OPTIVENT 2.0

USER MANUAL

September 2015 - Version 1.0

Created by Optivent
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OPTIVENT 2.0

Contents

Introduction

The following manual allows the user to know the mode of operation and processing results of the Optivent 2.0 web tool. The web site was designed for the user to choose strategies; complete the spaces required and can get immediate results regarding the use of natural ventilation.

The Optivent 2.0 is a tool for the initial calculation of natural ventilation in steady state, which allows to obtain the flow of air necessary to have fresh air or cooling depending on the passive ventilation strategy.

The program is based on the principles of calculating the Optivent 1.0 template, developed by architects and environmental consultants from Brian Ford & Associates in Nottingham, UK. The tool has been renovated on the web, with the support of the University of Bio-Bio, to expand the range of strategies and support decisions regarding the feasibility of natural ventilation during the initial design stage.

Home page / Access main

Optivent 2.0 can be accessed through to the web address: http://www.naturalcooling.co.uk/optivent/optivent.php

Program requirements

Web browser:
The program requires access to the website by any of the usual browsers: Internet Explorer, Mozilla Firefox, Google Chrome or Safari.

Screen resolution:
Use an appropriate screen resolution for reading. We recommend at least 768 x 1024.

The site has two versions: English (default) and Spanish. The user can change the version before starting work with the top buttons showing in Figure 1 (1). Once data have been entered the user could not change version since all entries are deleted.

All the time appears on the right side of the page a “Run” button (2). for obtaining preliminary results according data included within the program. Preliminary results will appear in the white space to the right of the screen.

The home page on the right side summarizes the references used for development (3) and developers of it (4).

On the left side the home page has a tab called "Natural Ventilation Strategies" (5) and four scenarios to choose from depending on the strategy to be assessed.

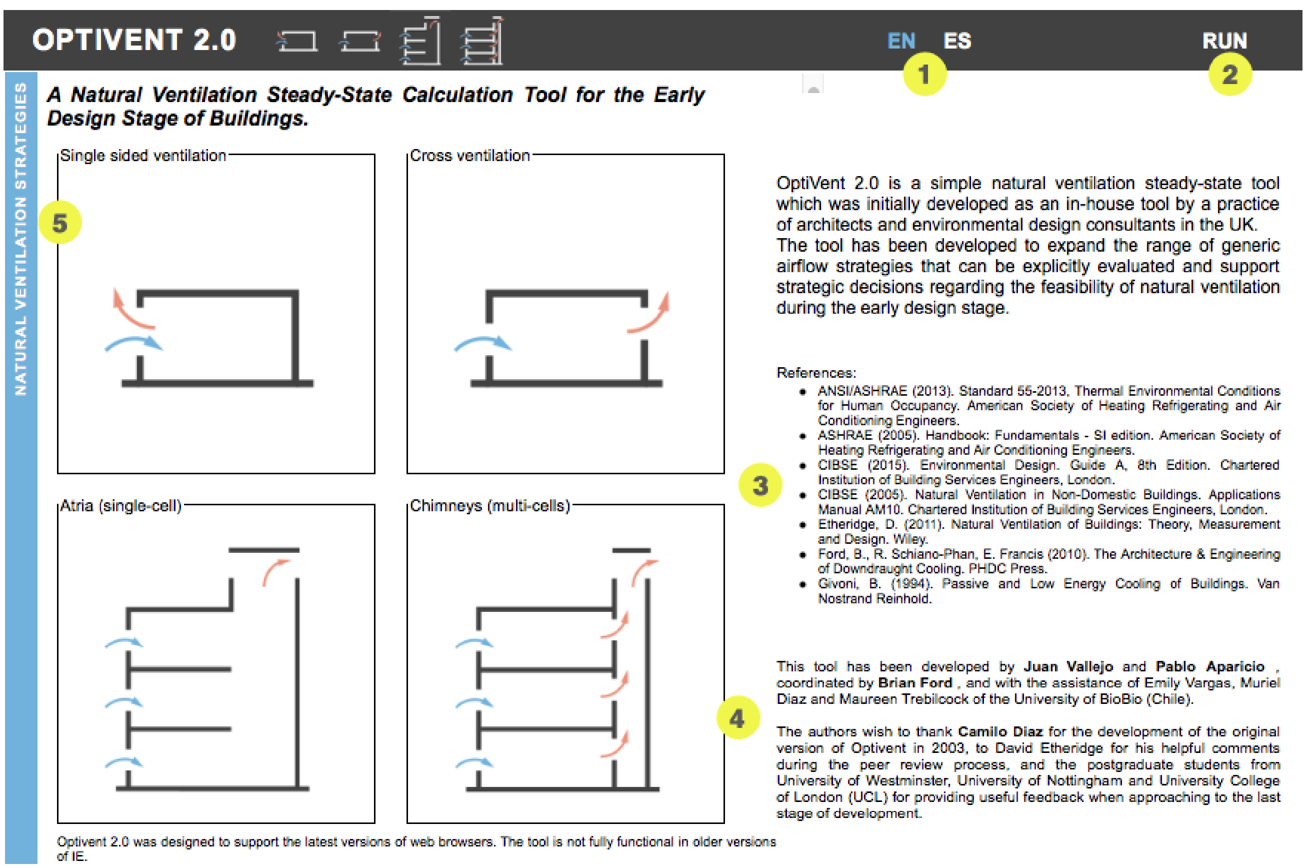
1. Simple ventilation: a single room with just one lateral opening through which air enters and leaves.

2. Cross ventilation: a single space with openings on two opposite walls, one for inlet and other to outlet.

3. Atrium: a construction of one or more levels with a lateral or central atrium leading the air outlet. In this case, it is important to consider that the program assumes that there is a direct communication between the levels and the atrium, acting as a single space.

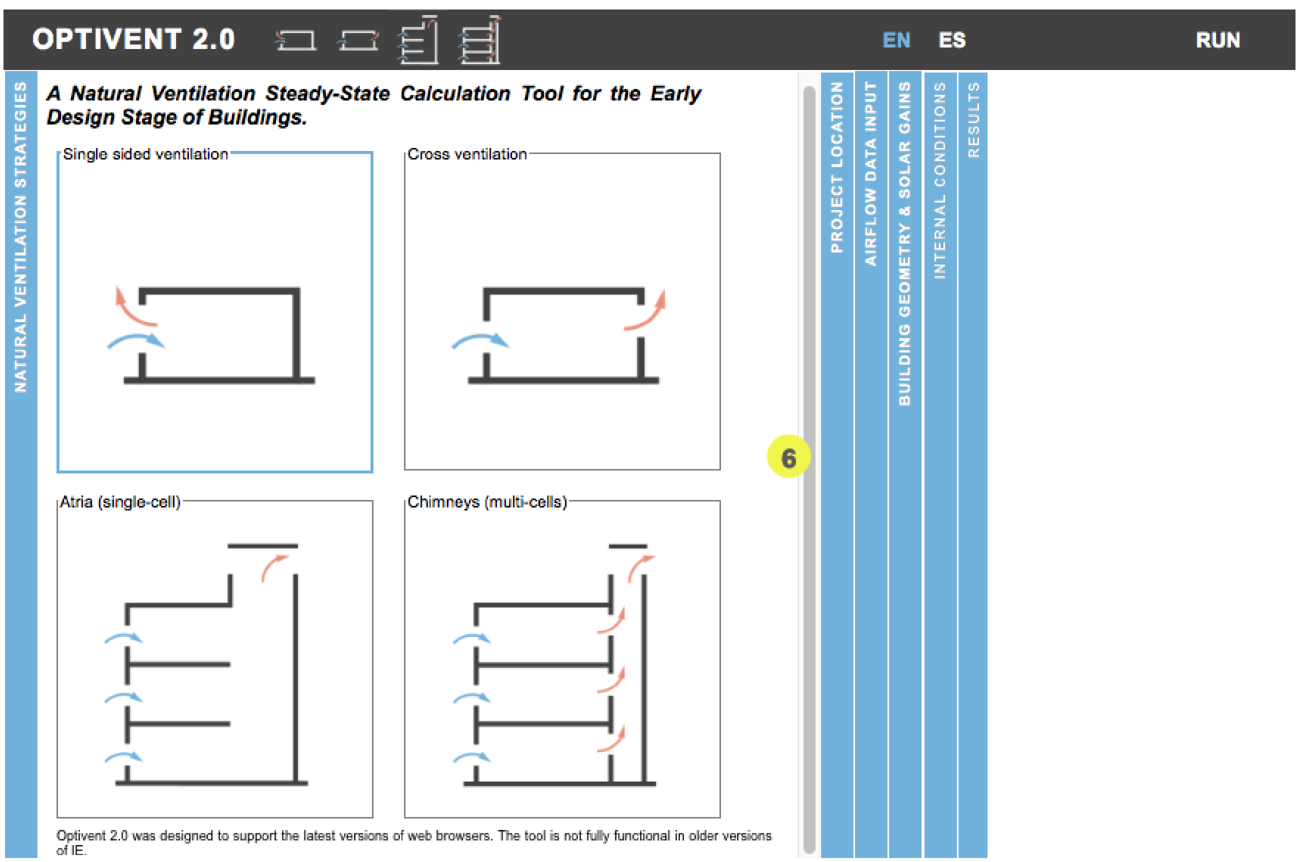
4. Chimney: a construction of one or more levels with a lateral chimney where the levels for the entry or exit of air are connected. In this case, each level is considered as an independent space that communicates with the chimney.

Figure 1: Home page Optivent 2.0



Of these four strategies must choose one to display the other tabs, as shown in Figure 2 (6). After choosing the case will be passed to the next tab.

Figure 2: At this stage, you should choose a strategy to evaluate

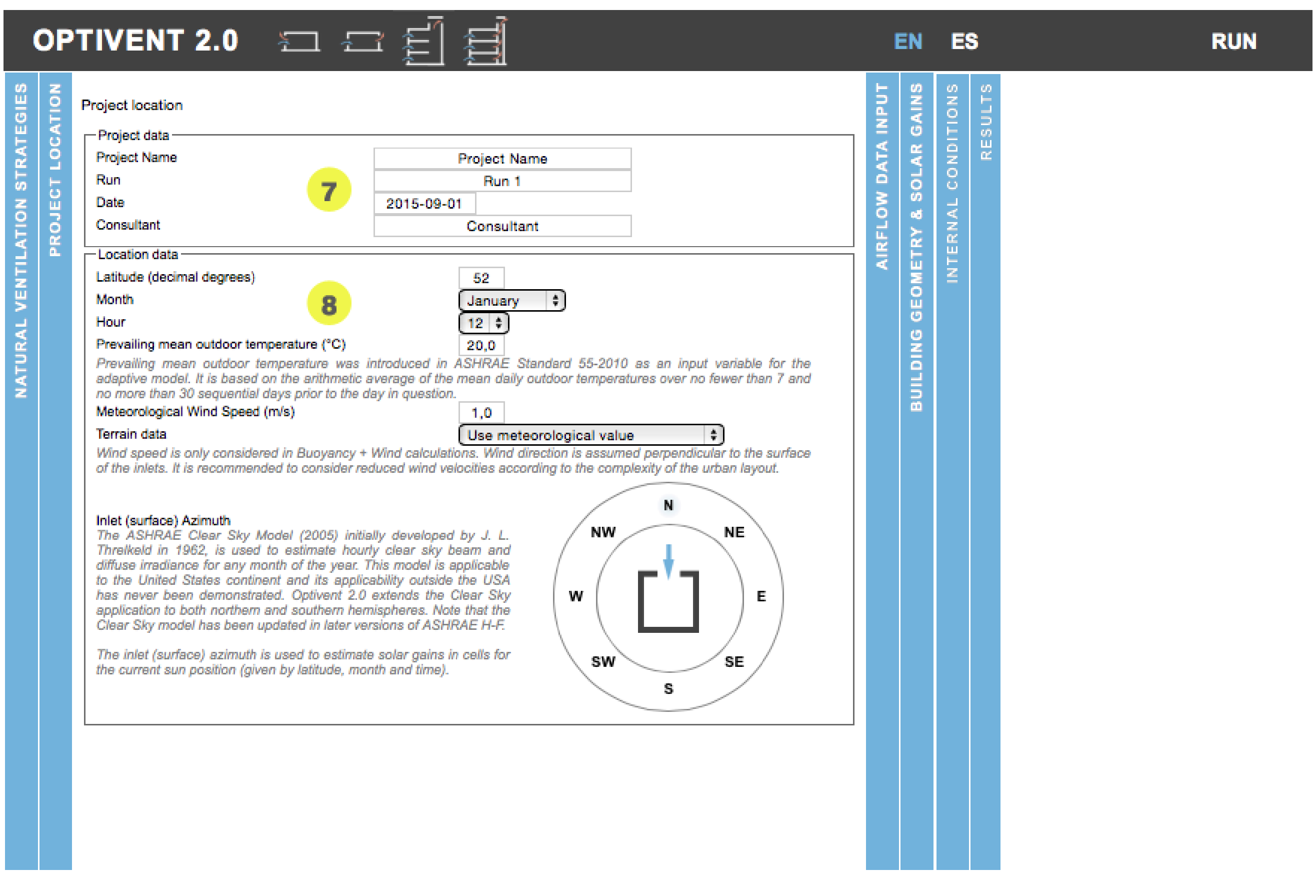


Project Location

On the first tab, to the right: Project Location, a window appears with different data to complete by the user, which can be seen in Figure 3.
First, the information is completed on the Project data. (7)

- The Project name, for identification.
- Then, you must identify the Version of the work. This is used in the event that different situations for the same project are calculated. So we can identify versions in the results.
- The Date on which the calculation is made, it will appear in the results report. By default, the program places the current date. You must change the date in the format that appears if you want to use another date for the report, depending on the browser.
- Finally, the name of the Consultant or office that is conducting the study: to identify in the report of results.
- Then, in the bottom section, the program asks the Location data. (8)

Figure 3: Project Location



- The Latitude of the place, which is evaluated. For the countries in the Northern Hemisphere, above the line of Ecuador, the latitude is used in positive numbers. For those located in the Southern Hemisphere, the latitude is entered as a negative value. Latitude must be indicated in decimal form. That means, if you have the data in degrees, minutes and seconds must be converted to decimal degrees. For that, you can use any converter on the web.

- The Month and the Hour to use, with respect to the calculation of ventilation. It is recommended to use a critical month and hour, with respect to ventilation and solar radiation, as these are factors that influence in cooling and heat gains. These data are required for calculation of the solar radiation. The hours are requested in 24-hour format.

- The Mean outdoor temperature (for the month being evaluated). Not necessarily the same as the outside temperature to be asked later. Since that, may correspond to a specific measurement for the case study. It is the mean temperature prevailing in the open air, which was introduced in the ASHRAE 55-2010 standard as an input variable for calculating the adaptive comfort model. It is based on the arithmetic average of the mean daily outdoor temperatures over no fewer than 7 and no more than 30 sequential days prior to the day in question. This data will be used for graphics comfort that the program will present as part of the results.

- The Meteorological Wind Speed, measured for the area, in meters per second. This depends on the data from nearby stations, measurements or documentation. According to CIBSE (England) this wind speed can be measured in an open field, at a height of 10 meters above ground level.

- The Terrain Data corresponding to terrain conditions that will influence the speed wind indicated in the previous point. The options are: keep meteorological values (this can be used when site conditions are unknown), open flat country, country with scattered windbreaks (some obstacles), an urban or a city. When choosing either of these options the program will apply a constant value of the wind speed to adjust to the effects of the terrain. As a footnote you can see: "*Wind speed is only considered in Buoyancy + Wind calculations. Wind direction is assumed perpendicular to the surface of the inlets. It is recommended to consider reduced wind velocities according to the complexity of the urban layout*".

- Finally, the Azimuth or plane direction of air entering the building is requested. The cardinal point is oriented to the side where the building has the inlets. In the image, click on the orientation and the arrow is positioned in the direction of the air inlet. The inlet (surface) azimuth is used to estimate solar gains in cells for the current sun position (given by latitude, month and time).

Airflow Data Input

In the tab, Data Calculation Airflow, a screen is blank. At the top, the natural ventilation strategy selected is shown. Some notes which clarify the operation of the strategy and other relevant data are included.
On the left (9) possible cases depending on the strategy used. Should choose the case to assess, and click the image.

When choosing a case, a series of images and options are displayed. The program comes with default data to be exchanged for the case data to assess.
A central image expands the chosen case (10). On the top, an explanatory note makes the clarification that to add temperature data should be considered a difference of temperature between 1 and 3 ° C for ventilation hours a day, and between 2 and 4 ° C for night ventilation. This for the buoyancy effect or temperature differential occurs.

The program requires data about outdoor temperature and the indoor temperature (which must be based on measurements or estimates be made for this type of building in the area of study). The temperature differential that appears on the left will be filled with data when entering the outdoor and indoor temperature. As you begin to make changes, you may display the program results in the right side. This is done according with changes that are made and lets you review previous results with data included.

It also requests the effect stack height in meters. This is usually the height between the center of the inlet vent and the center of the outlet vent. In the case of a single vent where air enters and leaves through of the same vent, this height corresponds to the full height of the opening. Such observations appear if you click on the question mark next to the box.

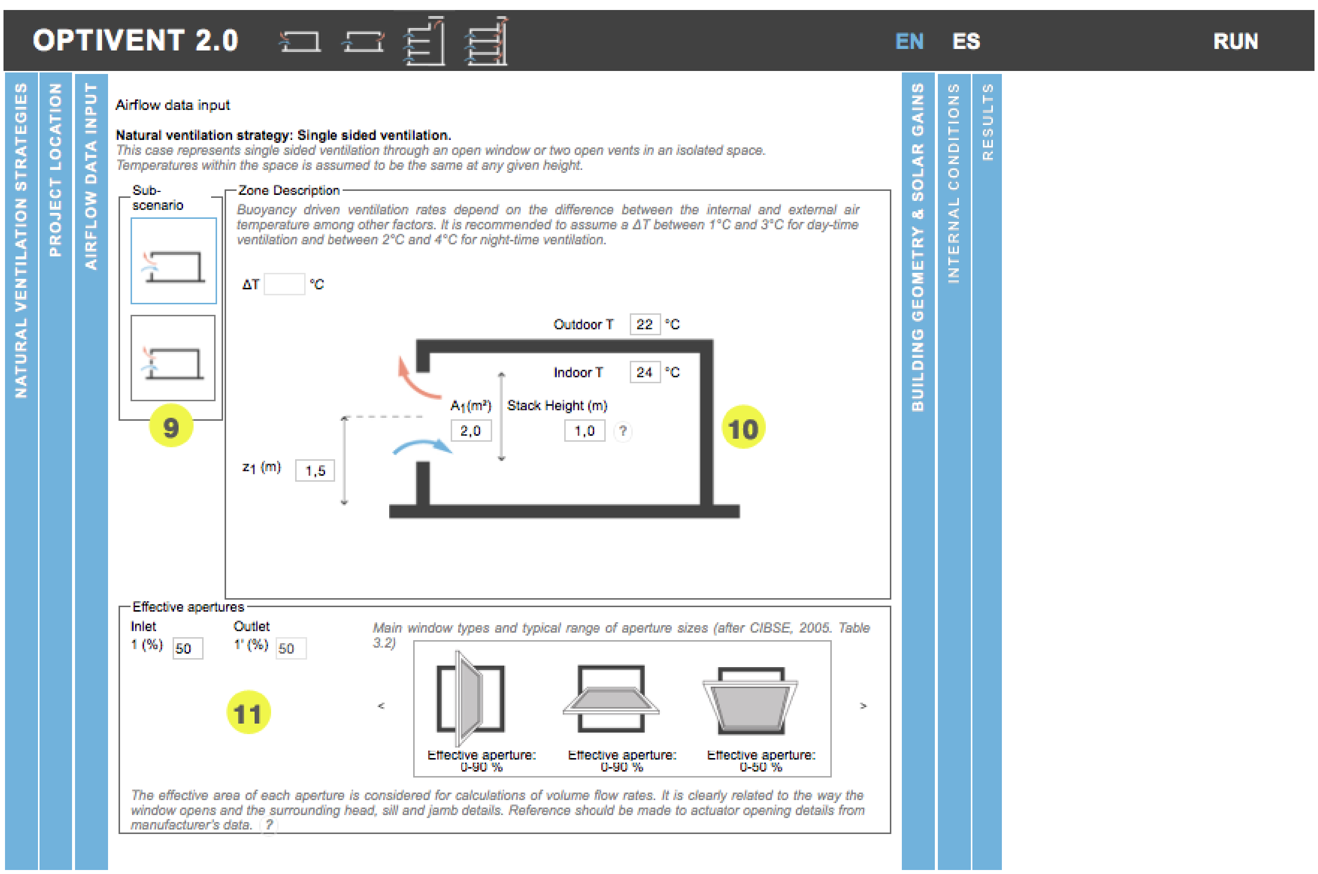
The image request the A1, this corresponds to the opening area 1 (inlet) in square meters. Depending on the case, several major areas may appear. This is the total area of the opening.

Then you must add the Z1, which corresponds to the distance in meters from the floor to the center of the inlet opening.

Below this image, another section (11) where the effective area of each opening inlet or outlet is calculated appears. The percentage of the effective aperture is defined according to the type of window to use. To the right of the section appear several types of options with their respective effective area for reference. If you moving to the right or left, you can see the options. With these data, the spaces of effective area for each opening (input or output) are filled..

A footnote indicates that the effective area of each opening is considered to calculate the air flows. It is directly related to the way in which the window frame, sill and jambs open. It is recommended seek a manufacturer reference on the opening mechanism.

Figure 4: Airflow Data Input

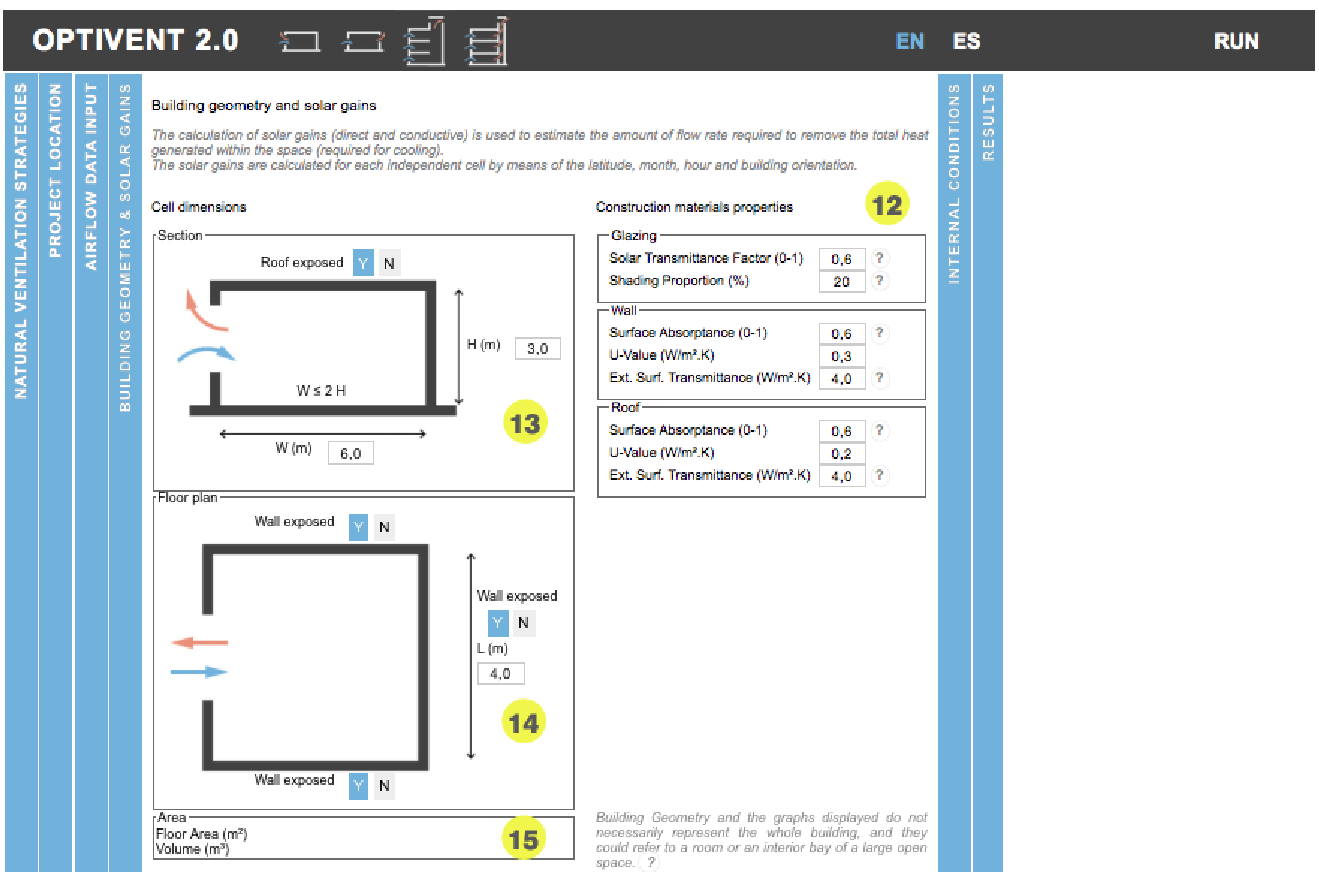


Building Geometry & Solar Gains

In the tab, Geometry Building & Solar Gains, displays on the right side section (12) to complete the calculation of direct solar gains and conduction through the glass, walls and ceiling. A note at the top indicates that the calculation of solar gains (direct and conductive) is used to estimate the flow rate required to remove the total heat generated inside the space (required for cooling).

In the section of Glazing, solar transmittance factor or G-Value is requested. This depends on the type of glass. If we enter the help symbol located next to the box, indicating that the G-value is the fraction of solar radiation transmitted by the glazing expressed as a number between 0 and 1, where 1 indicates the highest gain possible solar heat and zero non-solar heat gain. Besides the shading proportion of glazing is requested. The help message, explains that this corresponds to the proportion of the glazing that is in the shade, expressed in percentage format, where 100% indicates full shading and 0% no shading. This is used to represent external shading.

Figure 5: Building Geometry & Solar Gains



In the section, Walls is considered the same materiality for all exterior walls of the building (in order to simplify the calculation). First the surface absorptance is requested, which is defined as the proportion of solar radiation absorbed by a surface, expressed as a number between 1 and 0. Standardised values suggest 0.9 for dark coloured materials and 0.5 for light coloured materials. Then, the U value or thermal transmittance of walls is requested. This factor is well known and is defined in thermal regulations, according to the wall components. Is the rate of transfer of heat (in watts) through one square metre of a structure divided by the difference in temperature across the structure. It is expressed in watts per metres squared kelvin, or W/m^2K.
Finally, the External Surface Transmittance of the wall is required. This is the thermal transmittance of the external surface exposed to solar radiation expressed in W/m^2K and it is dependent on the thickness of the constructional layer and thermal conductivity of the material. In the help section, typical transmittance values for various building materials are indicated.

In the Roof section, the same data is requested, but for the ceiling surface. For thermal transmittance or U-value we consider the materials that form the roof. For the external surface transmittance will be considered the outer coating material of the roof.

After completing these spaces, in the central part of the screen two diagrams of the building section (13) and floor plan (14) appear. Here, the dimensions corresponding to H (height), W (width) and L (long) of space are requested in meters. For reference, the program tells us that for the strategy to work, the W (width) must have a relation to height (H) depending of the ventilation strategy. Below, (15) the program calculates the floor area in square meters and the total volume of space in cubic meters.

In addition, the program asks if the walls and ceiling are exposed to direct sunlight (to take into account gains heat in the interior). Here you have the option of marking Y (Yes) or N (No). For all the calculations it is assumed that the entrance wall is exposed.

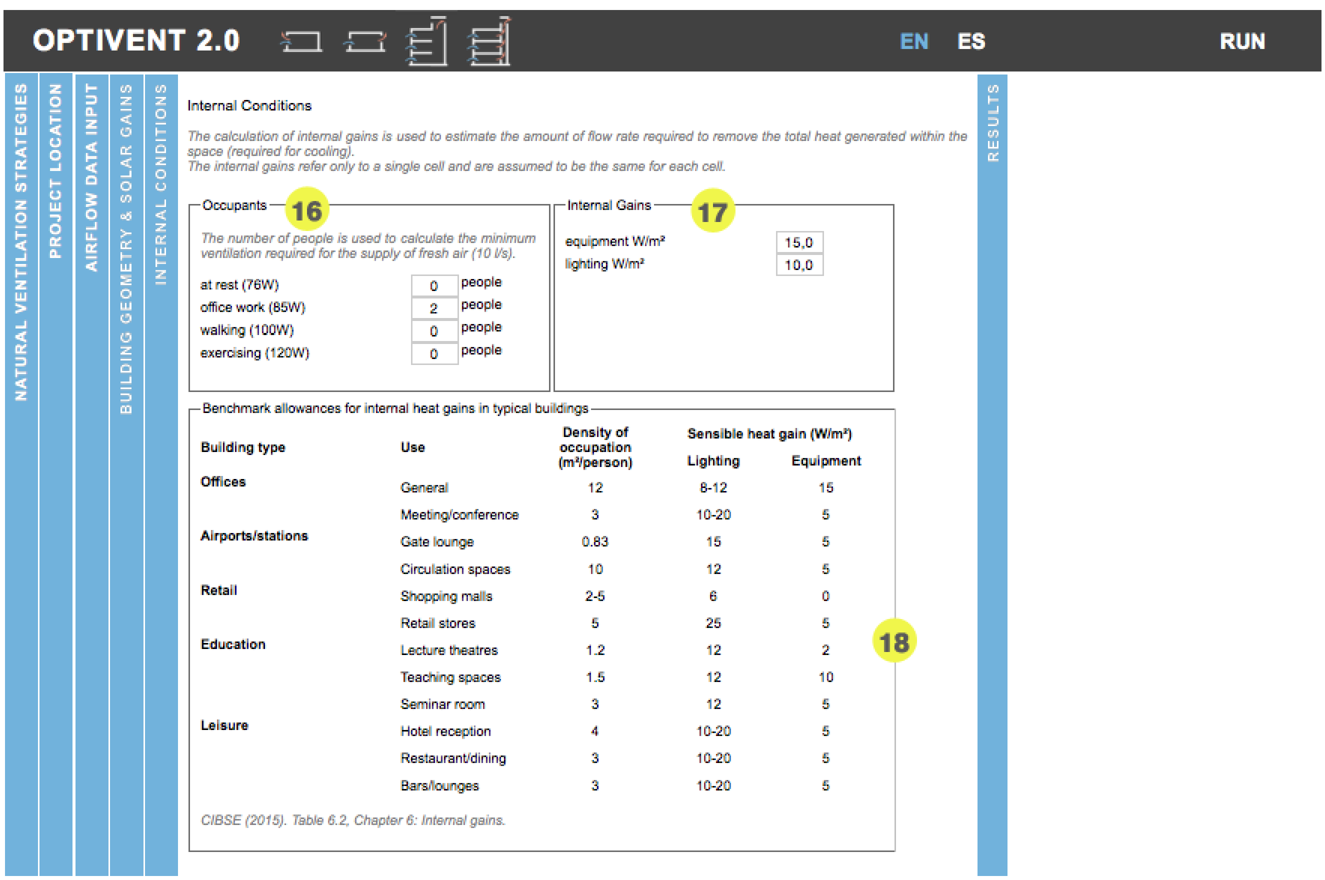
Internal Conditions

The last section to be completed by the user corresponds to the Internal Conditions. Some sections referring to data on occupants and internal gains from equipment are deployed.

A note at the top, indicates that the calculation of internal gains is used to estimate the amount of flow rate required to remove the total heat generated within the space (required for cooling). This section also comes with default data.

In the section Occupants (16), the number of users of space are requested, to be calculated according to the activity carried out. You must add the total number of occupants who perform each task. This data is used to calculate the minimum required ventilation to provide fresh air (10 liters per second per person).
In the section, Internal Gains (17) must be entered gains produced by equipment and lighting in watts per square meter. So to enter this data, you can use the lower table on page (18) where there are reference values for internal heat gains in buildings. With the density data, sensible heat gain and type of building, you have the information to fill in the table above. This information is taken as reference of the CIBSE (England), Chapter 6.

Figure 6: Internal Conditions



Building type	Use	Density of occupation (m²/person)	Sensible heat gain (W/m²) Lighting	Equipment
Offices	General	12	8-12	15
	Meeting/conference	3	10-20	5
Airports/stations	Gate lounge	0.83	15	5
	Circulation spaces	10	12	5
Retail	Shopping malls	2-5	6	0
	Retail stores	5	25	5
Education	Lecture theatres	1.2	12	2
	Teaching spaces	1.5	12	10
	Seminar room	3	12	5
Leisure	Hotel reception	4	10-20	5
	Restaurant/dining	3	10-20	5
	Bars/lounges	3	10-20	5

Results

Finally completed all the data is entered to the Results tab. To update should go to the section and click Run. (19)

The different graphics appear on the right half of the screen. (20) The total data appears in the left half. (21)

The results for Buoyancy appear on the right side of graphics and data relating to Buoyancy plus the effect of wind on the left side appear. Keep in mind that the worst case scenario is always the Buoyancy effect, then the result improved by adding wind.

In the first graph, the air flow in m3/s is observed. Comparing the required flow to fresh air, cooling (removing heat gains) and the air flow achieved. If the mouse is placed over each bar you can see the corresponding values.

Beside this first graph, you can pass the results to air changes per hour or energy in Wh/m2. Next to each graphic, you can see a menu (three horizontal lines). By clicking on it provides options to print or download the chart in PNG, JPG, PDF or vector graphics format.

The middle graph, indicates the Cooling Effect of Air Movement, which corresponds to the relationship between reducing internal temperature and the wind speed in meters per second. Placing the mouse over the graph, you can see the values achieved.

Finally, the lower graph corresponds to the Adaptive Comfort Band according to the ASHRAE 55-2013. This relates to the relationship between the operative temperature prevailing with the mean outdoor temperature. This in order to know if it is within the limits of acceptability. Passing the mouse over the graph indicates if it meets according to the provisions of the standard and accepted values. All these graphics can be saved by clicking on the menu.

The left side of the screen, shows summary values:

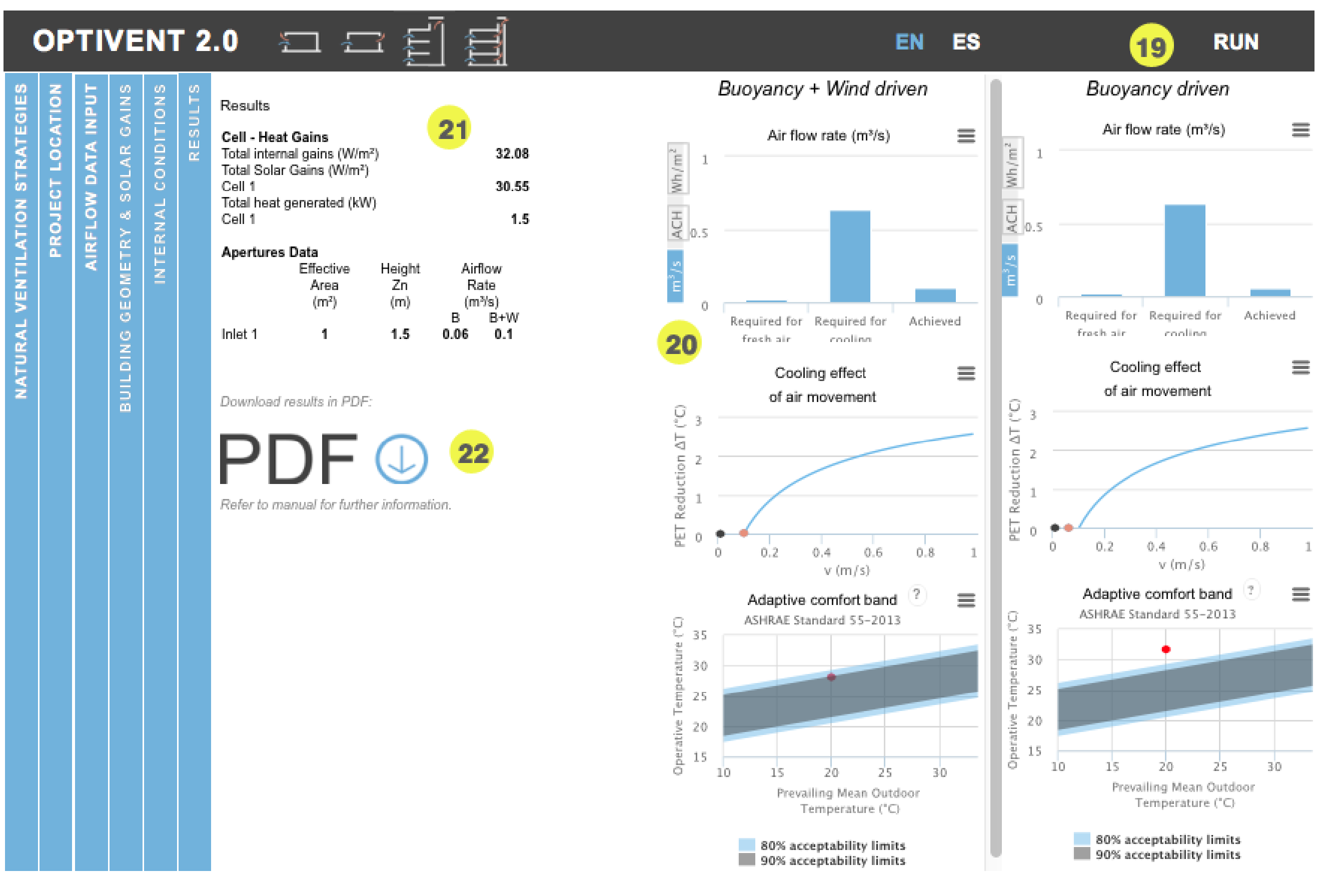
- Total Internal Gains, in watts per square meter (produced by occupants and equipment).
- Total Solar Gains in watts per square meter (produced by walls, glazing and roof).
- And the Total Heat Generated in kilowatts.

These data are given by space. If a space with several levels is calculated every level or space will appear separately.

Then, the data of window opening or inlet and outlet are described. Is described, the effective area, the location of the neutral plane and summary data air flow in cubic meters per second (for opening) for both buoyancy and, for buoyancy + wind.

Finally, a button appears to download the results in PDF format. (22)

Figure 7: Results



OPTIVENT 2.0

naturalcooling

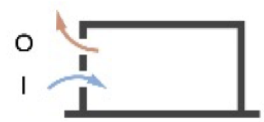
A Natural Ventilation Steady-State Calculation Tool for the Early Design Stage of Buildings.

Project Data:

Project Name:	**Project Name**
Version:	**Run 1**
Date:	**2015-08-06**
Consultant:	**Consultant**

Natural ventilation strategy:

Single sided ventilation



Location Data:

Latitude (decimal degrees):	**52**
Month:	**January**
Hour:	**12**
Prevailing mean outdoor temperature (°C):	**20.0**
Meteorological Wind Speed (m/s):	**1.0**
Terrain data:	**1**
Inlet (surface) Azimuth:	**N**

Building Data:

Cell - Floor area (m²):	**24**
Cell - Volume (m³):	**72**
Outdoor temperature (°C):	**22**
Indoor temperature (°C)	**24**
To - Ti (°C):	**2**

Construction Data:

Glazing:

Solar Transmittance Factor (0-1):	**0.6**
Shading Proportion (%):	**20**

Wall

Surface Absorptance (0-1):	**0.6**
U-Value (W/m²·K):	**0.3**
Ext. Surf. Transmittance (W/m²·K):	**4.0**

Roof

Surface Absorptance (0-1):	**0.6**
U-Value (W/m²·K):	**0.2**
Ext. Surf. Transmittance (W/m²·K)	**4.0**

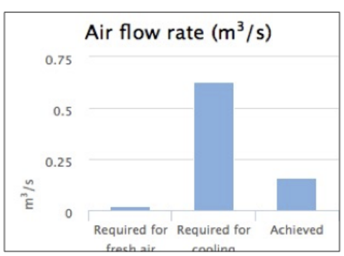
Cell - Heat Gains:

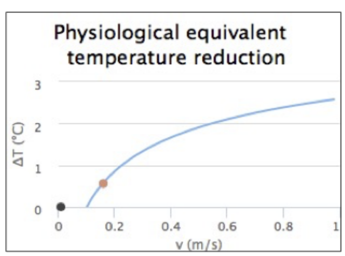
Number of people:	**2**
occupant gains (W/m²):	**7.08**
Equipment gains (W/m²):	**15**
Lighting gains (W/m²):	**10**
Total internal gains (W/m²):	**32.08**
Total Solar Gains (W/m²) Cell 1:	**30.55**
Total heat generated (kW) Cell 1:	**1.5**

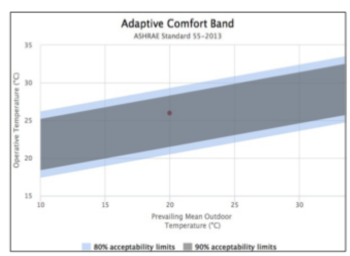
Apertures Data:

	Effective Area (m²)	Height Zn (m)	Airflow Rate (m³/s) B	Airflow Rate (m³/s) B+W
Inlet 1:	**1**	**1.5**	**0.16**	**0.25**
Outlet 1:	**1**	**2**	**0.16**	**0.25**

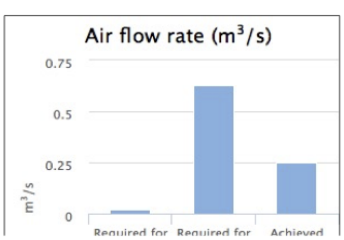
Buoyancy driven

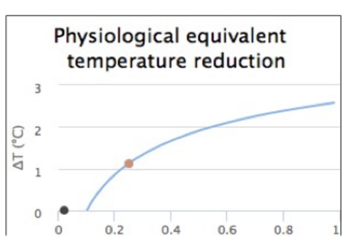


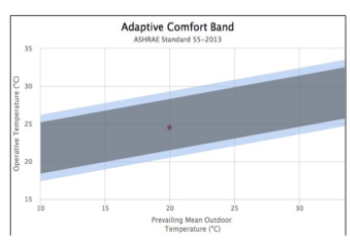




Buoyancy + Wind driven







The link to the PDF opens a new window where a summary sheet appears. This includes all data entered in the previous tabs: project data, the strategy chosen, the location data, building data, construction data, results for heat gains and air flows and complementary graphics. This sheet, can be saved or download to your computer.

Any data that you want to recalculate, you can return to the previous tabs, make changes and return to run. Remember that if you want a PDF of each change, you must return to the location tab and rename the version for control of changes.

For other strategies, the process is similar. Just change the graphics and the amount of information requested. Examples with more levels and openings, require data for each level. In the case of Chimney, the temperature of the chimney will be requested as additional data (it is the only case where it is not considered the uniform internal space temperature.)

This summarizes the stages for using the program, Optivent 2.0.
Any queries, you can access the web: http://optivent.ubiobio.cl, with project information and supporting data for its application.

Support

For questions or need to report a fault of the program, please write to:

http://optivent.ubiobio.cl/Contactenos/

Or write directly to

optivent@ubiobio.cl