Infiltration Calculations in AccuRate

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1. GENERAL

In AccuRate, the infiltration rate, in air changes per hour for each zone, is specified as $A + B*v$, where v is the hourly wind speed (m/s) from the AccuRate weather files multiplied by the terrain factor specified in Eq. (1):

$$f = \left(\frac{a_b}{a_r}\right)\left(\frac{10}{h_r}\right)^{b_r}\left(\frac{h_b}{10}\right)^{b_b} \quad (1)$$

where h_b is the eaves (or roof) height (m) above ground for building height less than 9 m. If the building is higher than 9 m, then h_b is the mid-height of the zone above the ground. h_r is the mast height (m) in the reference terrain at which the wind speed was measured, a_b and b_b are the terrain constants for the building terrain (given in the table below), and a_r and b_r are the terrain constants for the reference terrain where the wind speed was measured (given in the table below). Normally wind speed is measured at an airport with a 10 m mast, so that a_r = 1.00 and the formula simplifies to

$$f = a_b\left(\frac{h_b}{10}\right)^{b_b} \quad (2)$$

	Terrain Category			
	Exposed	**Open**	**Suburban**	**Urban**
a	1.00	0.85	0.67	0.47
b	0.15	0.20	0.25	0.35

A is the stack infiltration factor and B is the wind infiltration factor. A and B will be described in details later.

2. INFILTRATION RELATED INPUTS IN ACCURATE

Currently, in AccuRate, there are three locations for specifying infiltration related information:

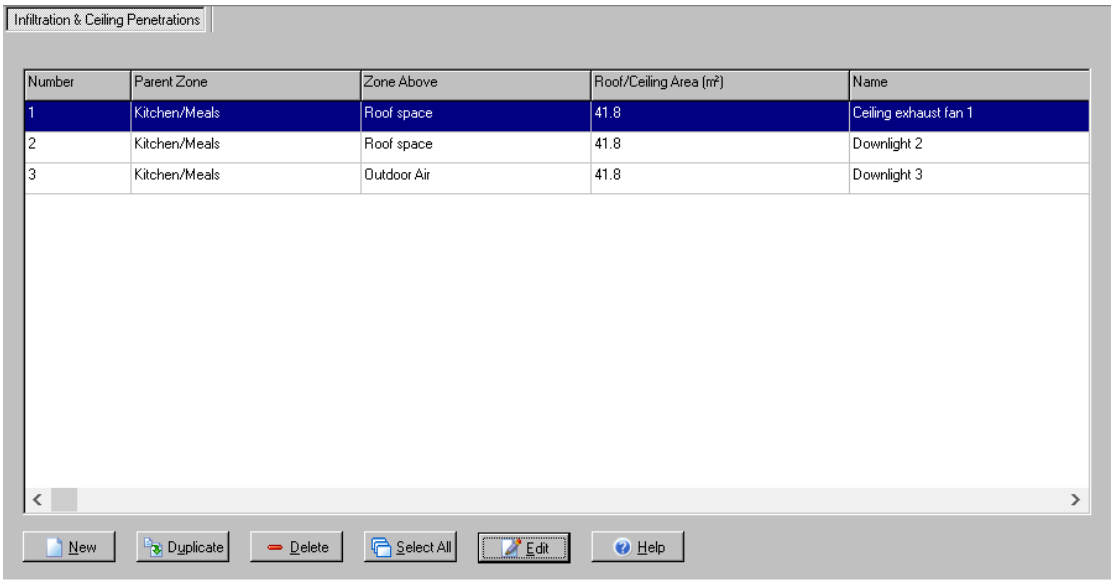
1. In the Zone Page
2. In the Element – External Wall Type – Window and Roof Windows
3. In the Element – External Wall Type – External Doors

2.1 Zone Page Infiltration Inputs

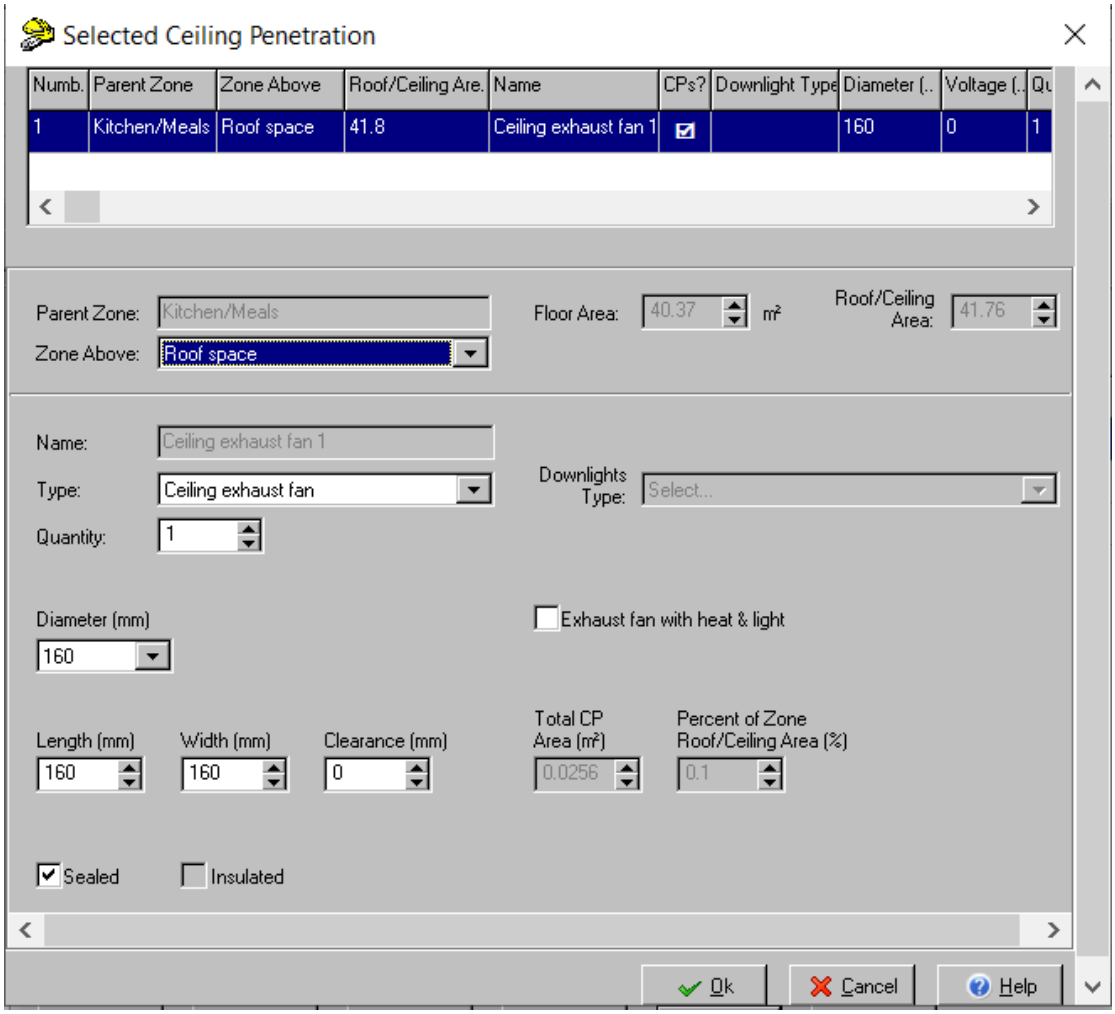
Infiltration: The information required depends on the zone type as follows:

Zone type is not Roof Space or Sub-floor

Add in infiltration-inducting items in the Zone | Infiltration & Ceiling penetration section:



Specify the type and number of infiltration-inducting items as shown below.



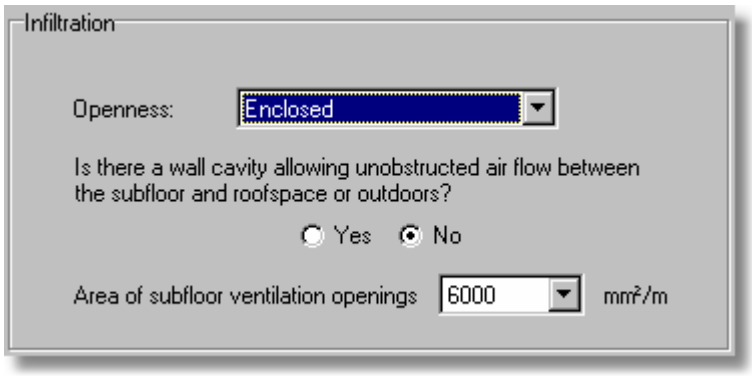
Zone type is Roof Space

Sarking: Choose 'Sarked' or 'Unsarked'. Sarked means that a continuous layer of sarking material is installed underneath the roof cladding (it need not be low-emissivity). Choosing Sarked imposes a lower infiltration rate than does Unsarked.

Roof Surface: Choose from 'Continuous' or 'Discontinuous'. Discontinuous indicates that there are gaps in the roof construction, and imposes a higher infiltration rate than does Continuous.

Openness: Choose from 'Standard', 'Ventilated' or 'Highly Ventilated'. Standard indicates that no specific ventilation openings are provided. Ventilated indicates that purpose-built ventilation openings are provided. Highly Ventilated indicates that the roof space is very well ventilated with large openings.

Zone type is Sub-floor



Openness: Choose from 'Enclosed', 'Open' or 'Very Open'.
'Enclosed' indicates that the only ventilation openings are those required for compliance with building codes (see below).
'Open' indicates that additional openings are provided for ventilation.
'Very Open' indicates that the sub-floor space is very well ventilated with large openings.

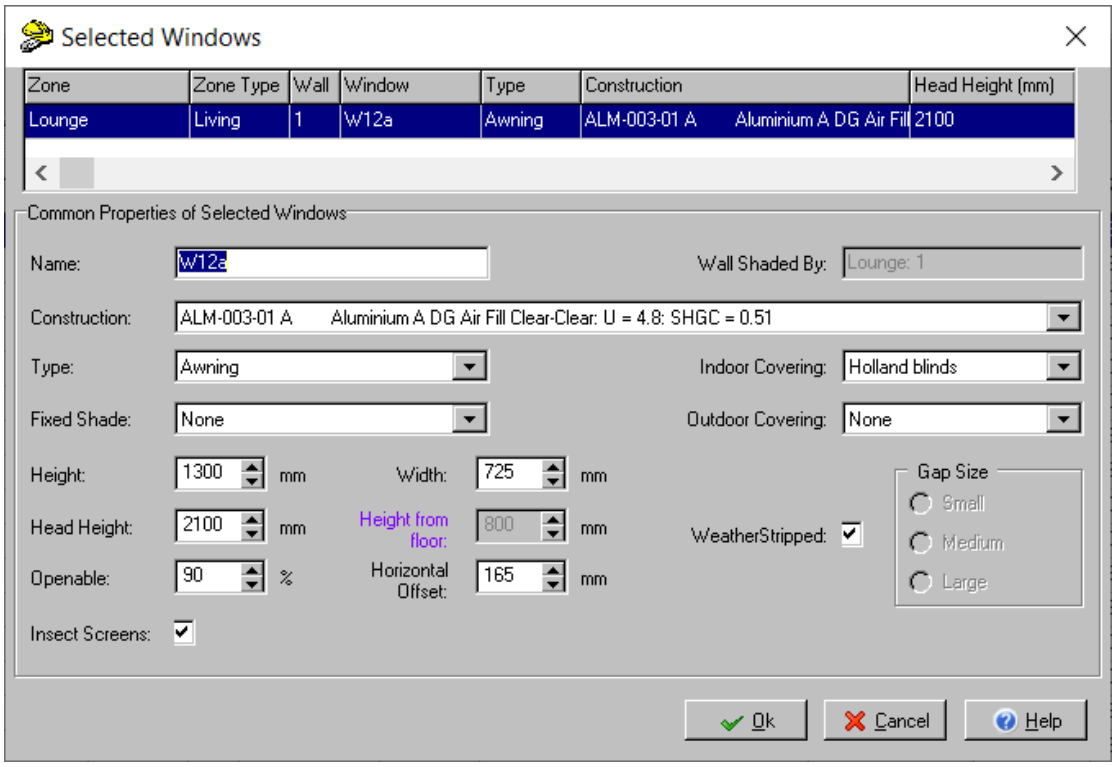
Is there a wall cavity..: Only relevant if Openness = 'Enclosed'. Select Yes or No.
If No is selected, the sub-floor infiltration rate is estimated from the area of ventilation openings (see below).
If Yes is selected, the infiltration rate will be higher, but is not yet well understood. For this version of AccuRate, the infiltration rate assumed is equal to that used in NatHERS.

Area of sub-floor

ventilation openings: Choose from one of the available values. Units are mm²/(m of sub-floor wall). Check the relevant building code to determine an appropriate value.

2.2 Window Infiltration Inputs

Window details



For windows, infiltration inputs are only allowed to modify for existing building and renovation, not allowed for new building in rating mode.

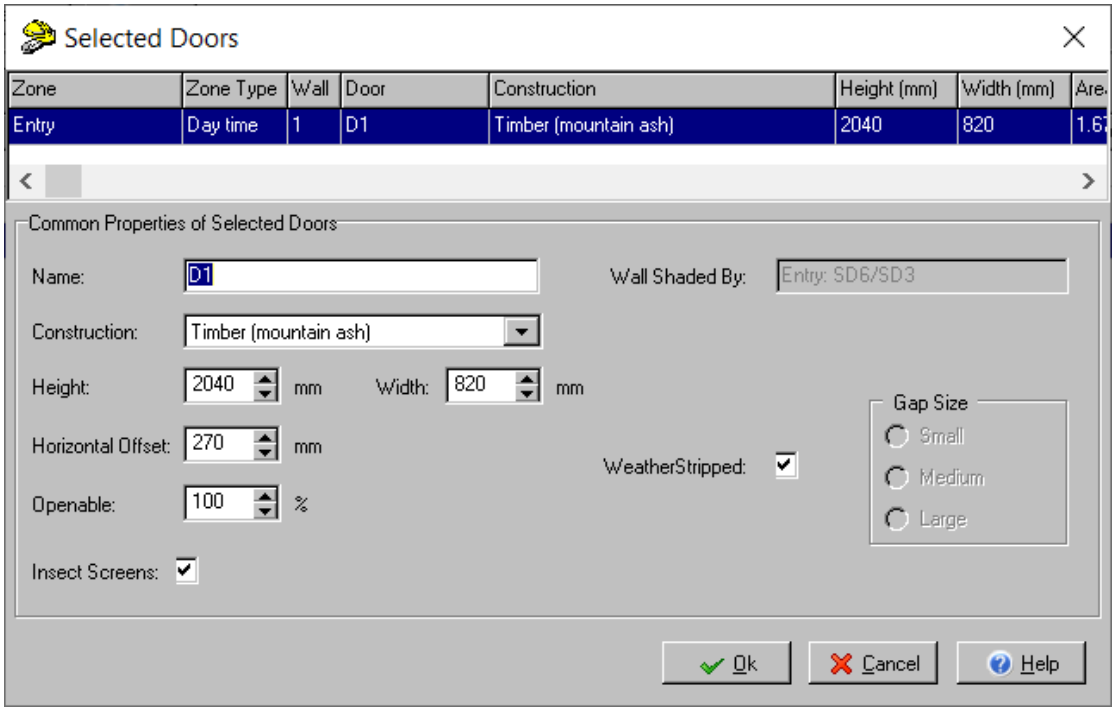
WeatherStripped: Check the box if the window has been weather stripped. If the box is checked, the Gap Size radio buttons are disabled and the Gap Size is set to Small.

Gap Size: This allows you to specify the size of gaps around the window frame.

Small: Very tight fit
Medium: Paper fits into gap
Large: Credit card fits into gap

2.3 Door Infiltration Inputs

Door details



For doors, infiltration inputs are only allowed to modify for existing building and renovation, not allowed for new building in rating mode.

WeatherStripped: Check the box if the door has been weather stripped. If the box is checked, the Gap Size radio buttons are disabled and the Gap Size is set to Small.

Gap Size panel: This allows you to specify the size of gaps around the door.

Small: 5 mm
Medium: 10mm
Large: 15mm

3. STACK AND WIND INFILTRATION FACTORS

3.1 Zones not of type roofspace or not of type subfloor/shared basement carpark

BaseStack_Factor = 0.011554;
BaseWind_Factor = 0.003851;

DownLightStack_Factor = 1.00909;
DownLightWind_Factor = 0.0;

ExhaustFanStack_FactorSealed = 1.12;
ExhaustFanWind_FactorSealed = 0.0;

ExhaustFanStack_FactorUnsealed = 5.6;
ExhaustFanWind_FactorUnsealed = 0.0;

FirePlaceStack_FactorSealed = 1.002;
FirePlaceWind_FactorSealed = 4.34478;

FirePlaceStack_FactorUnsealed = 16.7;
FirePlaceWind_FactorUnsealed = 72.41294;

WallVentStack_Factor = 1.39;
WallVentWind_Factor = 1.193555;

VentedSkylightStack_Leak = 11.1;
VentedSkylightWind_Leak = 8.9824;

UnsealedWindowStack_FactorLargeGap = 0.157153;
UnsealedWindowWind_FactorLargeGap = 0.052384;
UnsealedWindowStack_FactorMediumGap = 0.073954;
UnsealedWindowWind_FactorMediumGap = 0.024651;
UnsealedWindowStack_FactorSmallGap = 0.046225;
UnsealedWindowWind_FactorSmallGap = 0.015408;

SealedWindowStack_Factor = 0.032354;
SealedWindowWind_Factor = 0.010785;

SealedExternalDoorStack_Factor = 0.25434;
SealedExternalDoorWind_Factor = 0.08478;

UnsealedExternalDoorStack_FactorLargeGap = 2.79778;
UnsealedExternalDoorWind_FactorLargeGap = 0.93259;
UnsealedExternalDoorStack_FactorMediumGap = 1.74861;
UnsealedExternalDoorWind_FactorMediumGap = 0.58287;
UnsealedExternalDoorStack_FactorSmallGap = 0.95378;
UnsealedExternalDoorWind_FactorSmallGap = 0.31793;

DwellingStack_FactorDwellingWeatherstripped = 0.011556;
DwellingWind_FactorDwellingWeatherstripped = 0.003852;

DwellingStack_FactorDwellingUnweatherstripped = 0.027733;
DwellingWind_FactorDwellingUnweatherstripped = 0.009245;

Assuming Dwelling unweatherstripped:
WindowFrameStack_Factor = 0.035759;
WindowFrameWind_Factor = 0.01192;

BaseStackLeak := znFloorArea * BaseStack_Factor;
BaseWindLeak := znFloorArea * BaseWind_Factor;

DownLightStackLeak := znIFnumVentDownlights * DownLightStack_Factor;
DownLightWindLeak := znIFnumVentDownlights * DownLightWind_Factor;

ExhaustFanStackLeak := znIFnumExhaustFansSealed * ExhaustFanStack_FactorSealed + znIFnumExhaustFansUnsealed * ExhaustFanStack_FactorUnsealed;

ExhaustFanWindLeak := znIFnumExhaustFansSealed * ExhaustFanWind_FactorSealed + znIFnumExhaustFansUnsealed * ExhaustFanWind_FactorUnsealed;

FirePlaceStackLeak := znIFnumChimneysSealed * FirePlaceStack_FactorSealed + znIFnumChimneysUnsealed * FirePlaceStack_FactorUnsealed;

FirePlaceWindLeak := znIFnumChimneysSealed * FirePlaceWind_FactorSealed + znIFnumChimneysUnsealed * FirePlaceWind_FactorUnsealed;

GasHeaterStackLeak := znIFnumUnfluedGasHeaters * 5.3 * WallVentStack_Factor; (5.3 gives 7.3 l/s for stack due to additional vents as required by WA)
GasHeaterWindLeak := znIFnumUnfluedGasHeaters * 8.8 * WallVentWind_Factor; (8.8 gives 10.6v l/s for wind due to additional vents as required by WA)

WallVentStackLeak := znIFnumWallCeilingVents * WallVentStack_Factor;
WallVentWindLeak := znIFnumWallCeilingVents * WallVentWind_Factor;

For Zone lit by vented skylights
SkylightStackLeak := NumberVentedSkylights * VentedSkylightStack_Leak;
SkylightWindLeak := NumberVentedSkylights * VentedSkylightWind_Leak;

If Door WeatherStripped
ExternalDoorStackLeak := SealedExternalDoorStack_Factor + DwellingStack_FactorDwellingUnweatherstripped;
ExternalDoorWindLeak := SealedExternalDoorWind_Factor + DwellingWind_FactorDwellingUnweatherstripped;

If Door not WeatherStripped
ExternalDoorStackLeak := DoorStackFactorGapSize + DwellingStack_FactorDwellingUnweatherstripped;
ExternalDoorWindLeak := DoorWindFactorGapSize + DwellingWind_FactorDwellingUnweatherstripped;

Here
DoorStackFactorGapSize := UnsealedExternalDoorStack_FactorSmallGap/ UnsealedExternalDoorStack_FactorMediumGap/ UnsealedExternalDoorStack_FactorLargeGap
DoorWindFactorGapSize := UnsealedExternalDoorWind_FactorSmallGap / UnsealedExternalDoorWind_FactorMediumGap /UnsealedExternalDoorWind_FactorLargeGap

UnsealedExternalDoorStack_FactorLargeGap = 2.79778;
UnsealedExternalDoorWind_FactorLargeGap = 0.93259;
UnsealedExternalDoorStack_FactorMediumGap = 1.74861;
UnsealedExternalDoorWind_FactorMediumGap = 0.58287;
UnsealedExternalDoorStack_FactorSmallGap = 0.95378;
UnsealedExternalDoorWind_FactorSmallGap = 0.31793;

If Window WeatherStripped
WindowStackLeak := self.znFloorArea * (AWindow.elArea/TotalWindowArea)* SealedWindowStack_Factor;
WindowWindLeak := self.znFloorArea * (AWindow.elArea/TotalWindowArea)* SealedWindowWInd_Factor;

If Window not WeatherStripped
WindowStackLeak := self.znFloorArea * (AWindow.elArea/TotalWindowArea)* WindowStackFactorGapSize;
WindowWindLeak := self.znFloorArea * (AWindow.elArea/TotalWindowArea)* WindowWindFactorGapSize;

Here, AWindow.elArea is the area of one window; TotalWindowArea is the total window area of this zone. So, the above calculation needs to be carried out for each window in this zone.

The following window frame stack and wind leakages are always calculated once for each zone, no matter whether windows are exist in the zone or not.
WindowFrameStackLeak := WindowFrameStack_Factor * self.znFloorArea;
WindowFrameWindLeak := WindowFrameWind_Factor * self.znFloorArea;

The total infiltration air change rate due to stack pressure and wind pressure are calculated as

TotalStackLeak := BaseStackLeak + DownLightStackLeak + ExhaustFanStackLeak + FirePlaceStackLeak + GasHeaterStackLeak + WallVentStackLeak + SkylightStackLeak +1.5*WindowStackLeak + 1.5*WindowFrameStackLeak + 1.5*ExternalDoorStackLeak;

TotalWindLeak := BaseWindLeak + DownLightWindLeak + ExhaustFanWindLeak + FirePlaceWindLeak + GasHeaterWindLeak + WallVentWindLeak + SkylightWindLeak +1.5*WindowWindLeak + 1.5*WindowFrameWindLeak + 1.5*ExternalDoorWindLeak;

Zone stack infiltration factor (A) and wind infiltration factor (B) are calculated as:

A = TotalStackLeak *3.6/znVolume
B = TotalWindLeak *3.6/znVolume

3.2 Zones of type roofspace

Roof space air change rate is calculated as A + B*v, where v is the hourly wind speed (m/s) from the AccuRate weather file, multiplied by the terrain factor as specified in Eq. (1). The stack infiltration factor (A) and wind infiltration factor (B) are determined by the construction of the roof space as following:

3.2.1 **Unsarked** Roofspace with **Continuous** roof surface

Standard Openness:	A = 2 ,	B = 1
Ventilated Openness:	A = 10,	B = 10
Highly Ventilated Openness:	A = 20,	B = 30

3.2.2 **Unsarked** Roofspace with **Discontinuous** roof surface

Standard Openness:	A = 6 ,	B = 2.5
Ventilated Openness:	A = 10,	B = 10
Highly Ventilated Openness:	A = 20,	B = 30

3.2.3 **Sarked** Roofspace with **Continuous** roof surface

Standard Openness:	A = 2 ,	B = 1
Ventilated Openness:	A = 10,	B = 10
Highly Ventilated Openness:	A = 20,	B = 30

3.2.4 **Sarked** Roofspace with **Discontinuous** roof surface

Standard Openness:	A = 2 ,	B = 1
Ventilated Openness:	A = 10,	B = 10
Highly Ventilated Openness:	A = 20,	B = 30

3.3 Zones of type subfloor

Subfloor air change rate is calculated as A + B*v, where v is the hourly wind speed (m/s) from the AccuRate weather file, multiplied by the terrain factor as specified in Eq. (1). The stack infiltration factor (A) and wind infiltration factor (B) are determined by the construction of the subfloor as following:

3.3.1 Subfloor **Without Wall Cavity**

Enclosed: A = 0.00009612 * znPerimeter * znAreaSubFloorVentilationOpenings / (znFloorArea*znCeilingHeight)

B = 0.0003046 * znPerimeter * znAreaSubFloorVentilationOpenings * ShieldingFactor / (znFloorArea * znCeilingHeight)

Where the ShieldingFactor is listed in the following table.

Site Exposure	**ShieldingFactor**
Exposed	0.88
Open	0.74
Suburban	0.57
Protected	0.31

Open: A = 6, B = 2.5
Very Open: A = 100, B = 30

3.3.2 Subfloor **With Wall Cavity**

Enclosed: A = 3 , B = 1
Open: A = 6, B = 2.5
Very Open: A = 100, B = 30

3.4 Zones of type shared basement carpark

Shared basement carpark air change rate is calculated as A + B*v, where v is the hourly wind speed (m/s) from the AccuRate weather file, multiplied by the terrain factor as specified in Eq. (1). The stack infiltration factor (A) and wind infiltration factor (B) are determined by the construction of the Shared basement carpark as following:

Ceiling above ground: A = 3, B = 1
Ceiling below ground: A = 3, B = 0