

How to implement natural ventilation in BSim

Program: BSim (Building Simulation)
Development and maintenance: SBI (Danish Building Research Institute)

Introduction

BSim have an excellent user guide, so the purpose of this document is only to add lacking information on how to include natural ventilation in a BSim simulation.

Our experience is that the systems used for analyzing natural and hybrid ventilation in BSim are both user friendly and well tested.

If natural pulse ventilation is used during the winter, we recommend to supplement with a separate calculation analyzing the CO₂ level during winter time using steady state calculations. Using this calculation allows you to determine the required amount of time that windows

should be open throughout the day based on personal load. WindowMaster's dedicated experts will gladly help with you make this calculation.

Often it is only necessary to create models for two or three rooms (thermal zones), e.g. one typical room and one worst-case room. However, at other times, it is necessary to create models for more or less all rooms if the internal loads, usage, orientation etc. of the rooms differ markedly.

You will only get one operative temperature per thermal zone. Hence a room needs to be divided into more zones if for instance the exposure from the sun is very different in different areas in the room.

Thermal stratification up through the thermal zone can be simulated using "Kappa Model". This can be used for e.g. an atrium.



Systems for natural ventilation

BSim have two ways to calculate natural ventilation:

- Venting system
- Natural ventilation system

Venting system can be used for all kinds of building geometry while **Natural ventilation system** is primarily for buildings with traditional geometry (square and rectangular buildings) since this system will use standard wind pressure coefficients for each window. You could use **Natural ventilation system** for other geometry, then you just need to look closely into the air change variations during the year.

For a natural ventilation solution with assisting mechanical exhaust we recommend using **Venting system**.

If you have traditional building geometry your results using **Natural ventilation system** could be a bit more accurate compared to **Venting system**, but our experience is, that both systems are very suitable for calculating natural ventilation.

The weather data file must contain information about the wind speed to make a simulation of natural ventilation.

Venting system

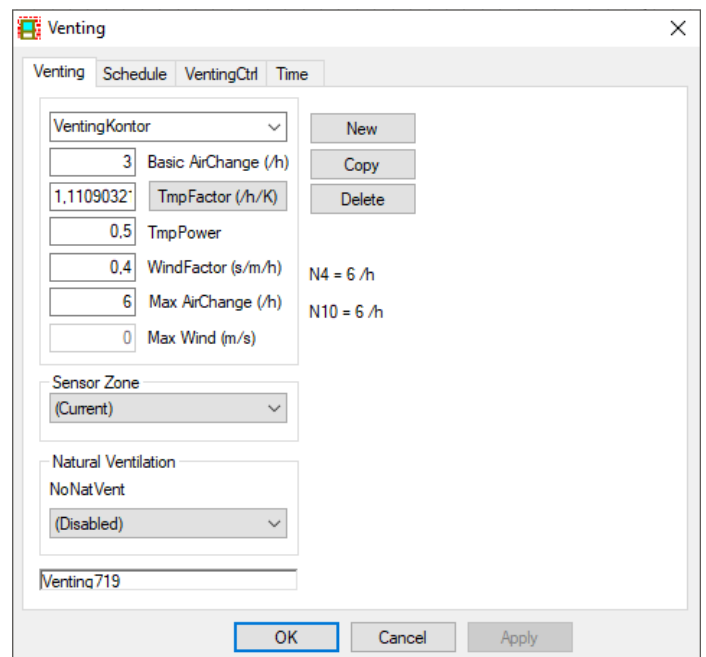
Venting can simulate an air change, which varies with the difference between the temperature indoors and outdoors plus the wind speed. When there is a tendency for the setpoint to be exceeded, the natural ventilation is increased, but only up to a user-defined maximum air change.

You will find help in the user guide for each value you need to enter in **Venting**.

On WindowMasters website, windowmaster.com/nvcalc, you will be able to calculate the **Basic AirChange**, if you are unsure what value to use.

Max AirChange will often be set to 6 h^{-1} if the room is for seated activity.

In **Schedule** you will often make more lines. One for summer day ventilation with a setpoint of e.g. 23°C and one for summer night ventilation with a setpoint of e.g. 20°C . Night ventilation could stop around 4-5 AM to make sure the building is well tempered when people arrive. Finally, you will make one line for winter ventilation with a setpoint of e.g. 21°C .



The screenshot shows the 'Venting' dialog box with the following settings:

- VentingKontor:** VentingKontor
- Basic AirChange (/h):** 3
- TmpFactor (/h/K):** 1,1109032
- TmpPower:** 0,5
- WindFactor (s/m/h):** 0,4
- Max AirChange (/h):** 6
- Max Wind (m/s):** 0
- Sensor Zone:** (Current)
- Natural Ventilation:** NoNatVent (Disabled)
- Instance Name:** Venting719

Buttons: New, Copy, Delete, OK, Cancel, Apply.

Example of Input in the Venting system



Natural ventilation system

Natural ventilation is implemented as a special kind of **Venting** in an expansion module of BSim and is based on By og Byg (SBI) Direction 202 (2002) which sets out how to make air change calculations for natural ventilation.

Natural ventilation requires input at various places: **Site**. **Finish**. **Opening**. **Window**. **Venting**. In the user guide you will find excellent help, we will only focus on a few elements.

Finish needs to be filled in for walls and roofs facing outdoors. You will find Finish in the tree structure just beneath the building element.

Window

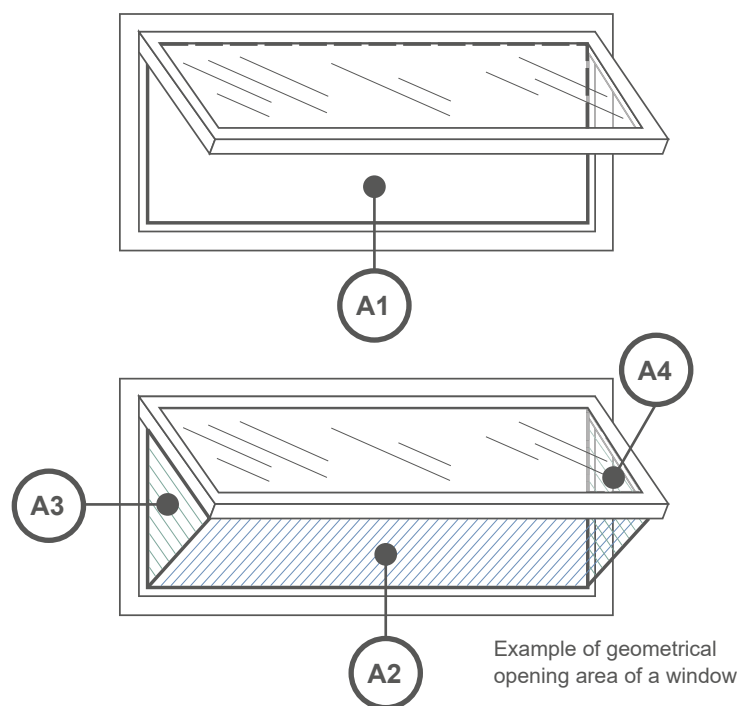
$A_{\text{frac}} \times A$ needs to be equal to the geometrical opening area of the window hence the opening area when the window is open for ventilation.

A1 or A2 + A3 + A4.

The lowest of the two is the windows geometrical opening area.

It needs to be considered whether building elements, solar shading or similar block for the airflow and therefore reduce the geometrical opening area.

Based on placement of openings the most suitable model can be identified automatically by BSim or you can choose yourself. Only openings facing the ambient are considered.



Results

When evaluating the results, it may be beneficial to look at outdoor temperature, operative temperature, windspeed and air change at the same time to see how the thermal zones performs during the year. If using pulse ventilation during winter time you can make a separate analysis as stated earlier in the document.



WindowMaster aspires to protect people and the environment by creating a healthy and safe indoor climate, automatically ventilating spaces with fresh air through facade and roof windows in buildings. We offer the construction industry foresighted, flexible and intelligent window actuators and control systems for natural ventilation, mixed-mode ventilation, and smoke ventilation – of the highest quality.

WindowMaster employs around 135 highly experienced cleantech specialists in Denmark, Norway, Germany, United Kingdom, Ireland, Switzerland, and the United States of America. In addition, we work with a vast network of certified partners. With our extensive expertise built up since 1990, WindowMaster is ready to help the construction industry meet its green obligations and achieve their architectural and technical ambitions.

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