# AirflowNetwork Model

### Model Output

### The available outputs from the AirflowNetwork model are described in the EnergyPlus Input Output Reference manual.Occupant Ventilation Control

The AirflowNetwork:OccupantVentilationControl object enhances the AirflowNetwork model and provides more practical and advanced controls for window opening and closing operations, based on the paper (Marais & Teichmann, 2014). This new feature includes minimum opening and closing time control, indoor thermal comfort control, and opening and closing probability controls.

A flow chart of indoor thermal comfort control is shown in Figure 1. The scheme includes controls for opening and closing probability controls. The calculation procedures are presented below:

* The first check will be closing and opening time check to ensure the window closing elapsed time or opening elapsed time is longer enough than the minimum time.

Closing elapsed time > minimum closing time

Opening elapsed time > minimum opening time

* If time is not long enough, the previous status will be kept. If time is long enough, it will check whether minimum time checked are only inputs or not. If yes, the other ventilation control defined in the field of Ventilation Control Mode in AirflowNetwork:MultiZone:Zone or AirflowNetwork:MultiZone:Surface will be used to determine window openness.
* The comfort temperature of Tcomf will be calculated as a function of the outdoor dry-bulb temperature: Tao\_i. The comfort calculation will be based on two curves and boundary temperature point. The filed names are provided below:

Thermal Comfort Low Temperature Curve Name

Thermal Comfort Temperature Boundary Point

Thermal Comfort High Temperature Curve Name

* Then the comfort band is calculated as a function of the design personal dissatisfaction PPD.

ϴ = -0.0028 (100-PPD)² + 0.3419 (100-PPD) – 6.6275

The equation is valid for PPD 0% to 35%

* The zone air operative temperature, Tg, will be compared to the thermal comfort, Tcomf, temperature and band, ϴ.

Tg > (Tcomf + ϴ) && Opening probability

* If the comparison of the zone operative temperature is greater, the further check of opening probability will be performed. If the comparison is less, the window will remain in its current state.
* If also the opening probability is greater than a random number, the window is opened. Otherwise, it will remain in its current state.
* In addition to opening probability check, a closing probability check will be performed. The comparison between the zone air operative temperature, Tg, and the comfort temperature and band is performed before the closing probability check.

Tg < (Tcomf - ϴ) && Closing Probability)

* If the comparison of the operative temperature is less than the allowed (Tcomf - ϴ), the window will be allowed close.
* If also the closing probability is greater than a random number, the window is closed. Otherwise, it will remain in its current state.



Figure 1 Flow chart of indoor thermal comfort control

A flow chart for opening probability control is illustrated in Figure 2. Opening probability control also provides an option for random number check. The control logic of opening probability is described as follows.

* The first check will be closing time to ensure the window closing elapsed time is longer enough than the minimum closing time.

Closing time > minimum closing time

* If not long enough, the output is false, so that a window remains closed.
* If time duration is long enough, a check of occupancy is performed.
* If a zone is not occupied and the occupancy check is requested, the output is false. If yes, zone air temperature at the previous time step will be checked as an.
* Perform setpoint check. If the temperature is between the cooling and heating setpoints, the probability check will be followed. Otherwise, the output is false.

Heating setpoint < Tzone-air < Cooling setpoint

* A choice is provide at this stage, so that the probability check may be performed or by-passed. If by-passed, the output will be true to open a window. If performed, probability will be calculated.

OTP = Schedule value or specific function

* If the probability check is performed and the probability is greater than a random number, the output is true.

OTP > random number

* The results will be false in other scenarios.



Figure 2 Flow chart of opening probability

A flow chart of opening probability is shown in Figure 3. The control logic of closing probability is described as follows.

* The first check will be opening time to ensure the window opening time duration is longer enough than the minimum opening time.

Opening time > minimum opening time

* If not long enough, the output is false, so that a window remains open.
* A choice is provide at this stage, so that the probability check may be performed or by-passed. If by-passed, the output will be true to close a window. If performed, probability will be calculated.

CTP = Schedule value or specific function

* If the probability check is performed and the probability is greater than a random number, the output is true.

CTP > random number

* The results will be false in other scenarios.



Figure 3 Flow chart of closing probability control

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