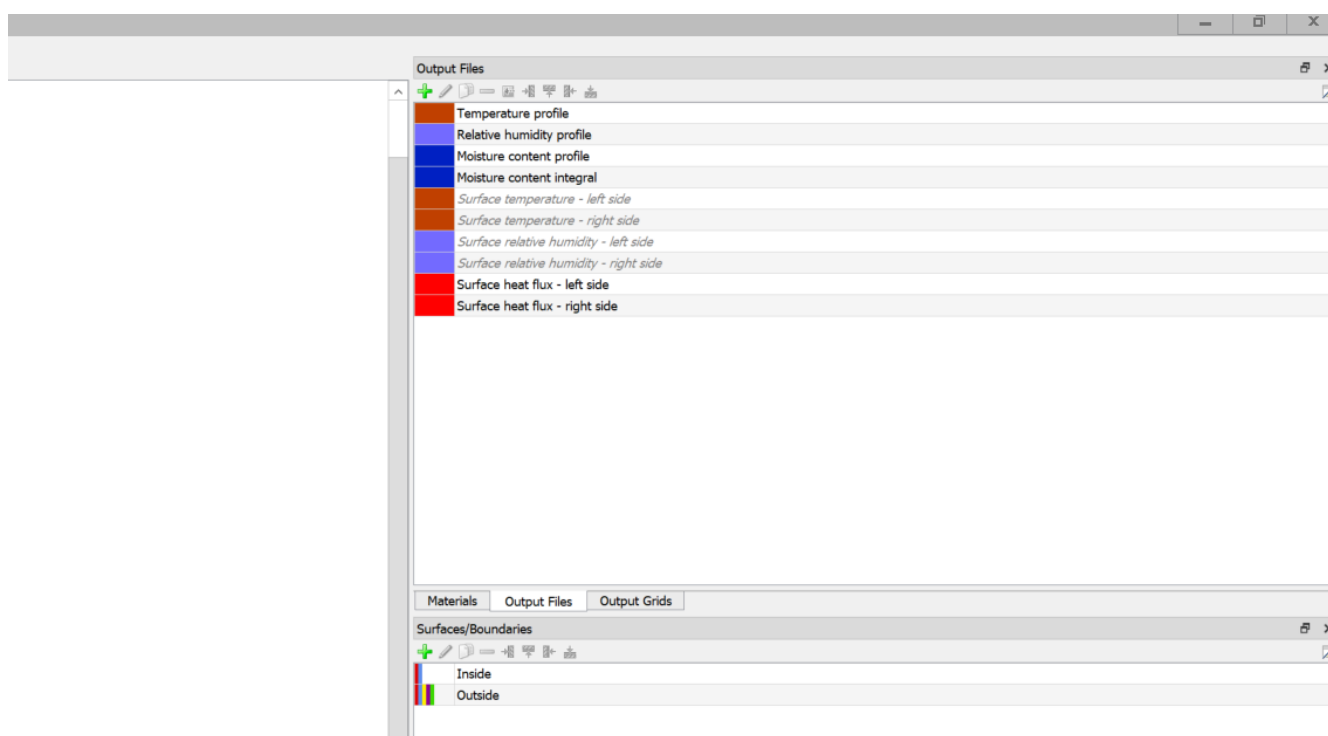


Image 18. List of output data created by the 1D project wizard

In the image above you can see **black and bold** and *grey and italic* data. The outputs shown in black are generated and already assigned to the construction. By clicking on a data set, the assignment is highlighted in the construction window. The first 4 data sets are assigned to the entire construction.

The following 4 outputs for temperature and relative humidity on the surfaces have been created but not yet assigned. This must now be done (see picture below). To do this, first mark the corresponding boundary element (1), then the output you want to assign (2) and finally click on the green 'Assign'-button (3).

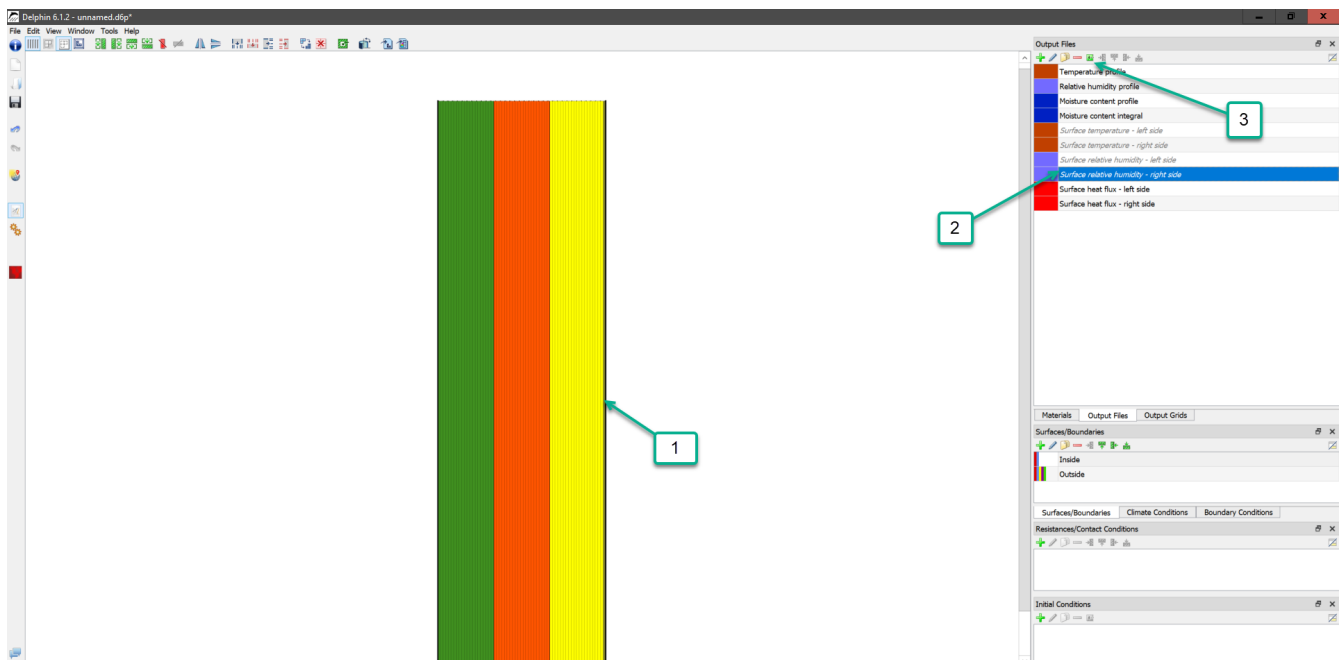


Image 19. Output list with selected output

In the case of the surface outputs, it would be good to adapt the output file names in this case in order to emphasise more clearly what they represent. For example, by default, one surface temperature is called 'Surface temperature - left side'. The left side of this construction is the surface for outside. Therefore, it would be better to rename the output to 'Surface Temperature Outside'.

For 2D constructions, the output section in the project wizard changes in that the outputs for the surfaces are no longer offered (see picture below). This is because in 2D constructions there is no longer a clear allocation of surfaces and adiabatic surfaces are possible. Surface outputs, like all other outputs, must be added later.

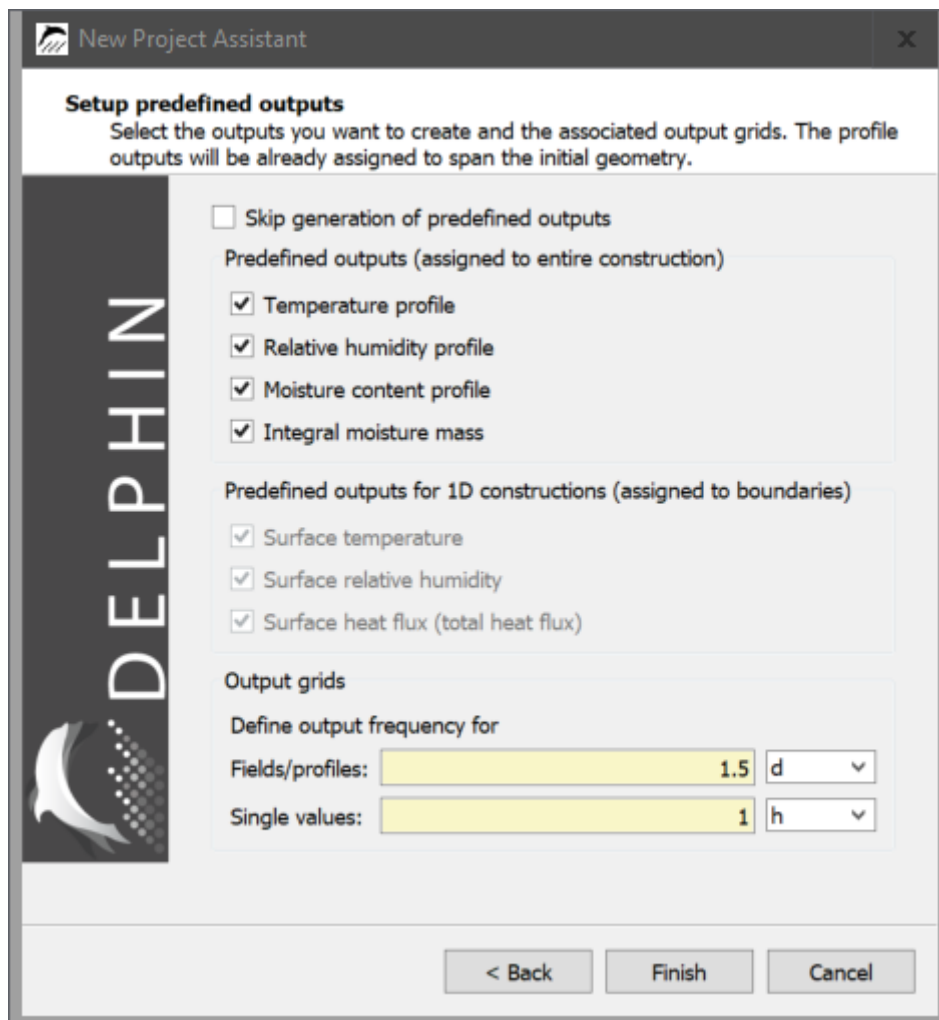


Image 20. Section for outputs in the project wizard for a 2D construction

3.2. Direct output creation

Outputs can be created directly by adding them to the output list or by copying existing outputs. To create outputs, proceed as follows:

- Click on the Add button of the output list.

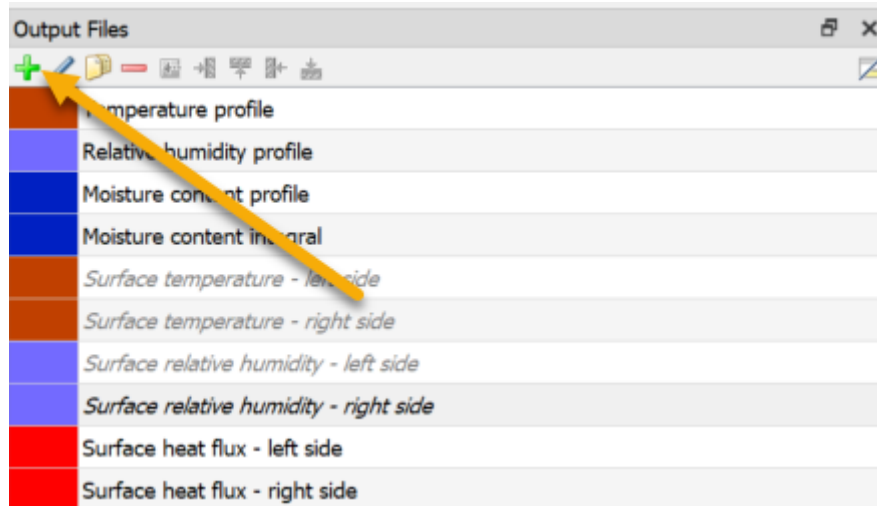


Image 21. Create a new output

- Configure the output in the [format dialogue](#).

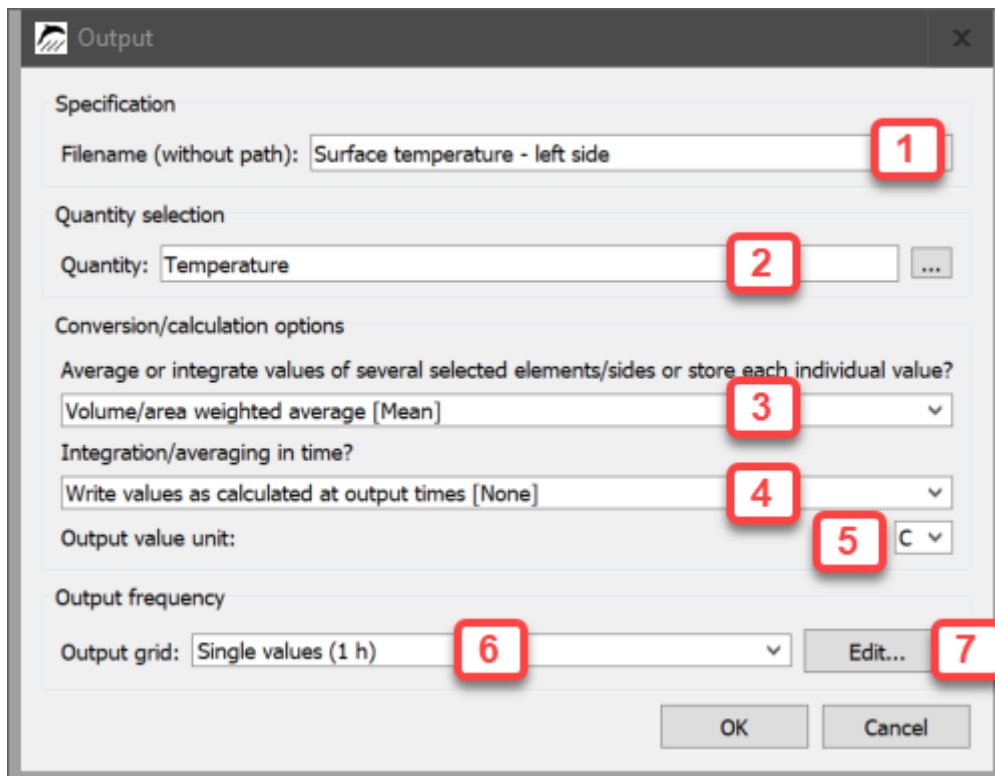


Image 22. Dialogue for output formatting

- Assign the new output to the design ([Assignment](#)).

Instead of creating a new output, you can also copy an existing one and then adapt it. This procedure is advantageous if the new output is similar in format (physical quantity, formatting, schedule) to the existing one. To copy, select an existing output and click on the 'Copy' button.

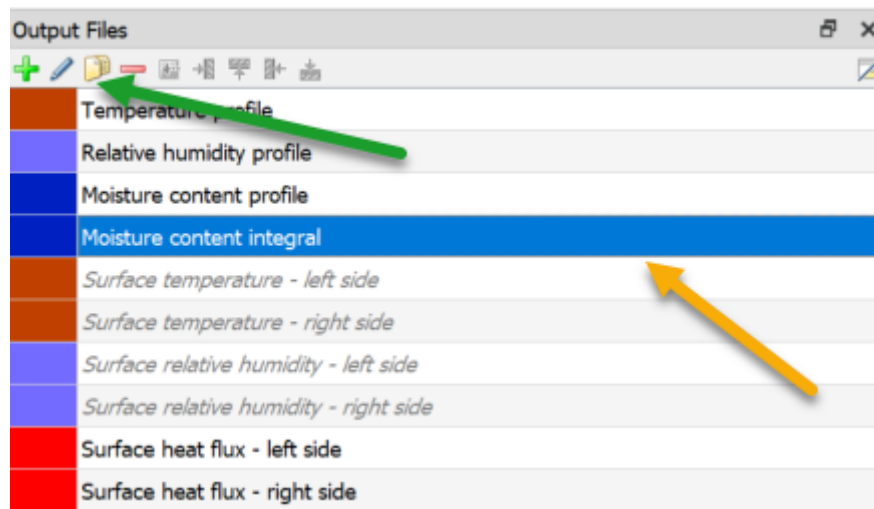


Image 23. Copying an existing output

It is especially important to define a new name. In a DELPHIN project, there must never be two outputs with the same name so that the output files are named differently. If this should happen, an error message will be displayed at the start of the simulation and the calculation will be aborted.

4. Possible output quantities

This list is valid for version 6.1.6. Older versions may contain fewer output quantities.

4.1. Element outputs

4.1.1. Heat transport

Table 1. All field outputs for heat transport

No.	Name	Unit	Explanation
1	Temperature	C	Temperature
2	EnergyDensity	J/m ³	Energy Density
Transport Parameter			
3	ThermalConductivity	W/mK	Thermal conductivity in general or in direction X
4	ThermalConductivity_Y	W/mK	Thermal conductivity in calculation direction Y
5	ThermalConductivity_Z	W/mK	Thermal conductivity in calculation direction Z

- the energy density (2, internal energy) is the current state variable.
- The temperature (1) is calculated from this via the material- and moisture-dependent heat storage function.
- The thermal conductivity depends on the parameters or functions set in the material of the selected elements (moisture content, temperature). The conductivities in Y- and Z-direction (4, 5) are only different from the normal conductivity if the material is parameterised anisotropically.

4.1.2. Moisture transport

Table 2. All field outputs for moisture transport

No.	Name	Unit	Explanation
6	MoistureMassDensity	kg/m ³	Total mass density of liquid water, water vapour and ice
7	OverhygroscopicWaterMassDensity	kg/m ³	Mass density of overhygroscopic water (condensate) related to REV
8	LiquidMassDensity	kg/m ³	Mass density of liquid water related to REV
9	VaporMassDensity	kg/m ³	Mass density of the gas phase related to REV
10	IntrinsicVaporMassDensity	kg/m ³ 3	Mass density of water vapour related to gas volume (absolute humidity)
11	LiquidContent	m ³ /m ³	Volume fraction of the liquid phase related to the REV

No.	Name	Unit	Explanation
12	MoistureMassByMass	kg/kg	Mass density of total moisture related to REV
13	DegreeOfSaturation	%	Percentage of pore space filled with water and ice (without ice exactly like LiquidVolumeRatio)
92	DegreeOfSaturationOver30	%	Percentage of pore space filled with water and ice above 30%.
14	LiquidVolumeRatio	%	Ratio of the volume of the liquid phase to the effective saturation (degree of saturation)
15	RelativeHumidity	%	Relative air humidity
16	LiquidPressure	Pa	Pressure of the liquid phase
17	TotalLiquidPressurePotential	Pa	Liquid Water Pressure Potential with Gravity
18	CapillaryPressure	Pa	Capillary pressure (negative)
19	VaporPressure	Pa	Vapour pressure
IceMass			
20	IceMassDensity	kg/m ³	Mass density of ice related to REV
21	IceVolumeRatio	%	Ratio of ice volume to effective saturation
91	IceCriteriaDIN4108_3	%	By how much does the current saturation level exceed 30% when the temperature is $\leq -5^{\circ}\text{C}$ at the same time?
Transport parameter			
22	KirchhoffPotentialLiquidFlux	-	Kirchhoff Potential, integral of liquid water conductivity versus liquid pressure
23	KirchhoffPotentialLiquidFlux_Y	-	Kirchhoff potential, integral of liquid water conductivity versus liquid pressure in calculation direction Y
24	KirchhoffPotentialLiquidFlux_Z	-	Kirchhoff potential, integral of liquid water conductivity versus liquid pressure in calculation direction Z
25	LiquidPermeability	s	Liquid water conductivity in general or in direction X

No.	Name	Unit	Explanation
26	LiquidPermeability_Y	s	Liquid water conductivity in calculation direction Y
27	LiquidPermeability_Z	s	Liquid water conductivity in calculation direction Z
28	VaporPermeability	s	Water vapour conductivity in general or in direction X
29	VaporPermeability_Y	s	Water vapour conductivity in calculation direction Y
30	VaporPermeability_Z	s	Water vapour conductivity in calculation direction Z

- The moisture mass density (6) is the primary state variable. All other quantities are derived from it.
 - the conversion to relative humidity and capillary pressure is done via the moisture storage function of the material and is independent of temperature
 - the vapour pressure results from the relative humidity at the temperature of the element
- The mass density of the overhygroscopic water (7) denotes the amount of moisture that lies above the hygroscopic limit value. By default, this is the water content at 95% relative humidity. However, this value can be changed in the options of DELPHIN.
- Data for ice (20, 21) are only available if ice calculation is switched on in the DELPHIN calculation options.
- The degree of saturation (13) is the ratio of total moisture content to effective saturation of the respective material. It plays a role especially in ice damage assessment according to WTA 6.5 or DIN 4108-3 D.
- The mass-related moisture content (12) is important in the assessment of timber components (DIN 68800-2).
- Quantities 91 and 92 have been available since version 6.1.5

All parameters of the moisture transport are only available if the moisture balance is switched on in the DELPHIN calculation options.

Table 3. All field outputs for air transport

No.	Name	Unit	Explanation
90	GasMassDensity	kg/m ³	Total mass density of gas
31	GasPressure	Pa	Gas pressure (total pressure)
32	GasPressureOffset	Pa	Gas pressure difference to atmospheric pressure (101325 Pa)
Transport parameter			
33	AirPermeability	s	Air permeability in general or in direction X
34	AirPermeability_Y	s	Air permeability in calculation direction Y
35	AirPermeability_Z	s	Air permeability in calculation direction Z
36	AirVelocityMagnitude	m/s	Mean air velocity

If the air balance is activated in DELPHIN, the outputs from the table above are available.

- The state variable for this transport would be the gas mass density.
- Quantity 36 (mean air velocity) allows the distribution of the flow velocity in a construction to be output as a field. To calculate this quantity, the flows are vectorially averaged over all sides of each volume element and an average velocity is determined from this.

4.1.4. Salt transport

Table 4. All field outputs for salt transport

No.	Name	Unit	Explanation
37	WaterActivity	-	Water Activity
38	Molality	mol/kg	Molality of dissolved salts
39	IntrinsicSolutionDensity	kg/m ³	Density of the salt solution related to the liquid volume
40	SolutionMassDensity	kg/m ³	Mass density of the salt solution related to REV
Transport parameter			
41	SaltDiffusionCoefficient	m ² /s	Diffusion coefficient of salt in porous material for gradient of molality

4.1.5. VOC Transport

Table 5. All field outputs for VOC Transport

No.	Name	Unit	Explanation
42	PartialPressureVOC	Pa	Partial pressure of VOC
43	IntrinsicVOCDensity	kg/m ³	Specific VOC density in the gas phase in kg(VOCg)/m3(gas)
44	VOCMassDensityGas	kg/m ³	Mass density of VOC in the gas phase
45	VOCMassDensityAdsorbed	kg/m ³	Mass density of the solid phase of VOC
Transport parameter			
46	VOCPermeability	s	VOC/pollutant conductivity in the gas phase

The salt transport and VOC calculations require additional material parameters which are not available for many materials. At present, an application should only be made in the scientific field.

4.2. Outputs for fluxes

Table 6. All flux outputs in the field and at the margin

No.	Name	Unit	Explanation
HeatConduction			
47	FluxHeatConduction	W/m ²	Heat flow (conduction)
48	TotalFluxHeat	W/m ²	Sum of all heat flows
Moisture transport			
49	FluxEnthalpyLiquidConvection	W/m ²	Enthalpy flow for liquid water convection
50	FluxEnthalpyVaporConvection	W/m ²	Enthalpy flux for water vapour convection
51	FluxEnthalpyVaporDiffusion	W/m ²	Enthalpy flux for water vapour diffusion
52	FluxLiquidConvection	kg/m ² s	Convective mass flow for liquid water
53	FluxVaporDiffusion	kg/m ² s	Mass flux for water vapour diffusion
54	TotalFluxMoisture	kg/m ² s	Sume of all moisture fluxes
Air transport			
55	FluxEnthalpyAirConvection	W/m ²	Enthalpy flux for convection of dry air
56	FluxVaporConvection	kg/m ² s	Mass flux for convection of water vapour
57	FluxAirConvection	kg/m ² s	Convective mass flux for dry air
Salt transport			
58	FluxEnthalpySaltDiffusion	W/m ²	Enthalpy flux for salt diffusion
59	FluxEnthalpySaltConvection	W/m ²	Enthalpy flux for salt convection
60	FluxSaltDiffusion	kg/m ² s	Mass flux for salt diffusion
61	FluxSaltConvection	kg/m ² s	Mass flux for salt convection
VOC transport			
62	FluxVOCDiffusion	kg/m ² s	Mass flow for VOC diffusion
63	FluxVOCConvection	kg/m ² s	Mass flow for VOC convection

The outputs for fluxes described above can be assigned both at the boundary and in the field. Here, the sign rule must be observed:

- in the field: positive from left to right, from bottom to top, from front to back.
- at the boundary: positive into the construction

If an assignment contains sides both at the boundary and in the field, the assignment rule for the field applies.

- Size 48 contains all possible heat fluxes, i.e. the heat conduction itself pluss all existing enthalpy fluxes.
- the fluxes for vapour convection (50) corresponds to the vapour fraction in air movement and is thus only present in air transport calculations

Table 7. All fluxes only for boundaries

No.	Name	Unit	Explanation
Boundary condition shortwave radiation			
64	FluxShortWaveRadiationDirect	W/m ²	Direct shortwave solar radiation absorbed by the surface
65	FluxShortWaveRadiationDiffuse	W/m ²	Diffuse shortwave solar radiation absorbed by the surface
66	FluxShortWaveRadiationGlobal	W/m ²	Global shortwave solar radiation absorbed by the surface
Boundary condition longwave radiation			
67	FluxLongWaveRadiation	W/m ²	Longwave radiation
Boundary condition driving rain			
68	FluxRain	kg/m ² s	Rain flow absorbed by the surface
69	FluxRainNormal	kg/m ² s	Rain flow normal to surface
70	FluxEnthalpyRain	W/m ²	Rainfall enthalpy
71	FluxRainRunoffCooling	W/m ²	Heat flux for cooling by running off rain
Boundary condition heat flux			
88	FluxHeatConductionGain	W/m ²	Heat flux density with positive heat flux
89	FluxHeatConductionLoss	W/m ²	Heat flux density with negativ heat flux

The flux outputs described above are linked to the specific boundary conditions mentioned.

- the short-wave radiations (64 - 66) are to be understood as normal radiation of the respective surface multiplied by the absorption coefficient.

- quantity 67 contains the total long-wave radiation balance at the assigned surface (irradiation - emission).
- FluxRain (68) is the liquid water flow absorbed by the surface element. This checks how much water is impinging (69) and how much can be absorbed at the current moisture content.
- FluxRainNormal (69) is the amount of driving rain impinging normal to the surface calculated according to the model of ISO 15927-3.
- FluxEnthalpyRain (70) is the enthalpy flow caused by FluxRain.
- In the case that not all of the driving rain can be absorbed, the remaining part is considered as runoff. The enthalpy of this runoff is represented by FluxRainRunoffCooling (71). Since the temperature of the rain is usually lower than the surface temperature, there is a cooling effect.
- Quantities 88 and 89 have been available since version 6.1.6

4.3. Outputs for sources and sinks

Table 8. All outputs for sources and sinks (field conditions)

No.	Name	Unit	Explanation
Single energy source			
72	ThermalLoad	W/m ³	Source: Heat load/Heat source
Long-wave radiation exchange in a cavity			
73	LongWaveRadiationLoad	W/m ³	Source: Heat load due to long-wave radiation exchange
Air exchange with ambient air ...			
74	ThermalLoadAirChange	W/m ³	Source: Heat load due to air exchange
75	MoistureLoadAirChange	kg/m ³ s	Source: moisture load (steam) due to air exchange
76	MoistureEnthalpyAirChange	W/m ³	Source: Enthalpy due to moisture load during air exchange
Moisture source due to air flow as a result of air leakage according to WTA 6.2			
77	MoistureLoadWTAConvection	kg/m ³ s	Source: Enthalpy due to moisture load during air exchange
78	MoistureEnthalpyWTAConvection	W/m ³	Source: Enthalpy of moisture load by convective source according to WTA 6.2
Single Moisture Source			
79	MoistureLoad	kg/m ³ s	Source: moisture load/liquid water source

No.	Name	Unit	Explanation
80	MoistureLoadEnthalpy	W/m ³	Source: enthalpy of moisture load/liquid water source
81	SaltProductionRateBoundWater	kg/m ³ s	source: mass production rate of bound water from dissolved salt
82	SaltProductionRateEnthalpy	W/m ³	Source: Enthalpy due to isothermal solution or crystallisation of salt
Water flow in one direction through the structure			
83	ThermalLoadGroundWaterFlow	W/m ³	Source: Thermal load/heat source due to injected groundwater
Simple VOC/pollutant source			
84	VOCAdsorptionRate	kg/m ³ s	Source: Mass production rate of the solid phase of VOC by condensation from the gas phase
85	VOCDesorptionRate	kg/m ³ s	Source: mass production rate of the gas phase of VOC by emission from the solid phase
86	VOCLoadAirChange	kg/m ³ s	Source: VOC mass concentration source due to air exchange
87	VOCSource	mg/m ³ s	Source: VOC mass production rate from specified emission source

All source outputs described above are determined by the assigned named source models. The assignment to the design must be made to volume elements to which a source model is also assigned. Each assignment thereby defines its own outputs.

5. Which outputs are needed?

When creating a DELPHIN project, the question always arises which outputs are needed. Ultimately, the solution results from the task itself.

Why do I carry out this calculation?

What statements do I want to make?

The [standard outputs](#) should always be present. If the project was created using the project wizard, they are usually present (if not deselected).

For all other outputs, one must consider what statement is to be made. Mostly, calculations are supposed to make statements about the functionality of a construction. For this purpose, one can ask the following questions:

- How does the moisture behave over time?
 - Moisture mass integral of the entire construction
- What damage can occur in this construction?
 - What expenditure do I need to determine a case of damage?
 - Where, in the construction, could this damage occur?

The most common damage assessments are:

- Mould on the internal surface
 - Average temperature (1) and humidity (15) at the surface where mould is expected to occur.
 - in PostProc 2 different mould models are available (isopleths, viitans)
- Algae formation on the outside
 - average temperature (1) and humidity (15) at a location on the outside
 - in PostProc 2 there is an experimental algae model for brick facades
 - Test on longer periods with high surface humidities at temperatures above 0°C can provide an indication of algae formation
- Wood-damaging fungi in wooden building components
 - mean temperature (1) and humidity (15) at all positions in timber components where damage can be expected
 - do not choose the area of allocation too large to avoid errors due to averaging
 - for worst-case consideration, **Maximum** (air humidity) can also be selected here instead of mean value
 - in PostProc 2 2 different damage models are available (WTA 6.8, Viitanen)
 - mass-related moisture content (12) in the wood
 - can be used for evaluation according to DIN 68800-2 as well as WTA 6.8
 - the range should be selected as for temperature and humidity
- Ice formation in the construction
 - for the damage model according to DIN 4108-3 D.7.5 one needs the degree of saturation (13) and the temperature (1) in a 1x1cm² area (2D calculation)
 - for this ice calculation does not need to be activated
 - further possibilities are the output of the pore volume ratio for ice as well as the ice content (no damage model available)
 - ice calculation must be activated for this

For other possible moisture damage (corrosion, source/shrinkage, dissolution, etc.), no good damage models exist yet.