User Instruction for VentConcept

Before VentConcept will work correctly, OpenStudio should be installed from the following website (Windows version): *https://openstudio.net/downloads*. The installation should be done as suggested by the OpenStudio installation wizard and should include all suggested third-party programs as seen in Figure 1.

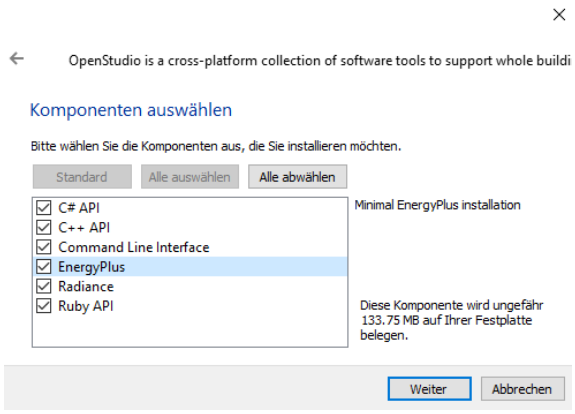

Figure 1: All check boxes should be selected, EnergyPlus must be selected

After the successful installation of OpenStudio, VentConcept can be installed through its own installer by double-clicking on the *VentConcept_install.exe*. After the installation has finished, VentConcept can be opened. The simulation workflow is structured in three sections: The ventilation concept section (including the geometry creation and the construction management), the simulation parameters section and the results section. The VentConcept main menu bar contains three tabs with these three sections. Text inputs as in shown in Figure 2 are displayed in red color when clicked inside them. The text input is only confirmed by pressing the enter key. Confirmed text will be displayed in black color, red text is always unconfirmed.

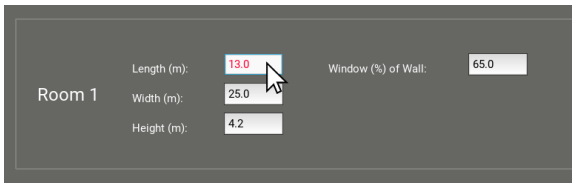

Figure 2: Text input behavior, red text is unconfirmed

1 Ventilation Concept

The *ventilation concept* tab is organized in three subsections, the three available ventilation templates, *single-sided ventilation*, *cross ventilation* and *atrium ventilation*. Inde-

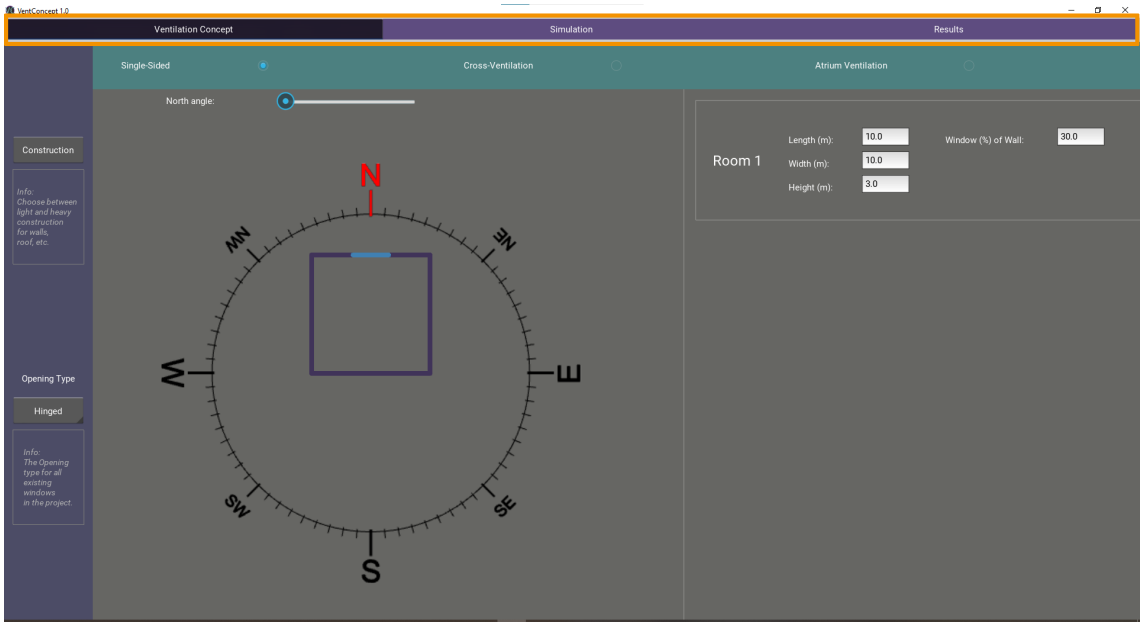

Figure 3: Main menu bar of VentConcept: *Ventilation concept*, *simulation* and *results*

pendently of the selected ventilation template, the construction and opening type of the project can be modified.

1.1 Construction

The construction can be modified by the *construction* button in the blue bar on the left side of the VentConcept window under the *ventilation concept* tab (Figure 5). The construction and opening type are changed independent of the ventilation template. The selected construction and opening type will be applied to the active template. When the *construction* button is pressed, a popup window will open. In this popup window, the construction can be modified for every building element type. By default, a light construction is selected for all building element types. A light or a heavy construction can be selected for building elements of the type *wall*, *roof*, *floor* and *interior wall*. For building elements besides the *interior wall* elements, the thermal transmittance (u-value) can be determined. The u-value must be higher than 0.0 and lower than 4.0 $W/(m^2 * K)$. Additionally, the window construction can be chosen from a drop-down menu from the following options: *Triple + thermal coating*, *double + thermal coating*, *double glazing*, *single glazing*. Construction modifications have a big potential of influencing the simulation results. The opening type can be chosen out of a drop-down menu with the following options: *Hinged*, *slided*, *tilt*, *closed*. The opening type will change the *openable* window area for all windows and openings of the project. Therefore the air exchange rate depends directly on it.

1.2 Single-Sided Ventilation Template

By default, the one-sided ventilation is selected. In Figure 4 the adaptable inputs are highlighted in orange. Input modifications are shown on the geometry preview on the left side of the window. The length, width and height of the room are given in meters, the percentage of the wall is given in percents between 2 % and 98 %. This number is the percentage of the wall which is used for the window. Besides the height input, all changes can be seen in the floor plan view on the left side of the VentConcept window.

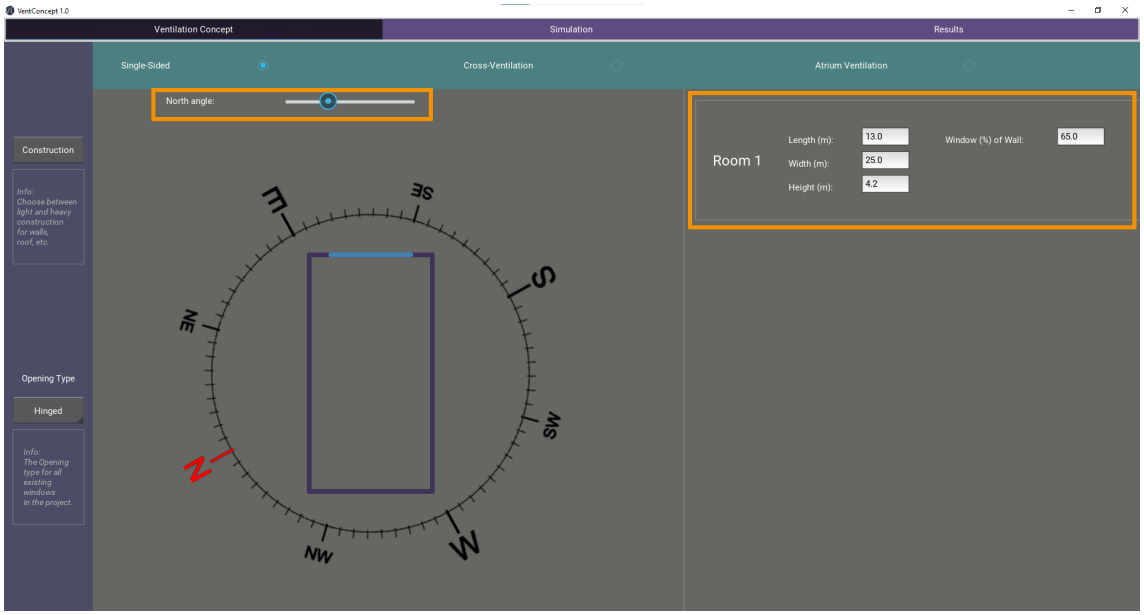

Figure 4: Single-sided ventilation, modified inputs

1.3 Cross Ventilation Template

The second ventilation concept template is the cross ventilation template. By default, one room with two opposed windows is proposed by VentConcept. In this template up to three rooms can be created by clicking on the plus symbol (see: Figure 6). When a second or third room is created, certain text inputs from previous rooms are deactivated and not alterable. In Figure 6 all alterable inputs are highlighted in orange for the case when a second room is created. The height which is set the same for all rooms can only be changed in the state where there is only one room created, and will then be taken for all further rooms of the template. By clicking the three boxes *L*, *M* and *R*, it is possible to align the second (or third) room to the left or right edge or to the middle of the previous room. When two or three rooms are in created, between the rooms an opening is created. The opening and window ratio is given in percent per wall, analogously to Section 1.2.

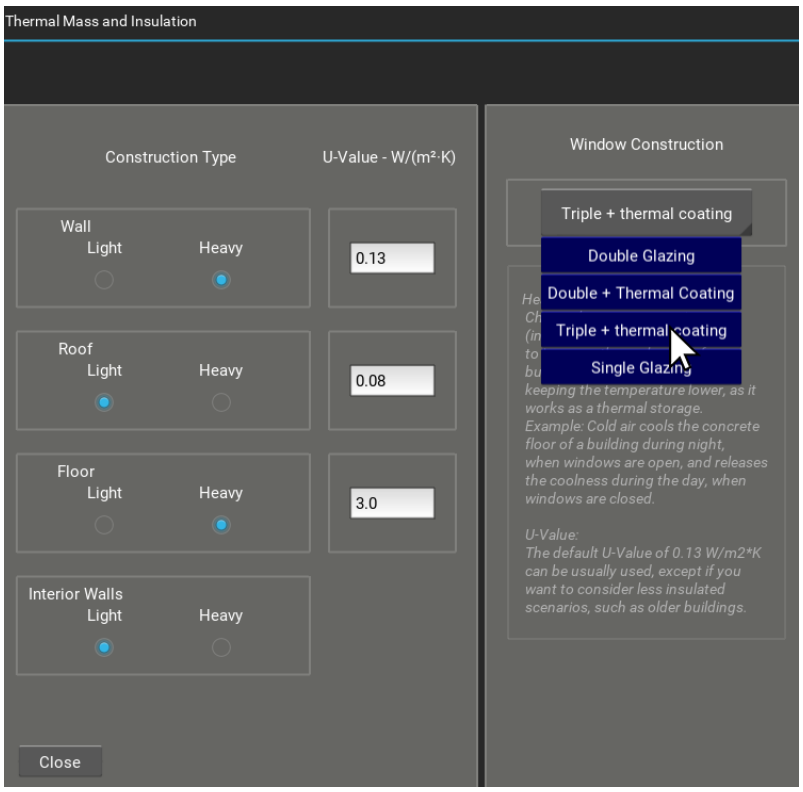

Figure 5: Construction popup window

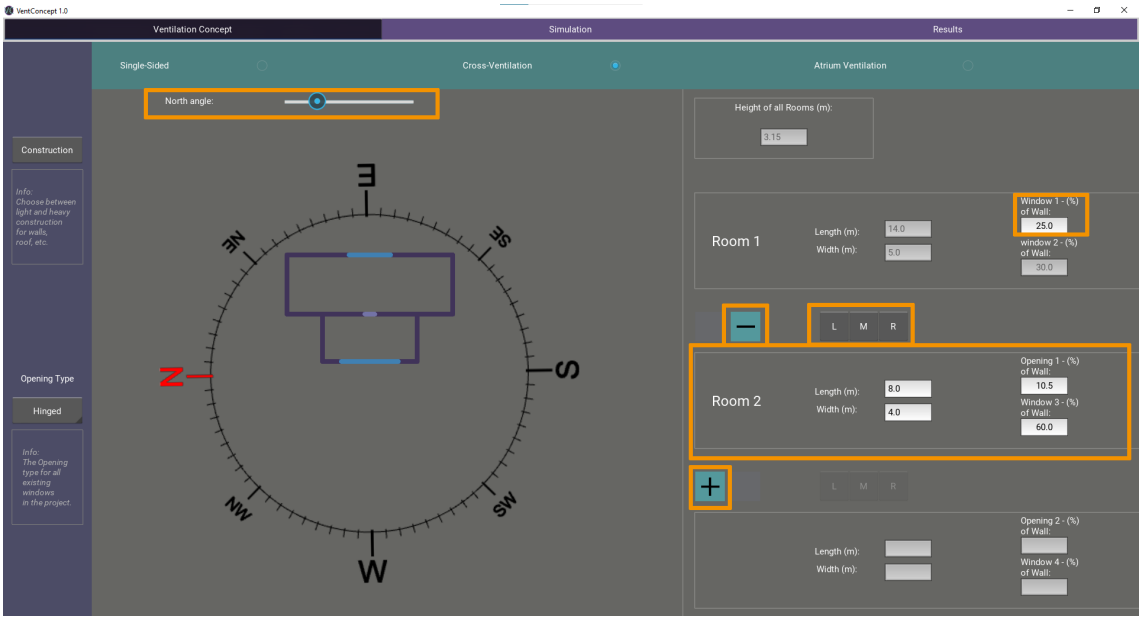

Figure 6: Cross ventilation template

1.4 Atrium Ventilation Template

The atrium ventilation template allows the user to create one room or a room connected to a second room, an atrium. The inputs are similar to the cross ventilation template, but the control over the window dimensions and window positioning is higher, is it directly influences the effectiveness of the buoyancy effect. Therefore, the window width and

height percentages can be set individually. The vertical position of the window at its wall can be set between 2 % (aligned to the floor) and 98 % (aligned to the ceiling). If two rooms were created, the vertical position or offset of the first room can be modified. The vertical position of the first room can be flexibly set between 0& (the floor of the atrium) and 100 % (the ceiling of the atrium). Analogously to Figure 6, text fields may be deactivated. In Figure 7, all alterable inputs are highlighted in orange, in an example of one room + atrium.

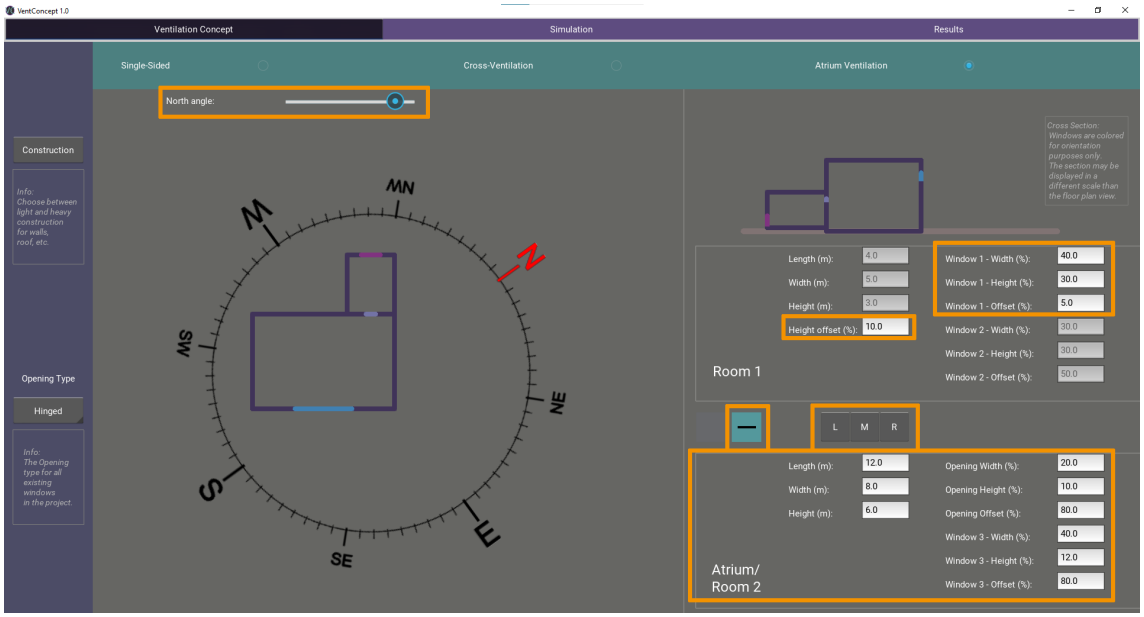

Figure 7: Atrium ventilation template

2 Simulation Section

The simulation tab bundles required simulation parameters and settings in one window (Figure 8). Most of the parameters have preset values, only the weather file must always be loaded according to the location of interest.

2.1 Loading a Weather File

A weather file must be loaded for the simulations to work in VentConcept. The *epw* (EnergyPlus Weather) format is used by VentConcept. Weather data in the *epw* format can be found in different data banks online. Ladybug provides a website with *epw* data from several data banks organized in a graphic manner as a world map. The weather data can be downloaded for any available location a click on the location of choice (Figure 9). The entire content of the downloaded weather folder should be unpacked

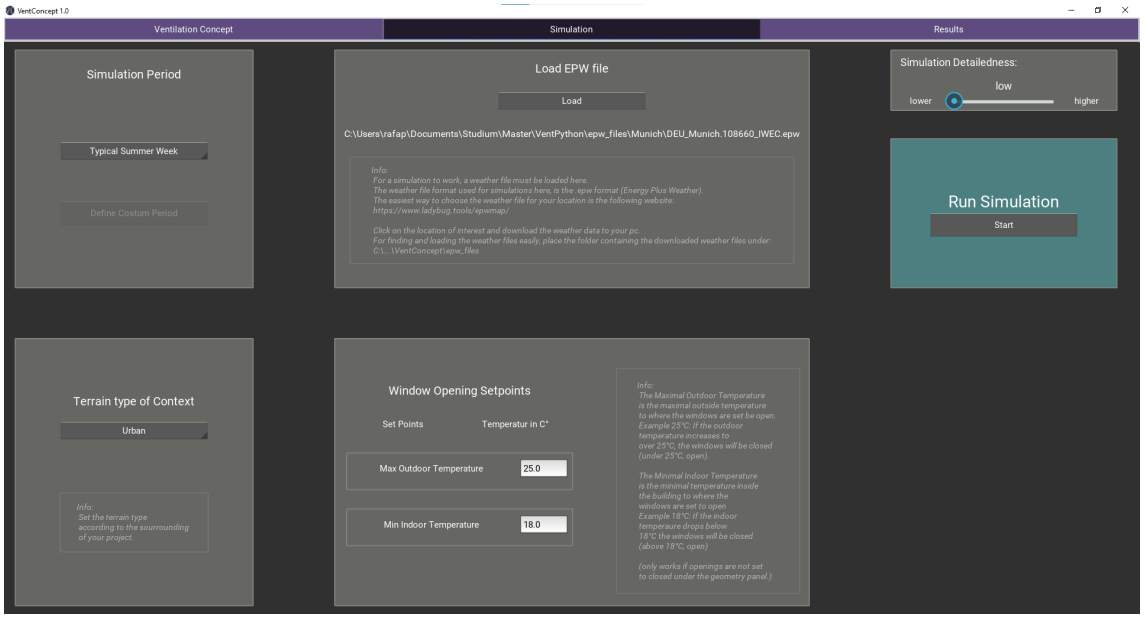

Figure 8: Results tab

inside a custom folder under the following path *C:/.../VentConcept/epw_files*. The use of this directory will facilitate the workflow in VentConcept. By clicking on the *Load* button as seen in Figure 10, a file explorer window will pop up, in which the previously downloaded *epw* file can be selected and loaded (Figure 11).

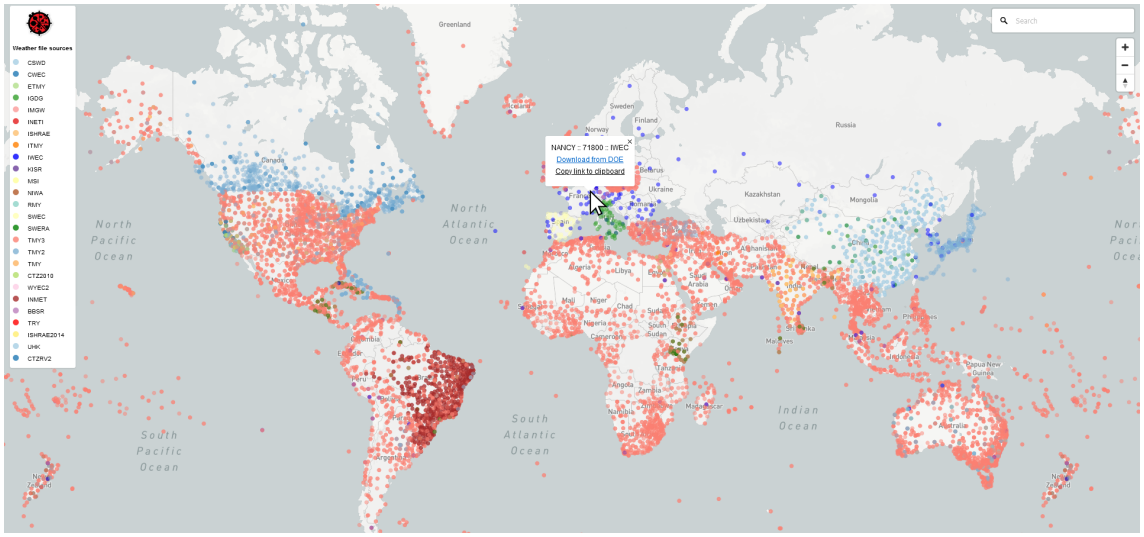

Figure 9: Ladybug weather data website

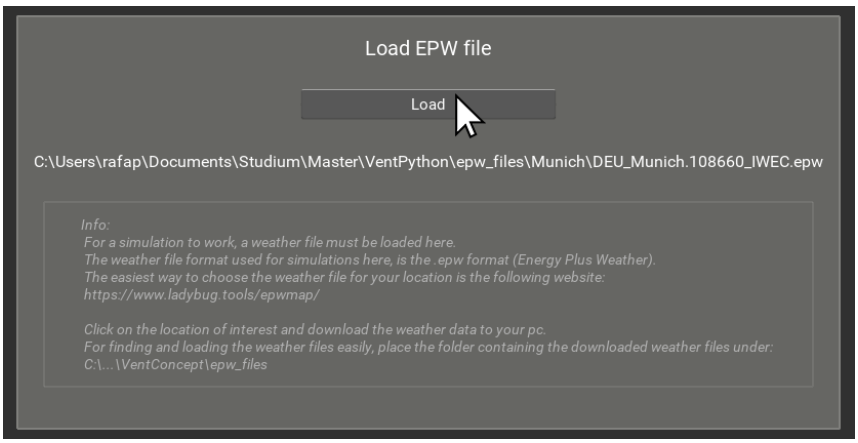

Figure 10: Load the *epw* weather file

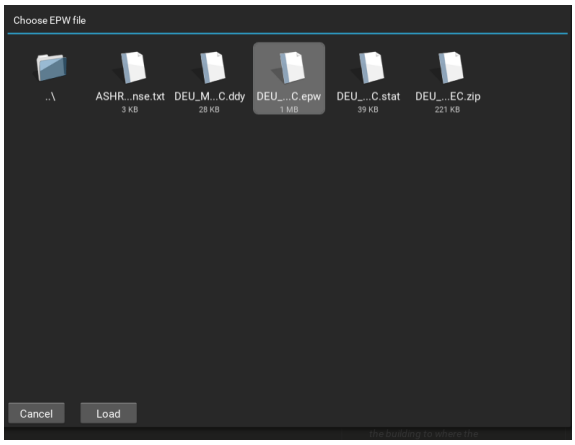

Figure 11: Choose an *epw* file from the PC

2.2 The Window Opening and Closing Temperature Setpoints

The setpoints determine the temperature at which all windows will be closed or opened. The maximum outdoor temperature is the highest outdoor temperature, at which the windows are still open. If the outdoor temperature increases above the maximum outdoor temperature, the windows will be closed. The minimum indoor temperature is the lowest temperature inside the project rooms, until where the windows will be open. If the inside temperature drops below this value, the window will be closed. By default, the maximum outdoor temperature is set to 25°C and the minimum indoor temperature to 18°C (Figure 12).

2.3 Simulation and Simulation Parameters

The *terrain type of context* drop down lets the user select a terrain that comes closest to the terrain of the intended context of the project. The type of context will modify the wind data, which comes with the loaded weather file and therefore the ventilation

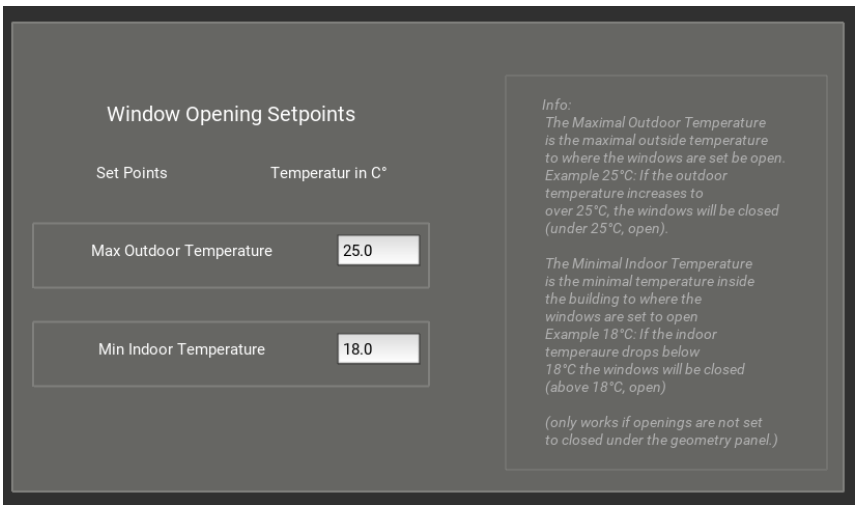

Figure 12: Window opening and closing setpoint temperatures

rates of the design. By default, it is set to *urban* (Figure 13). The *simulation period* determines the period of the year for which the simulation will be run. By default it is set to *Hot Summer Day*. Most used for the testing of overheating scenarios would be the *Hot Summer Day* and the *Hot Summer Week*. Alternatively, it can be chosen to use a custom simulation period (Figure 13). The simulation detail defines the degree of detail, that EnergyPlus will use to perform the simulation. In general, the lowest option is sufficient. By clicking on *Run Simulation*, the simulation will be run through OpenStudio and EnergyPlus. When the simulation has finished, the user is notified to switch to the *Results* tab.

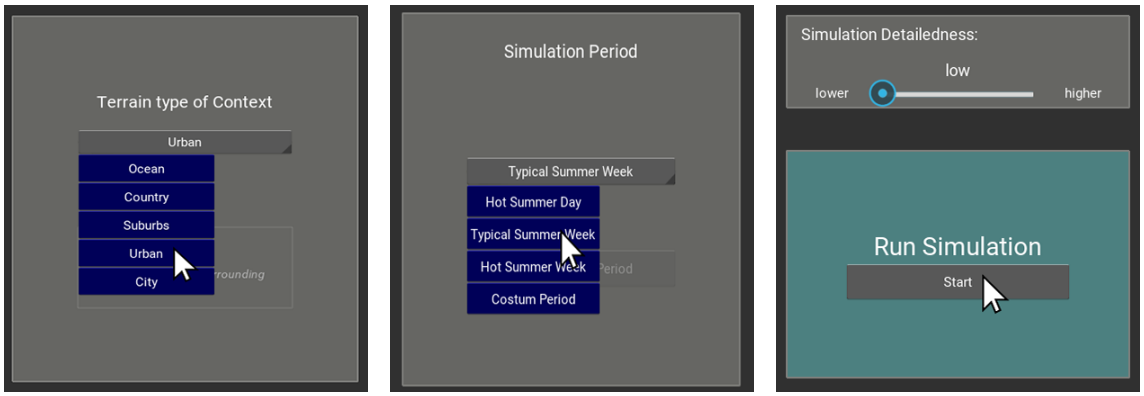

Figure 13: Left: Select the type of context, Middle: Choose simulation period, Right: Detail of simulation and run simulation

3 Results Section

By default, the result tab is set to the *Room 1* option. A notification will appear under the *Results* tab to indicate that a new simulation was run and must be loaded. By

clicking on *Load Results*, the newest simulation results will be loaded and displayed (see Figure 14). This can be done for up to three different rooms, depending on how many rooms were used for the simulation. The results must be loaded for each room under the respective section in the *Results* tab. It is possible to load simulation results of successive simulations in the same graph, as seen in Figure 15. However, the different results are not distinguishable in the graphs by colors. This loading of several results in the same graph is a feature that can be useful for the designer to obtain quick comparisons in his/her working progress. To clear previous results from the graph, the button *Clear Previous* can be pressed, and only the most recent results will be shown.

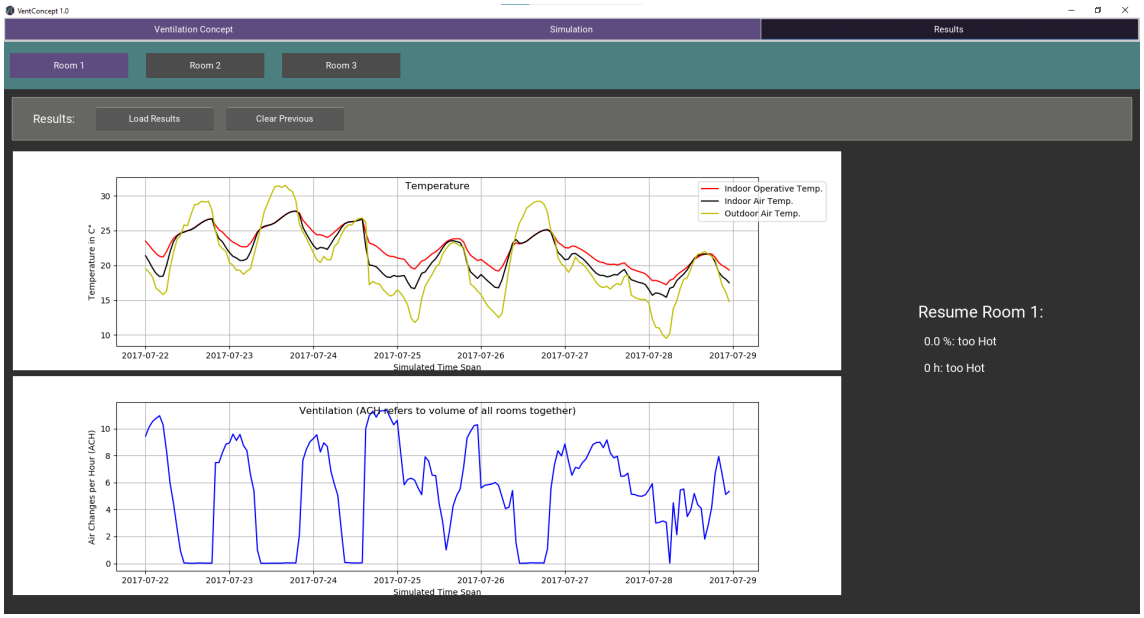

Figure 14: Loaded simulation results

Figure 15: Clear previous simulation results