### AirflowNetwork:Multizone:Zone

This object allows control of natural ventilation through exterior and interior openings in a zone, where “opening” is defined as an openable window or door. (Note that only window, door or glass door subsurfaces in a zone that are specified using AirflowNetwork:MultiZone:Component:DetailedOpening, AirflowNetwork:MultiZone:Component:HorizontalOpening or AirflowNetwork:Multizone:Component:SimpleOpening and have an associated AirflowNetwork:Multizone:Surface object are considered to be openings). The control will be applied in the same way to all of the openings in the zone.

This object is required to perform Airflow Network calculations. Note that ventilation control for all openings is provided at the zone level as default and individual ventilation control of a surface opening can be used to override the zone-level control (see the AirflowNetwork:Multizone:Surface object description below).

#### Field: Zone Name

The name of the EnergyPlus thermal zone corresponding to the AirflowNetwork zone.

#### Field: Ventilation Control Mode

Specifies the type of zone-level natural ventilation control.

Let Tout equal the outdoor air temperature, Tzone equal the previous timestep’s zone air temperature, Tset equal the Vent Temperature Schedule value, Hzone equal the specific enthalpy of zone air from the previous timestep, and Hout equal the specific enthalpy of outdoor air. Then the four allowed choices for Ventilation Control Mode are:

**NoVent**: All of the zone’s openable windows and doors are closed at all times independent of indoor or outdoor conditions. The Venting Availability Schedule is ignored in this case. This is the default value for this field.

**Temperature**: All of the zone’s openable windows and doors are opened if Tzone > Tout **and** Tzone > Tset **and** Venting Availability Schedule (see below) allows venting.

**Enthalpy:** All of the zone’s openable windows and doors are opened if Hzone > Hout **and** Tzone > Tset **and** Venting Availability Schedule allows venting.

**Constant**: Whenever this object’s Venting Availability Schedule allows venting, all of the zone’s openable windows and doors are open, independent of indoor or outdoor conditions. Note that “Constant” here means that the size of each opening is fixed while venting; the air flow through each opening can, of course, vary from timestep to timestep.

**ASHRAE55Adaptive**: All of the zone’s operable windows and doors are opened if the operative temperature is greater than the comfort temperature (central line) calculated from the ASHRAE Standard 55-2010 adaptive comfort model andVenting Availability Schedule allows venting.

**CEN15251Adaptive:** All of the zone’s operable windows and doors are opened if the operative temperature is greater than the comfort temperature (central line) calculated from the CEN15251 adaptive comfort model andVenting Availability Schedule allows venting.

#### Field: Ventilation Control Zone Temperature Setpoint Schedule Name

The name of a schedule of zone air temperature set points that controls the opening of windows and doors in the thermal zone to provide natural ventilation. This setpoint is the temperature above which all the openable windows and doors in the zone will be opened if the conditions described in the previous field Ventilation Control Mode are met.

The Ventilation Control Zone Temperature Setpoint Schedule Name applies only to windows and doors in the zone that are specified using AirflowNetwork:MultiZone:Component:DetailedOpening, AirflowNetwork:MultiZone:Component:HorizontalOpening or AirflowNetwork:MultiZone:Component:SimpleOpening and have an associated AirflowNetwork:MultiZone:Surface object.

(The discussion under the field Window/Door Opening Factor in the AirflowNetwork:MultiZone:Surface object describes how the actual opening area of a window or door in a particular timestep is determined.)

*Modulation of Openings*

The following five fields can be used to modulate the window/door openings when Ventilation Control Mode = Temperature or Enthalpy. These fields determine a factor between 0 and 1 that multiplies the opening factor of each window and door in the zone according to the control action shown in Figure 96 for Ventilation Control Mode = Temperature and in Figure 97 for Ventilation Control Mode = Enthalpy. Modulation of the openings can reduce the large temperature swings that can occur if the windows/doors are open too far when they are venting, especially when there is a large inside-outside temperature difference.

The modulation takes the following form when Ventilation Control Mode = Temperature:

Tzone - Tout [Lower Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor] **🡺**  Multiplication factor = 1.0

[Lower Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor] < Tzone - Tout < [Upper Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor] **🡺** Multiplication factor varies linearly from 1.0 to [Limit Value on Multiplier for Modulating Venting Open Factor]

Tzone - Tout [Upper Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor]  **🡺** Multiplication factor = [Limit Value on Multiplier for Modulating Venting Open Factor]

One way of “tuning” the following modulation control parameters is to perform a sensitivity analysis for winter and/or summer design days to determine what combination of values causes the biggest reduction in zone air temperature fluctuations due to venting.

Note that the default values for the following fields are such that, if none of the fields are specified, the default values are assigned.

#### Field: Minimum Venting Open Factor

See Figure 96 or Figure 97. This field applies only if Ventilation Control Mode = Temperature or Enthalpy. This value may be from zero to 1.0, with the default being 0.0.

#### Field: Indoor and Outdoor Temperature Difference Lower Limit For Maximum Venting Open Factor

See Figure 96. This field applies only if Ventilation Control Mode = Temperature. This value may be from zero to less than 100˚C, with the default being 0˚C. The value for this field must be less than the value specified for the following field.

#### Field: Indoor and Outdoor Temperature Difference Upper Limit for Minimun Venting Open Factor

See Figure 96. This field applies only if Ventilation Control Mode = Temperature. This value must be greater than 0˚C, with the default being 100˚C. The value for this field must be greater than the value specified for the previous field..

#### Field: Indoor and Outdoor Enthalpy Difference Lower Limit For Maximum Venting Open Factor

See Figure 97. This field applies only if Ventilation Control Mode = Enthalpy. This value may be from zero to less than 300,000 J/kg, with the default being 0 J/kg. The value for this field must be less than the value specified for the following field.

#### Field: Indoor and Outdoor Enthalpy Difference Upper Limit for Minimum Venting Open Factor

See Figure 97. This field applies only if Ventilation Control Mode = Enthalpy. This value must be greater than zero, with the default being 300,000 J/kg. The value for this field must be greater than the value specified for the previous field.

#### Field: Venting Availability Schedule Name

The name of a schedule that specifies when venting is available. A zero or negative schedule value means venting is not allowed. A value greater than zero means venting can occur if other venting control conditions (specified by Ventilation Control Mode and Vent Temperature Schedule Name) are satisfied. This schedule name should not be confused with Vent Temperature Schedule Name.

If a Venting Availability Schedule Name is not specified, it is assumed that venting is always available.

Using Venting Availability Schedule allows you to turn off venting at certain times of the day (at night, for example), of the week (on weekends, for example), or of the year (during the winter, for example).

If used with Ventilation Control Mode = Constant, the ventilation rate is constant only when this schedule allows venting; otherwise the ventilation rate is set to zero.

If Ventilation Control Mode = NoVent, this schedule has no effect.

#### Field: Occupant Ventilation Control Name

The name of an AirlowNetwork:OccupantVentilationControl object. The object is used to perform advanced window opening control based on occupant conditions. When an object name is given, advanced window opening control is performed and the ventilation control defined in the Ventilation Control Mode field will be overridden.

**Note:** The Occupant Ventilation Control object can be assigned to a zone (AirflowNetwork:MultiZone:Zone) or a surface (AirflowNetwork:MultiZone:Surface). When the object is assigned to a zone, the Occupant Ventilation Control is assigned to the surfaces belonging to the zone automatically. The surface objects must have an associated AirflowNetwork:MultiZone:Component:DetailedOpening, AirflowNetwork:MultiZone:Component:HorizontalOpening, or AirflowNetwork:MultiZone:Component:SimpleOpening component specified in the field of Leakage Component Name. All output variables will be shown under surface names only, and not under zone names.



Figure 96. Modulation of venting area according to inside-outside temperature difference.



Figure 97. Modulation of venting area according to inside-outside enthalpy difference.

**Note:** In order to establish an airflow network, each AirflowNetwork:Multizone:Zone object must have at least two surfaces defined with AirflowNetwork:Multizone:Surface objects, so that air can flow from one zone into other zones (or to outdoors) through the network (air mass flow conserved). In addition, for all AirflowNetwork:Multizone:Surface objects facing the same Zone (ref. BuildingSurface:Detailed), at least two different environments must be defined for the other side of these surfaces (e.g., an external node and an adjacent zone, two adjacent zones, or two external nodes).

An IDF example is shown below:

AirflowNetwork:MultiZone:Zone,

RESISTIVE ZONE, !- Name of Associated Thermal Zone

Temperature, !- Ventilation Control Mode

WindowVentSched, !- Vent Temperature Schedule Name

0.3, !- Limit Value on Multiplier for Modulating Venting Open Factor

!- {dimensionless}

5.0, !- Lower Value on Inside/Outside Temperature Difference for

!- Modulating the Venting Open Factor {deltaC}

10.0, !- Upper Value on Inside/Outside Temperature Difference for

!- Modulating the Venting Open Factor {deltaC}

0.0, !- Lower Value on Inside/Outside Enthalpy Difference for Modulating

!- the Venting Open Factor {J/kg}

300000.0, !- Upper Value on Inside/Outside Enthalpy Difference for Modulating

!- the Venting Open Factor {J/kg}

VentingSched; !- Venting Availability Schedule Name

### AirflowNetwork:Multizone:Surface

The AirflowNetwork:Multizone:Surface object specifies the properties of a surface “linkage” through which air flows. This linkage is always associated with a heat transfer surface (wall, roof, floor, or a ceiling) or subsurface (door, glass door, or window) with both faces exposed to air. The linkage specifies two connected nodes: two zone nodes defined in AirflowNetwork:Multizone:Zone objects based on inside and outside face environment for an interior surface, or a zone node defined in an AirflowNetwork:Multizone:Zone object based on inside face environment and an external node defined in an AirflowNetwork:MultiZone:ExternalNode object for an exterior surface. The associated leakage component for this surface can be a crack (or surface effective leakage area) in an exterior or interior heat transfer surface or subsurface, or an exterior or interior window, door or glass door (heat transfer subsurface) that can be opened to allow air flow. The allowed surface air leakage components are:

* AirflowNetwork:MultiZone:Surface:Crack
* AirflowNetwork:MultiZone:Surface:EffectiveLeakageArea
* AirflowNetwork:MultiZone:Component:DetailedOpening
* AirflowNetwork:MultiZone:Component:HorizontalOpening
* AirflowNetwork:MultiZone:Component:SimpleOpening
* AirflowNetwork:MultiZone:Component:ZoneExhaustFan

The two “opening” components are used to modulate openness based on required conditions.

The AirflowNetwork:Multizone:Surface object allows a heat transfer surface or subsurface to have one crack (or one surface effective leakage area object), or a subsurface (i.e., window, door or glass door) to have one opening (detailed or simple).

An interior heat transfer surface (BuildingSurface:Detailed) whose surface name is used as the input for the Outside Boundary Condition Object field represents a floor without ground contact and is not allowed as an AirflowNetwork:Multizone:Surface. A heat transfer surface defined in the BuildingSurface:Detailed:ExteriorNaturalVentedCavity is also not allowed.

#### Field: Surface Name

This is the name of the corresponding surface (wall, roof, ceiling, floor, window, door or glass door).

Information on this surface is used by the program as follows:

1. For a linkage associated with an exterior heat transfer surface: air flow through this linkage is between the outside environment and the thermal zone to which the surface belongs.
2. For a linkage associated with an interior (i.e., interzone) heat transfer surface: air flow through this linkage is between the thermal zones separated by the surface (i.e., the thermal zone associated with the inside face environment and the thermal zone associated with the outside face environment).
3. This heat transfer surface determines the height of the linkage, which is used in calculating buoyancy-related flow through the linkage.

**Note:** It is possible to define an interzone surface twice in EnergyPlus, once in each of the zones that the surface separates. Previously this was a requirement of EnergyPlus (prior to version 2.0), but now it is optional and the user also has the option of only defining the surface once (EnergyPlus defines the second surface automatically within the program). For each interzone surface, use only one (of possible two) interzone surface names in the AirflowNetwork:Multizone:Surface object for “Surface Name.” **Do not** enter two AirflowNetwork:Multizone:Surface objects corresponding to the two possible interzone names. This would cause the air flow through the surface to be counted twice.

#### Field: Leakage Component Name

The name of the AirflowNetwork:MultiZone:Surface:Crack,  
AirflowNetwork:MultiZone:Surface:EffectiveLeakageArea,  
AirflowNetwork:MultiZone:Component:SimpleOpening,  
AirflowNetwork:MultiZone:Component:HorizontalOpening,  
AirflowNetwork:MultiZone:Component:DetailedOpening  
or AirflowNetwork:MultiZone:Component:ZoneExhaustFan object associated with this air flow linkage.

If the name of an opening component (i.e. AirflowNetwork:MultiZone:Component:DetailedOpening. AirflowNetwork:MultiZone:Component:HorizontalOpening, or AirflowNetwork:MultiZone:Component:SimpleOpening is given here, then the Surface Name in the previous field must be that of a window, door or glass door heat transfer subsurface. Otherwise an error message will be reported.

If the name of an AirflowNetwork:MultiZone:Surface:Crack object or AirflowNetwork:MultiZone:Surface:EffectiveLeakageArea object is given here, the program will position the crack at the average height of the associated heat transfer surface or subsurface. The user can define multiple heat transfer surfaces (e.g., split a wall into several surfaces) to be more precise in establishing the crack location. Similarly, the user can define multiple heat transfer surfaces if a wall, for example, has multiple cracks or openings that need to be defined individually.

If the name of an AirflowNetwork:MultiZone:Component:ZoneExhaustFan is given here, then the Surface Name in the previous field must be that of an exterior heat transfer surface. The zone name defined in the Zone Name field for this heat transfer surface must be the same zone name defined in the ZoneHVAC:EquipmentConnections object (which references a ZoneHVAC:EquipmentList containing the name of the corresponding zone exhaust fan). Otherwise an error message will be reported. When this zone exhaust fan is operating for a simulation timestep, all surface-level controls described below are ignored for that timestep.

#### Field: External Node Name

The name of the associated AirflowNetwork:MultiZone:ExternalNode object, which determines the wind pressure coefficients for the heat transfer surface. Used only if Surface Name is for an exterior surface.

If Wind Pressure Coefficient Type = SurfaceAverageCalculation in the AirflowNetwork:SimulationControl object, this field is not used and a blank may be entered. If the surface is an interior (i.e., interzone) surface, leave this field blank.

#### Field: Window/Door Opening Factor, or Crack Factor

If this linkage is associated with an AirflowNetwork:MultiZone:Component:DetailedOpening or AirflowNetwork:MultiZone:Component:SimpleOpening object (which means it is an openable window or door), then this field is called “Window/Door Opening Factor” and represents the value of the Opening Factor that is in effect when the Vent Temperature Schedule (defined in the AirflowNetwork:Multizone:Zone object) indicates that this window or door is open.

The AirflowNetwork model uses a combination of factors to determine the actual opening area for a window or door when it is venting. For example, consider a window that is 1.5m high and 2.0m wide (excluding frame). Assume that the AirflowNetwork:MultiZone:Component:DetailedOpening for this window has Type of Large Vertical Opening = 1 (non-pivoting window), Height Factor = 0.5 and Width Factor = 0.8. Then when the window is fully open, the opening area = height of opening (0.5x1.5) times width of opening (0.8x2.0) = 0.75x1.6 = 1.2 m2. If the Window/Door Opening Factor is 0.75, then the opening area = 0.75x1.2 = 0.9 m2.

If, in addition, the window is in a thermal zone for which opening modulation has been specified (ref: AirflowNetwork:Multizone:Zone) and the multiplication factor due to modulation is 0.3 in a particular timestep, then the actual opening factor that timestep = 0.3x0.75 = 0.225 and the actual opening area that timestep = 0.3x0.9 = 0.27 m2.

If this linkage is associated with an AirflowNetwork:MultiZone:Surface:Crackobject, the following crack air flow equation is used.



Where

*Q* = air mass flow (kg/s)

*CQ*  = air mass flow coefficient (kg/s @ 1 Pa)

*CT*  = reference condition temperature correction factor (dimensionless). See AirflowNetwork:MultiZone:Surface:Crack object.

= pressure difference across crack (Pa)

*n*  = air flow exponent (dimensionless)

*The following fields control venting. They are used only when Name of Associated Heat Transfer Surface is that of an openable exterior or interior window, door or glass door. They only apply to openings, and do not apply to surface cracks, effective leakage area or zone exhaust fans. If none of these fields is specified, or if Ventilation Control Mode = ZoneLevel, venting is controlled by the AirflowNetwork:Multizone:Zone object for the thermal zone containing the window or door (ref: AirflowNetwork:Multizone:Zone Data).*

#### Field: Ventilation Control Mode

Specifies the type of surface-level natural ventilation control.

Let Tout equal the outdoor air temperature, Tzone equal the previous timestep’s zone air temperature, Tset equal the Vent Temperature Schedule value, Hzone equal the specific enthalpy of zone air from the previous timestep, and Hout equal the specific enthalpy of outdoor air. Then the four allowed choices for Ventilation Control Mode are:

**NoVent**: The openable window or door associated with this surface is closed at all times independent of indoor or outdoor conditions. The Venting Availability Schedule is ignored in this case.

**Temperature**: The openable window or door associated with this surface is opened if Tzone > Tout **and** Tzone > Tset **and** Venting Availability Schedule (see below) allows venting.

**Enthalpy:** The openable window or door associated with this surface is opened if Hzone > Hout **and** Tzone > Tset **and** Venting Availability Schedule allows venting.

**Constant**: Whenever this object’s Venting Availability Schedule allows venting, the openable window or door associated with this surface is open, independent of indoor or outdoor conditions. Note that “Constant” here means that the size of this opening is fixed while venting; the air flow through this opening can, of course, vary from timestep to timestep.

**ASHRAE55Adaptive**: The openable window or door associated with this surface is opened if the operative temperature is greater than the comfort temperature (central line) calculated from the ASHRAE Standard 55-2010 adaptive comfort model **and** Venting Availability Schedule allows venting.

**CEN15251Adaptive:** The openable window or door associated with this surface is opened if the operative temperature is greater than the comfort temperature (central line) calculated from the CEN15251 adaptive comfort model **and** Venting Availability Schedule allows venting.

**ZoneLevel**: Venting of the window or door is not controlled individually, but is controlled instead at the zone level. This means that the venting is determined by the AirflowNetwork:Multizone:Zone object for the thermal zone containing the window or door (ref: AirflowNetwork:Multizone:Zone object). This is the default value for this field.

**AdjacentTemperature**: This choice is used for an interior surface only. The openable interior window or door associated with this surface is opened if Tzone > Tadjacent zone **and** Tzone > Tset **and** Venting Availability Schedule (see below) allows venting, where Tadjacent zone is the adjacent zone temperature.

**AdjacentEnthalpy:** This choice is also used for an interior surface only. The interior openable window or door associated with this surface is opened if Hzone > Hadjacent zone **and** Tzone > Tset **and** Venting Availability Schedule allows venting, where Hadjacent zone is the adjacent zone specific enthalpy.

#### Field: Ventilation Control Zone Temperature Setpoint Schedule Name

The name of a schedule of zone air temperature set points that controls the opening of a window or door associated with this surface to provide natural ventilation. This setpoint is the temperature above which this openable window or door will be opened if the conditions described in the previous field Ventilation Control Mode are met.

The Ventilation Control Zone Temperature Setpoint Schedule applies only to a window or door attached to this surface that is specified using AirflowNetwork:MultiZone:Component:DetailedOpening or AirflowNetwork:MultiZone:Component:SimpleOpening.

(The discussion under the field Window/Door Opening Factor in this object describes how the actual opening area of a window or door in a particular timestep is determined.)

*Modulation of Openings*

The following five fields can be used to modulate this window/door opening when Ventilation Control Mode = Temperature or Enthalpy. These fields determine a factor between 0 and 1 that multiplies the opening factor of this window or door according to the control action shown in Figure 96 for Ventilation Control Mode = Temperature and in Figure 97 for Ventilation Control Mode = Enthalpy. Modulation of this opening can reduce the large temperature swings that can occur if the window/door is open too far when it is venting, especially when there is a large inside-outside temperature difference.

The modulation takes the following form when Ventilation Control Mode = Temperature:

Tzone - Tout [Lower Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor] **🡺**  Multiplication factor = 1.0

[Lower Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor] < Tzone - Tout < [Upper Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor] **🡺** Multiplication factor varies linearly from 1.0 to [Limit Value on Multiplier for Modulating Venting Open Factor]

Tzone - Tout [Upper Value on Inside/Outside Temperature Difference for Modulating the Venting Open Factor]  **🡺** Multiplication factor = [Limit Value on Multiplier for Modulating Venting Open Factor]

One way of “tuning” the following modulation control parameters is to perform a sensitivity analysis for winter and/or summer design days to determine what combination of values causes the biggest reduction in zone air temperature fluctuations due to venting.

Note that the default values for the following fields are such that, if none of the fields are specified, modulation will not occur.

#### Field: Minimum Venting Open Factor

See Figure 96 or Figure 97. This field applies only if Ventilation Control Mode = Temperature or Enthalpy. This value may be from zero to 1.0, with the default being 0.0.

#### Field: Indoor and Outdoor Temperature Difference Lower Limit For Maximum Venting Open Factor

See Figure 96. This field applies only if Ventilation Control Mode = Temperature. This value may be from zero to less than 100°C, with the default being 0°C. The value for this field must be less than the value specified for the following field.

#### Field: Indoor and Outdoor Temperature Difference Upper Limit for Minimun Venting Open Factor

See Figure 96. This field applies only if Ventilation Control Mode = Temperature. This value must be greater than 0°C, with the default being 100°C. The value for this field must be greater than the value specified for the previous field.

#### Field: Indoor and Outdoor Enthalpy Difference Lower Limit For Maximum Venting Open Factor

See Figure 97. This field applies only if Ventilation Control Mode = Enthalpy. This value may be from zero to less than 300,000 J/kg, with the default being 0 J/kg. The value for this field must be less than the value specified for the following field.

#### Field: Indoor and Outdoor Enthalpy Difference Upper Limit for Minimun Venting Open Factor

See Figure 97. This field applies only if Ventilation Control Mode = Enthalpy. This value must be greater than zero, with the default being 300,000 J/kg. The value for this field must be greater than the value specified for the previous field.

#### Field: Venting Availability Schedule Name

The name of a schedule that specifies when venting is available. A zero or negative schedule value means venting is not allowed. A value greater than zero means venting can occur if other venting control conditions (specified by Ventilation Control Mode and Vent Temperature Schedule Name) are satisfied. This schedule name should not be confused with Vent Temperature Schedule Name.

If a Venting Availability Schedule Name is not specified, it is assumed that venting is always available.

Using Venting Availability Schedule allows you to turn off venting at certain times of the day (at night, for example), week (on weekends, for example), or year (during the winter, for example).

If used with Ventilation Control Mode = Constant, the ventilation rate is constant only when this schedule allows venting; otherwise the ventilation rate is set to zero.

If Ventilation Control Mode = NoVent, this schedule has no effect.

**Note:** In order to establish an airflow network, each AirflowNetwork:Multizone:Zone object must have at least two surfaces defined with AirflowNetwork:Multizone:Surface objects, so that air can flow from one zone into other zones (or to outdoors) through the network (air mass flow conserved). In addition, for all AirflowNetwork:Multizone:Surface objects facing the same Zone Name (ref. BuildingSurface:Detailed), at least two different environments must be defined for the other side of these surfaces (e.g., an external node and an adjacent zone, two adjacent zones, or two external nodes).

#### Field: Occupant Ventilation Control Name

The name of an AirlowNetwork:OccupantVentilationControl object. The object is used to perform advanced window opening control based on occupant conditions. When an object name is given, advanced window opening control is performed and the Ventilation Control defined in the Ventilation Control Mode field will be overridden.

IDF examples are provided below:

AirflowNetwork:MultiZone:Surface,

Zn001:Wall001, !- Name of Associated Heat Transfer Surface

CR-1, !- Leakage Component Name

SFacade, !- External Node Name

1.0; !- Window/Door Opening Factor, or Crack Factor {dimensionless}

AirflowNetwork:MultiZone:Surface,

Zn001:Wall001:Win001, !- Name of Associated Heat Transfer Surface

WiOpen1, !- Leakage Component Name

SFacade, !- External Node Name

0.5; !- Window/Door Opening Factor, or Crack Factor {dimensionless}

AirflowNetwork:MultiZone:Surface,

Zn003:Wall003, !- Name of Associated Heat Transfer Surface

Zone3 Exhaust Fan, !- Leakage Component Name

EFacade, !- External Node Name

1.0; !- Window/Door Opening Factor, or Crack Factor {dimensionless}

AirflowNetwork:MultiZone:Surface,

Zn001:Wall001:Win002, !- Name of Associated Heat Transfer Surface

WiOpen2, !- Leakage Component Name

WFacade, !- External Node Name

0.5; !- Window/Door Opening Factor, or Crack Factor {dimensionless}

Temperature, !- Ventilation Control Mode

WindowVentSched, !- Vent Temperature Schedule Name

0.3, !- Limit Value on Multiplier for Modulating Venting Open Factor

!- {dimensionless}

5.0, !- Lower Value on Inside/Outside Temperature Difference for

!- Modulating the Venting Open Factor {deltaC}

10.0, !- Upper Value on Inside/Outside Temperature Difference for

!- Modulating the Venting Open Factor {deltaC}

0.0, !- Lower Value on Inside/Outside Enthalpy Difference for Modulating

!- the Venting Open Factor {J/kg}

300000.0, !- Upper Value on Inside/Outside Enthalpy Difference for Modulating

!- the Venting Open Factor {J/kg}

VentingSched; !- Venting Availability Schedule Name

An IDF example is provided below:

**AirflowNetwork:MultiZone:WindPressureCoefficientValues,**

NFacade\_WPCValue, !- Name

Every 30 Degrees, !- AirflowNetwork:MultiZone:WindPressureCoefficientArray Name

0.60, !- Wind Pressure Coefficient Value 1 {dimensionless}

0.48, !- Wind Pressure Coefficient Value 2 {dimensionless}

0.04, !- Wind Pressure Coefficient Value 3 {dimensionless}

-0.56, !- Wind Pressure Coefficient Value 4 {dimensionless}

-0.56, !- Wind Pressure Coefficient Value 5 {dimensionless}

-0.42, !- Wind Pressure Coefficient Value 6 {dimensionless}

-0.37, !- Wind Pressure Coefficient Value 7 {dimensionless}

-0.42, !- Wind Pressure Coefficient Value 8 {dimensionless}

-0.56, !- Wind Pressure Coefficient Value 9 {dimensionless}

-0.56, !- Wind Pressure Coefficient Value 10 {dimensionless}

0.04, !- Wind Pressure Coefficient Value 11 {dimensionless}

0.48; !- Wind Pressure Coefficient Value 12 {dimensionless}

### AirflowNetwork:OccupantVentilationControl

The AirflowNetwork:OccupantVentilationControl object provides control options with minimum opening and closing time checks and opening and closing probability values. In general, the probability values could be a constant or a specific function. Due to lack of real data, two schedules are selected to represent probability values. If real data are available, this object may be modified to adopt new data.

#### Field: Name

This is the name of the object.

#### Field: Minimum Opening Time

The field represents the minimum time that windows will remain open. If a window has been open for a time less than this value, the window will remain open.

#### Field: Minimum Closing Time

The field represents the minimum time that windows will remain closed. If a window has been closed for a time less than this value, the window will remain closed.

#### Field: Thermal Comfort Low Temperature Curve Name

This alpha field defines the name of a curve to be used for thermal comfort temperature calculation at low outdoor dry-bulb temperature. This curve is a linear or quadratic equation using outdoor dry-bulb temperatures as an independent variable. This performance curve can be used to describe the thermal comfort temperature at low outdoor dry-bulb temperature. It allows maximum two curves to describe the thermal comfort temperature in two different outdoor dry-bulb temperature regions. If a single curve is used, blanks are entered in the following two fields.

#### Field: Thermal Comfort Temperature Boundary Point

When there are two piecewise curves to represent thermal comfort temperature calculation, this field represents a boundary point of outdoor dry-bulb temperature. The low temperature curve and the high temperature curve should have the same values at the boundary point. If a single curve is used, this field may be left blank.

#### Field: Thermal Comfort High Temperature Curve Name

This alpha field defines the name of a curve to be used for thermal comfort temperature calculation at high outdoor dry-bulb temperature. This curve is a linear or quadratic equation using outdoor dry-bulb temperatures as an independent variable. This performance curve can be used to describe the thermal comfort temperature at high outdoor dry-bulb temperature. It allows maximum two curves to describe the thermal comfort temperature in two different outdoor dry-bulb temperature regions. If a single curve is used, blanks are entered in this field.

#### Field: Maximum Threshold for Persons Dissatisfied PPD

This field is used to calculate the comfort band as a function of predicted percentage of dissatisfied (PPD). The default value is 10%. The equation is based on curve fit and is valid between 0% and 35%.

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

where

ϴ = Comfort band ©

PPD = predicted percentage of dissatisfied (%)

#### Field: Occupancy Check

Input is Yes or No. The default is No. If Yes, an occupancy check is performed used in the opening probability check. If No, the occupancy check is bypassed.

#### Field: Opening Probability Schedule Name

The name of a schedule of opening probability that controls the opening of windows and doors in the thermal zone to provide natural ventilation. If the probability value is greater a random number, windows are allowed to open. Otherwise, the output will be false. This control will occur when minimum time checks for both opening and closing are satisfied.

#### Field: Closing Probability Schedule Name

The name of a schedule of closing probability that controls the closing of windows and doors in the thermal zone to reduce natural ventilation. If the probability value is greater a random number, windows are allowed to be closed. Otherwise, the output will be false. This control will occur when minimum time checks for both opening and closing are satisfied.

IDF examples are provided below:

AirlowNetwork:OccupantVentilationControl,

VentilationControl, !- Name

5.0, !- Minimum Opening Time

5.0, !- Minimum Opening Time

ComfortLowTempCurve, !- Thermal Comfort Low Temperature Curve Name

10.0, !- Thermal Comfort Temperature Boundary Point

ComfortHighTempCurve, !- Thermal Comfort High Temperature Curve Name

10.0, !- Maximum Threshold for Persons Dissatisfied PPD

Yes, !- Occupancy Check

OpeningProbabilitySch, !- Opening Probability Schedule Name

ClosingProbabilitySch; !- Closing Probability Schedule Name

<snip>

The previous sections of this AirflowNetwork model discussion describe input objects used for multizone airflow calculations. The following sections describe input objects used for air distribution system simulations. These objects work when control option “MultiZone with Distribution” or “MultiZone with Distribution Only During Fan Operation” is defined in the AirflowNetwork Control field in the AirflowNetwork:SimulationControl object.

The first section presents the input object for distribution system nodes. Although thermal zones are required to perform air distribution system simulations, the thermal zones are already defined in the multizone input section (described previously), so that there is no need to repeat the inputs for thermal zones when modeling an air distribution system. The same is also true for surface air leakage. This section has only one object: AirflowNetwork:Distribution:Node.

### AirflowNetwork:Distribution:Node

The AirflowNetwork:Distribution:Node object is used to represent air distribution system nodes for the AirflowNetwork model. The EnergyPlus nodes defined in an AirLoopHVAC are a subset of the nodes used to simulate the distribution system using the AirflowNetwork model. For example, the inlet node of a fan and the outlet node of a coil defined in an AirLoopHVAC must be defined as nodes using the AirflowNetwork:Distribution:Node object. A set of EnergyPlus Zone Equipment nodes is also a subset of the AirflowNetwork:Distribution:Nodes. For example, zone inlet and outlet nodes must be defined as nodes using the AirflowNetwork:Distribution: Node object. In addition, although mixers and splitters are defined as objects with inlet and outlet nodes within EnergyPlus, the AirflowNetwork:Distribution:Node object treats mixers and splitters as single nodes. The node objects are referenced by AirflowNetwork:Distribution:Linkage objects.

In summary, all nodes used to define an AirLoopHVAC (except splitters, mixers, and outdoor air systems which are treated as single nodes) and its connections to a thermal zone must be specified as AirflowNetwork:Distribution:Nodes. If distribution system air leaks are to be modeled, additional AirflowNetwork:Distribution:Nodes may be defined along with AirflowNetwork:Distribution:Components (e.g., leak or leak ratio) to define the air leakage characteristics.

### Airflow Network Outputs

The AirflowNetwork nodes in the following output variables includes zones defined in AirflowNetwork:Multizone:Zone objects, external nodes defined in AirflowNetwork:MultiZone:ExternalNode objects, and nodes defined in AirflowNetwork:Distribution:Node objects.

The AirflowNetwork linkage used in following output variables includes surfaces defined in AirflowNetwork:Multizone:Surface objects, and linkages defined in AirflowNetwork:Distribution:Linkage objects. The surface linkages represent airflows through surface cracks or openings between two zones or between a zone and outdoors. The distribution linkages represent airflows in an air distribution system.

HVAC,Average,AFN Node Temperature [C]

HVAC,Average,AFN Node Humidity Ratio [kgWater/kgDryAir]

HVAC,Average,AFN Node Total Pressure [Pa]

HVAC,Average,AFN Node Wind Pressure [Pa]

HVAC,Average,AFN Node CO2 Concentration [ppm]

HVAC,Average,AFN Node Generic Air Contaminant Concentration [ppm]

HVAC,Average,AFN Linkage Node 1 to Node 2 Mass Flow Rate [kg/s]

HVAC,Average,AFN Linkage Node 2 to Node 1 Mass Flow Rate [kg/s]

HVAC,Average,AFN Linkage Node 1 to Node 2 Volume Flow Rate [m3/s]

HVAC,Average,AFN Linkage Node 2 to Node 1 Volume Flow Rate [m3/s]

HVAC,Average,AFN Linkage Node 1 to Node 2 Pressure Difference [Pa]

HVAC,Average,AFN Surface Venting Window or Door Opening Factor []

HVAC,Average,AFN Surface Venting Window or Door Opening Modulation Multiplier []

HVAC,Average,AFN Surface Venting Inside Setpoint Temperature [C]

HVAC,Average,AFN Surface Venting Availability Status []

HVAC,Average,AFN Zone Infiltration Sensible Heat Gain Rate [W]

HVAC,Sum,AFN Zone Infiltration Sensible Heat Gain Energy [J]

HVAC,Average,AFN Zone Mixing Sensible Heat Gain Rate [W]

HVAC,Sum,AFN Zone Mixing Sensible Heat Gain Energy [J]

HVAC,Average,AFN Zone Infiltration Sensible Heat Loss Rate [W]

HVAC,Sum,AFN Zone Infiltration Sensible Heat Loss Energy [J]

HVAC,Average,AFN Zone Mixing Sensible Heat Loss Rate [W]

HVAC,Sum,AFN Zone Mixing Sensible Heat Loss Energy [J]

HVAC,Average,AFN Zone Infiltration Latent Heat Gain Rate [W]

HVAC,Sum,AFN Zone Infiltration Latent Heat Gain Energy [J]

HVAC,Average,AFN Zone Infiltration Latent Heat Loss Rate [W]

HVAC,Sum,AFN Zone Infiltration Latent Heat Loss Energy [J]

HVAC,Average,AFN Zone Mixing Latent Heat Gain Rate [W]

HVAC,Sum,AFN Zone Mixing Latent Heat Gain Energy [J]

HVAC,Average,AFN Zone Mixing Latent Heat Loss Rate [W]

HVAC,Sum,AFN Zone Mixing Latent Heat Loss Energy [J]

HVAC,Average,AFN Zone Duct Leaked Air Sensible Heat Gain Rate [W]

HVAC,Sum,AFN Zone Duct Leaked Air Sensible Heat Gain Energy [J]

HVAC,Average,AFN Zone Duct Leaked Air Sensible Heat Loss Rate [W]

HVAC,Sum,AFN Zone Duct Leaked Air Sensible Heat Loss Energy [J]

HVAC,Average,AFN Zone Duct Leaked Air Latent Heat Gain Rate [W]

HVAC,Sum,AFN Zone Duct Leaked Air Latent Heat Gain Energy [J]

HVAC,Average,AFN Zone Duct Leaked Air Latent Heat Loss Rate [W]

HVAC,Sum,AFN Zone Duct Leaked Air Latent Heat Loss Energy [J]

HVAC,Average,AFN Zone Duct Conduction Sensible Heat Gain Rate [W]

HVAC,Sum,AFN Zone Duct Conduction Sensible Heat Gain Energy [J]

HVAC,Average,AFN Zone Duct Conduction Sensible Heat Loss Rate [W]

HVAC,Sum,AFN Zone Duct Conduction Sensible Heat Loss Energy [J]

HVAC,Average,AFN Zone Duct Diffusion Latent Heat Gain Rate [W]

HVAC,Sum,AFN Zone Duct Diffusion Latent Heat Gain Energy [J]

HVAC,Average,AFN Zone Duct Diffusion Latent Heat Loss Rate [W]

HVAC,Sum,AFN Zone Duct Diffusion Latent Heat Loss Energy [J]

HVAC,Average,AFN Distribution Sensible Heat Gain Rate [W]

HVAC,Sum,AFN Distribution Sensible Heat Gain Energy [J]

HVAC,Average,AFN Distribution Sensible Heat Loss Rate [W]

HVAC,Sum,AFN Distribution Sensible Heat Loss Energy [J]

HVAC,Average,AFN Distribution Latent Heat Gain Rate [W]

HVAC,Sum,AFN Distribution Latent Heat Gain Energy [J]

HVAC,Average,AFN Distribution Latent Heat Loss Rate [W]

HVAC,Sum,AFN Distribution Latent Heat Loss Energy [J]

HVAC,Sum,AFN Zone Infiltration Volume [m3]

HVAC,Sum,AFN Zone Infiltration Mass [kg]

HVAC,Average,AFN Zone Infiltration Air Change Rate [ach]

HVAC,Sum,AFN Zone Mixing Volume [m3]

HVAC,Sum,AFN Zone Mixing Mass [kg]

**The following output variables are reported only when a Fan:OnOff object is used:**

HVAC,Average,AFN Zone Average Pressure [Pa]

HVAC,Average,AFN Zone On Cycle Pressure [Pa]

HVAC,Average,AFN Zone Off Cycle Pressure [Pa]

HVAC,Average,AFN Linkage Node 1 to 2 Average Mass Flow Rate [kg/s]

HVAC,Average,AFN Linkage Node 2 to 1 Average Mass Flow Rate [kg/s]

HVAC,Average,AFN Linkage Node 1 to 2 Average Volume Flow Rate [m3/s]

HVAC,Average,AFN Linkage Node 2 to 1 Average Volume Flow Rate [m3/s]

HVAC,Average,AFN Surface Average Pressure Difference [Pa]

HVAC,Average,AFN Surface On Cycle Pressure Difference [Pa]

HVAC,Average,AFN Surface Off Cycle Pressure Difference [Pa]

**The following output variables are reported only when an AirflowNetwork:OccupantVentilationControl** **object is used:**

HVAC,Average,AFN Surface Venting Window or Door Opening Factor at Previous Time Step []

HVAC,Average,AFN Surface Opening Elapsed Time [min]

HVAC,Average,AFN Surface Closing Elapsed Time [min]

HVAC,Average,AFN Surface Opening Status at Previous Time Step []

HVAC,Average,AFN Surface Opening Status []

HVAC,Average,AFN Surface Opening Probability Status []

HVAC,Average,AFN Surface Closing Probability Status []

#### AFN Node Temperature [C]

This is the AirflowNetwork node temperature output in degrees C. When a Fan:OnOff object is used and is scheduled to operate in the cycling fan operation mode, this value for AirflowNetwork:Distribution:Node objects reflects the temperature when the fan is operating (ON).

#### AFN Node Humidity Ratio [kgWater/kgDryAir]

This is the AirflowNetwork node humidity ratio output in kgWater/kgDryAir. When a Fan:OnOff object is used and is scheduled to operate in the cycling fan operation mode, this value for AirflowNetwork:Distribution:Node objects reflects the humidity ratio when the fan is operating (ON).

#### AFN Node Total Pressure [Pa]

This is the AirflowNetwork node total pressure in Pa with respect to outdoor barometric pressure. The total pressure is the sum of static pressure, dynamic pressure, and elevation impact at the node’s relative height. When a Fan:OnOff object is used and is scheduled to operate in the cycling fan operation mode, the value for AirflowNetwork:Distribution:Node objects reflects the total pressure when the fan is operating (ON). The total pressures for nodes associate with AirflowNetwork:Multizone:Zone objects are reported in different output variables (below).

#### AFN Node CO2 Concentration [ ppm]

This is the AirflowNetwork node carbon dioxide concentration level in parts per million (ppm). When a Fan:OnOff object is used and is scheduled to operate in the cycling fan operation mode, this value for AirflowNetwork:Distribution:Node objects reflects the carbon dioxide when the fan is operating (ON).

#### AFN Node Generic Air Contaminant Concentration [ppm]

This is the AirflowNetwork node generic contaminant concentration level in parts per million (ppm). When a Fan:OnOff object is used and is scheduled to operate in the cycling fan operation mode, this value for AirflowNetwork:Distribution:Node objects reflects the carbon dioxide when the fan is operating (ON).

#### AFN Zone Average Pressure [Pa]

This is the AirflowNetwork average zone total pressure in Pa with respect to outdoor barometric pressure. This output is only available when a Fan:OnOff object is used in the air distribution system. The average zone pressure is weighted by the system fan part-load ratio using the calculated zone pressures during the fan on and off periods for the system timestep. The system fan part-load ratio is defined as the ratio of the air distribution system mass flow rate (average for the simulation timestep) to the system design mass flow rate.

Average zone pressure = (Zone pressure during on cycle \* Part-load ratio) + Zone pressure during off cycle \* (1.0 – Part-load ratio)

#### AFN Zone On Cycle Pressure [Pa]

This is the AirflowNetwork zone total pressure in Pa with respect to outdoor barometric pressure when the air distribution system fan is operating (ON). This output is only available when a Fan:OnOff object is used in the air distribution system. When the fan part-load ratio is equal to 0.0, this pressure value will be zero because the air distribution system is not simulated when the fan is off for the entire timestep.

#### AFN Zone Off Cycle Pressure [Pa]

This is the AirflowNetwork zone total pressure in Pa with respect to outdoor barometric pressure when the air distribution system fan is not operating (OFF). This output is only available when a Fan:OnOff object is used in the air distribution system. Even if the fan part-load ratio is equal to 1.0, the pressure calculated as if the fan were not operating (OFF) is reported.

#### AFN Node Wind Pressure [Pa]

This is the AirflowNetwork wind pressure output in Pa. The wind pressure depends on several factors, including wind speed, wind direction, the wind-pressure coefficient (Cp) values for the AirflowNetwork:MultiZone:ExternalNode associated with the heat transfer surface and the site wind conditions.

When Wind Pressure Coefficient Type = “Input” in the AirflowNetwork:SimulationControl object, the output represents external node pressures driven by wind defined in an AirflowNetwork:MultiZone:ExternalNode object. When Wind Pressure Coefficient Type = “SurfaceAverageCalculation” in AirflowNetwork:SimulationControl, the program assumes five external nodes:

* FACADE1 Representing north orientation
* FACADE2 Representing east orientation
* FACADE3 Representing south orientation
* FACADE4 Representing west orientation
* ROOF Representing horizontal orientation

In this case, the output represents the wind pressures for the five external nodes defined above.

#### AFN Linkage Node 1 to Node 2 Mass Flow Rate [kg/s]

This is the AirflowNetwork linkage mass flow rate output in kg/s in the direction from Node 1 to Node 2. It reports surface airflows through a crack or opening, and through linkages defined in an AirflowNetwork:Distribution:Linkage object. The surface linkage is divided into two types of surfaces, exterior surface and interior surface. Node 1 for an exterior surface linkage is a thermal zone and Node 2 is an external node. The value of AFN Linkage Node 1 to Node 2 Mass Flow Rate represents the flow rate from a thermal zone to outdoors. The flow direction through an interior surface crack or opening is defined from a thermal zone defined by a surface’s Zone Name (Node 1) to an adjacent thermal zone defined by a surface’s OutsideFaceEnvironment (Node 2). For an AirflowNetwork:Distribution:Linkage object, the value represents the air mass flow rate flowing from Node 1 to Node 2.

It should be pointed out that in general, each linkage has one directional flow at any given time, either from Node 1 to 2 or from Node 2 to 1. However, there are three components which may have flows in both directions simultaneously: AirflowNetwork:MultiZone:Component:DetailedOpening, AirflowNetwork:MultiZone:Component:SimpleOpening, and AirflowNetwork:MultiZone:Component:HorizontalOpening.

When a Fan:OnOff object is used, the air mass flow rates reported for the AirflowNetwork:Distribution:Linkage objects are the values when the fan is operating (ON). It is assumed that the air mass flow rates when the fan is off are zero for the distribution system air linkage objects. The air mass flow rates for the AirflowNetwork:Multizone:Surface object are reported in different output variables (below).

#### AFN Linkage Node 2 to Node 1 Mass Flow Rate [kg/s]

This is the AirflowNetwork linkage mass flow rate output in kg/s in the direction from Node 2 to Node 1. It reports airflows from surfaces through a crack or opening, and from linkages defined in an AirflowNetwork:Distribution:Linkage object. Node 1 and Node 2 for a surface or subsurface are defined in the same manner as AFN Linkage Node 1 to Node 2 Mass Flow Rate.

When a Fan:OnOff object is used, the air mass flow rates reported for the AirflowNetwork:Distribution:Linkage objects are the values when the fan is operating (ON). It is assumed that the air mass flow rates when the fan is off are zero for the distribution system air linkage objects. The air mass flow rates for the AirflowNetwork:Multizone:Surface object are reported in different output variables (below).

#### AFN Linkage Node 1 to 2 Average Mass Flow Rate [kg/s]

This is the AirflowNetwork linkage average mass flow rate in kg/s in the direction from Node 1 to Node 2 defined in the AirflowNetwork:Multizone:Surface objects. This output is only available when a Fan:OnOff object is used in the air distribution system. The average mass flow rate is weighted by the system fan part-load ratio using the calculated air mass flow rates during the fan on and off periods for the system timestep. The system fan part-load ratio is defined as the ratio of the air distribution system mass flow rate (average for the simulation timestep) to the system design mass flow rate.

Average surface mass flow rate = (Surface mass flow rate during on cycle \* Part-load ratio) + Surface mass flow rate during off cycle \* (1.0 – Part-load ratio)

#### AFN Linkage Node 2 to 1 Average Mass Flow Rate [kg/s]

This is the AirflowNetwork linkage average mass flow rate in kg/s in the direction from Node 2 to Node 1 defined in the AirflowNetwork:Multizone:Surface objects. This output is only available when a Fan:OnOff object is used in the air distribution system. The average mass flow rate is weighted by the system fan part-load ratio using the calculated air mass flow rates during the fan on and off periods for the system timestep. The system fan part-load ratio is defined as the ratio of the air distribution system mass flow rate (average for the simulation timestep) to the system design mass flow rate.

#### AFN Linkage Node 1 to Node 2 Volume Flow Rate [m3/s]

This is the AirflowNetwork linkage volume flow rate output in m3/s in the direction from the Node 1 to Node 2. It is defined in the same manner as AFN Linkage Node 1 to Node 2 Mass Flow Rate.

When a Fan:OnOff object is used, the air volume flow rates reported for the AirflowNetwork:Distribution:Linkage objects are the values when the fan is operating (ON). It is assumed that the air volume flow rates when the fan is off are zero for the distribution system air linkage objects. The air volume flow rates for the AirflowNetwork:Multizone:Surface object are reported in different output variables (below).

#### AFN Linkage Node 2 to Node 1 Volume Flow Rate [m3/s]

This is the AirflowNetwork linkage volume flow rate output in m3/s in the direction from Node 2 to Node 1. It is defined in the same manner as AFN Linkage Node 2 to Node 1 Mass Flow Rate.

When a Fan:OnOff object is used, the air volume flow rates reported for the AirflowNetwork:Distribution:Linkage objects are the values when the fan is operating (ON). It is assumed that the air volume flow rates when the fan is off are zero for the distribution system air linkage objects. The air volume flow rates for the AirflowNetwork:Multizone:Surface object are reported in different output variables (below).

#### AFN Linkage Node 1 to 2 Average Volume Flow Rate [m3/s]

This is the AirflowNetwork linkage average volume flow rate in m3/s in the direction from Node 1 to Node 2 defined in the AirflowNetwork:Multizone:Surface objects. This output is only available when a Fan:OnOff object is used. The average volume flow rate is weighted by the system fan part-load ratio using the calculated air volume flow rates during the fan on and off periods for the system timestep.

Average surface volume flow rate = (Surface volume flow rate during on cycle \* Part-load ratio) + Surface volume flow rate during off cycle \* (1.0 – Part-load ratio)

#### AFN Linkage Node 2 to 1 Average Volume Flow Rate [m3/s]

This is the AirflowNetwork linkage average volume flow rate in m3/s in the direction from Node 2 to Node 1 defined in the AirflowNetwork:Multizone:Surface objects. This output is only available when a Fan:OnOff object is used. The average volume flow rate is weighted by the system fan part-load ratio using the calculated air volume flow rates during the fan on and off periods for the system timestep.

#### AFN Linkage Node 1 to Node 2 Pressure Difference [Pa]

This is the pressure difference across a linkage in Pa. The linkage includes both objects: AirflowNetwork:Multizone:Surface and AirflowNetwork: Distribution:Linkage.

When a Fan:OnOff object is used, the pressure differences reported for the AirflowNetwork:Distribution:Linkage objects are the values calculated when the fan is operating (ON). It is assumed that the pressure differences when the fan is off are zero for the distribution system air linkage objects. The pressure differences defined in the AirflowNetwork:Multizone:Surface are reported in different output variables (below).

#### AFN Surface Average Pressure Difference [Pa]

This is the average pressure difference across a linkage in Pa for the AirflowNetwork:Multizone:Surface objects only when a Fan:OnOff object is used. The average pressure difference is weighted by the system fan part-load ratio using the calculated pressure differences during the fan on and off periods for the system timestep. The system fan part-load ratio is defined as the ratio of the air distribution system mass flow rate (average for the simulation timestep) to the system design mass flow rate.

Surface Average Pressure Difference = (Surface Average Pressure Difference during on cycle \* Part-load ratio) + Surface Average Pressure Difference during off cycle \* (1.0 - Part-load ratio)

#### AFN Surface On Cycle Pressure Difference [Pa]

This is the pressure difference across a linkage in Pa for the AirflowNetwork:Multizone:Surface objects only when the air distribution system fan is operating (ON). This output is only available when a Fan:OnOff object is used. When the fan part-load ratio is equal to 0.0, this pressure difference value will be zero because the air distribution system is not simulated when the fan is off for the entire timestep.

#### AFN Surface Off Cycle Pressure Difference [Pa]

This is the pressure difference across a linkage in Pa for the AirflowNetwork:Multizone:Surface objects only when the air distribution system fan is not operating (OFF). This output is only available when a Fan:OnOff object is used. Even if the fan part-load ratio is equal to 1.0, the pressure difference calculated as if the fan were not operating (OFF) is reported.

#### AFN Surface Venting Window or Door Opening Factor []

The current time-step value of the venting opening factor for a particular window or door. When the window or door is venting, this is the input value of the opening factor (see AirflowNetwork:Multizone:Surface, Window/Door Opening Factor) times the multiplier for venting modulation (see description of next output variable, “Opening Factor Multiplier for AirflowNetwork Venting Modulation”). For example, if the input Window/Door opening factor is 0.5 and the modulation multiplier is 0.7, then the value of this output variable will be 0.5x0.7 = 0.35.

#### AFN Surface Venting Window or Door Opening Modulation Multiplier []

This is the multiplier on a window or door opening factor when venting modulation is in effect. See “Modulation of Openings” under AirflowNetwork:Multizone:Zone for a description of how the multiplier is determined.

When modulation is in effect the value of the multiplier is between 0.0 and 1.0. When modulation does not apply the value of the multiplier may be –1.0. When modulation applies but the surface is not venting, the value is –1.0. This is summarized in the following table. In this table, “Zone” means a thermal zone for which AirflowNetwork:Multizone:Zone has been specified. See object AirflowNetwork: Multizone:Zone for definition of “Ventilation Control Mode.”

Table 25. Value of opening factor multiplier for different venting conditions.

|  |  |  |  |
| --- | --- | --- | --- |
| **Is surface in a Zone?** | **Ventilation Control Mode** | **Is surface venting?** | **Value of opening factor multiplier** |
| Yes | **Temperature** | Yes | 0.0 to 1.0 |
| No | -1.0 |
| **Enthalpy** | Yes | 0.0 to 1.0 |
| No | -1.0 |
| **Constant** | Yes | 1.0 |
| **NoVent** | No | -1.0 |

#### AFN Surface Venting Inside Setpoint Temperature [C]

The time-step value of the venting setpoint temperature for the zone to which the surface belongs. This setpoint is determined from the Vent Temperature Schedule input (ref: AirflowNetwork:Multizone:Zone).

#### AFN Surface Venting Availability Status [ ]

A value of 1.0 means venting through the surface can occur if venting control conditions are satisfied. A value of 0.0 means venting through the surface cannot occur under any circumstances. This value is determined by the Venting Availability Schedule input (ref: AirflowNetwork:Multizone:Zone or AirflowNetwork:Multizone: Surface).

#### AFN Zone Infiltration Sensible Heat Gain Rate [W]

The average convective sensible heat gain rate, in Watts, to the zone air corresponding to the Zone Infiltration Volume averaged over the reporting period. This value is calculated for each timestep when the outdoor dry-bulb temperature is higher than the zone temperature; otherwise, the sensible gain rate is set to 0.

When a Fan:OnOff object is used, this reported value is weighted by the system run time fraction using the calculated infiltration sensible gain rate during the system on and off cycles for the reporting period:

Infiltration Sensible Gain Rate = (Infiltration Sensible Gain Rate during on cycle \* Run time fraction) + Infiltration Sensible Gain Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Sensible Heat Gain Energy [J]

The average convective sensible heat gain, in Joules, to the zone air corresponding to the Zone Infiltration Volume averaged over the reporting period. This value is calculated for each timestep when the outdoor dry-bulb temperature is higher than the zone temperature; otherwise, the sensible gain rate is set to 0.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration sensible gain during the system on and off cycles for the reporting period:

Infiltration Sensible Gain = (Infiltration Sensible Gain during on cycle \* Run time fraction) + Infiltration Sensible Gain during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Sensible Heat Loss Rate [W]

The average convective sensible heat loss rate, in Watts, to the zone air corresponding to the Zone Infiltration Volume averaged over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration sensible loss rate during the system on and off cycles for the reporting period:

Infiltration Sensible Loss Rate = (Infiltration Sensible Loss Rate during on cycle \* Run time fraction) + Infiltration Sensible Loss Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Sensible Heat Loss Energy [J]

The average convective sensible heat loss, in Joules, to the zone air corresponding to the Zone Infiltration Volume averaged over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration sensible loss rate during the system on and off cycles for the reporting period:

Infiltration Sensible Loss = (Infiltration Sensible Loss during on cycle \* Run time fraction) + Infiltration Sensible Loss during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Latent Heat Gain Rate [W]

The average convective latent heat gain rate, in Watts, to the zone air corresponding to the Zone Infiltration Volume averaged over the reporting period, when the outdoor humidity ratio is higher than the zone air humidity ratio.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration latent gain rate during the system on and off cycles for the reporting period:

Infiltration Latent Gain Rate = (Infiltration Latent Gain Rate during on cycle \* Run time fraction) + Infiltration Latent Gain Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Latent Heat Gain Energy [J]

The total convective latent heat gain, in Joules, to the zone air corresponding to the Zone Infiltration Volume summed over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration latent gain during the system on and off cycles for the reporting period:

Infiltration Latent Gain = (Infiltration Latent Gain during on cycle \* Run time fraction) + Infiltration Latent Gain during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Latent Heat Loss Rate [W]

The average convective latent heat loss rate, in Watts, to the zone air corresponding to the Zone Infiltration Volume averaged over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration latent loss rate during the system on and off cycles for the reporting period:

Infiltration Latent Loss Rate = (Infiltration Latent Gain Loss Rate during on cycle \* Run time fraction) + Infiltration Latent Loss Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Infiltration Latent Heat Loss Energy [J]

The total convective latent heat loss, in Joules, to the zone air corresponding to the Zone Infiltration Volume summed over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated infiltration latent loss during the system on and off cycles for the reporting period:

Infiltration Latent Loss = (Infiltration Latent Gain Loss during on cycle \* Run time fraction) + Infiltration Latent Loss during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Sensible Heat Gain Rate [W]

The average convective sensible heat gain rate, in Watts, to the zone air corresponding to the Zone Mixing Volume averaged over the reporting period. The mixing-volume is defined as incoming volume flow from other adjacent zones where the air temperature is higher than the temperature in this zone. For example, there are two zones (Zone 2 and Zone 3) adjacent to this zone (Zone 1). Zone 1 receives airflows from both Zone 2 and Zone 3. The air temperature is 21°C in Zone 1. The air temperatures are 20°C in Zone 2 and 22°C in Zone 3. The sensible gain rate only includes heat gain from Zone 3 with respect to Zone 1. The energy received from Zone 2 is considered as a sensible loss, instead of a gain, because the air temperature in Zone 2 is lower than in Zone 1.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing sensible gain rate during the system on and off cycles for the reporting period:

Mixing Sensible Gain Rate = (Mixing Sensible Gain Rate during on cycle \* Run time fraction) + Mixing Sensible Gain Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Sensible Heat Loss Rate [W]

The average convective sensible heat loss rate, in Watts, to the zone air corresponding to the Zone Mixing Volume averaged over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing sensible loss rate during the on and off cycles for the reporting period:

Mixing Sensible Loss Rate = (Mixing Sensible Loss Rate during on cycle \* Run time fraction) + Mixing Sensible Loss Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Sensible Heat Gain Energy [J]

The total convective sensible heat gain, in Joules, to the zone air corresponding to the Zone Mixing Volume summed over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing sensible gain during the on and off cycles for the reporting period:

Mixing Sensible Gain = (Mixing Sensible Gain during on cycle \* Run time fraction) + Mixing Sensible Gain during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Sensible Heat Loss Energy [J]

The total convective sensible heat loss, in Joules, to the zone air corresponding to the Zone Mixing Volume summed over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing sensible loss during the on and off cycles for the reporting period:

Mixing Sensible Loss = (Mixing Sensible Loss during on cycle \* Run time fraction) + Mixing Sensible Loss during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Latent Heat Gain Rate [W]

The average convective latent heat gain rate, in Watts, to the zone air corresponding to the Zone Mixing Volume averaged over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing latent gain rate during the on and off cycles for the reporting period:

Mixing Latent Gain Rate = (Mixing Latent Gain Rate during on cycle \* Run time fraction) + Mixing Latent Gain Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Latent Heat Gain Energy [J]

The total convective latent heat gain, in Joules, to the zone air corresponding to the Zone Mixing Volume summed over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing latent gain during the on and off cycles for the reporting period:

Mixing Latent Gain = (Mixing Latent Gain during on cycle \* Run time fraction) + Mixing Latent Gain during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Latent Heat Loss Rate [W]

The average convective latent heat loss rate, in Watts, to the zone air corresponding to the Zone Mixing Volume averaged over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing latent loss rate during the on and off cycles for the reporting period:

Mixing Latent Loss Rate = (Mixing Latent Loss Rate during on cycle \* Run time fraction) + Mixing Latent Loss Rate during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing Latent Heat Loss Energy [J]

The total convective latent heat loss, in Joules, to the zone air corresponding to the Zone Mixing Volume summed over the reporting period.

When a Fan:OnOff object is used, the reported value is weighted by the system run time fraction using the calculated mixing latent loss during the on and off cycles for the reporting period:

Mixing Latent Loss = (Mixing Latent Loss during on cycle \* Run time fraction) + Mixing Latent Loss during off cycle \* (1.0 – Run time fraction)

#### AFN Zone Mixing CO2 Mass Flow Rate [kg/s]

This is a sum of mass flow rates from adjacent zones multiplied by the corresponding zone carbon dioxide concentration level to the receiving zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the mixing mass flow rate calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Mixing Generic Air Contaminant Mass Flow Rate [kg/s]

This is a sum of mass flow rates from adjacent zones multiplied by the corresponding zone generic contaminant concentration level to the receiving zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the mixing mass flow rate calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Duct Leaked Air Sensible Heat Gain Rate [W]

This is the average sensible heat gain rate, in Watts, to a specific zone due to supply air leaks from the forced air distribution system. This value is averaged over the reporting period. A sensible heat gain occurs when duct air is warmer than zone air. It should be pointed out that when multiple supply air leaks are present in a single zone, the output value is the summation of all the supply air leak gains in this zone. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Sensible Heat Gain Energy [J]

This is the total sensible heat gain, in Joules, to a specific zone due to supply air leaks summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Sensible Heat Loss Rate [W]

This is the average sensible heat loss rate, in Watts, to a specific zone due to supply air leaks from the forced air distribution system. This value is averaged over the reporting period. A sensible heat loss occurs when duct air is cooler than zone air. It should be pointed out that when multiple supply air leaks are present in this zone, the output value is the summation of all the supply air leak losses in this zone. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Sensible Heat Loss Energy [J]

This is the total sensible heat loss, in Joules, to a specific zone due to supply air leaks summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Latent Heat Gain Rate [W]

This is the average latent heat gain rate, in Watts, to a specific zone due to supply air leaks from the forced air distribution system for the reported time period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Latent Heat Gain Energy [J]

This is the total latent heat gain, in Joules, to a specific zone due to supply air leaks summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Latent Heat Loss Rate [W]

This is the average latent heat loss rate, in Watts, to a specific zone due to supply air leaks from the forced air distribution system for the reported time period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Leaked Air Latent Heat Loss Energy [J]

This is the total latent heat loss, in Joules, to a specific zone due to supply air leaks summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Conduction Sensible Heat Gain Rate [W]

This is the average sensible heat gain rate, in Watts, of duct conduction to a specific zone where the ducts are located. This value is averaged over the reporting period. A sensible heat gain occurs when duct air is warmer than the zone air. It should be pointed out that when ducts are located in different zones, the total duct conduction loss should be the summation of the duct conduction losses in these zones. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Conduction Sensible Heat Gain Energy [J]

This is the total sensible heat gain, in Joules, to a specific zone due to duct conduction summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Conduction Sensible Heat Loss Rate [W]

This is the average sensible heat loss rate, in Watts, of duct conduction to a specific zone where the ducts are located. This value is averaged over the reporting period. A sensible heat loss occurs when duct air is cooler than the zone air. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Conduction Sensible Heat Loss Energy [J]

This is the total sensible heat loss, in Joules, to a specific zone due to duct conduction summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Diffusion Latent Heat Gain Rate [W]

This is the average latent heat gain rate, in Watts, of vapor diffusion through the walls of the air distribution system to a specific zone where the ducts are located. This value is averaged over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Diffusion Latent Heat Gain Energy [J]

This is the total latent heat gain, in Joules, to a specific zone due to duct vapor diffusion summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Diffusion Latent Heat Loss Rate [W]

This is the average latent heat loss rate, in Watts, of duct vapor diffusion to a specific zone where the ducts are located. This value is averaged over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Duct Diffusion Latent Heat Loss Energy [J]

This is the total latent heat loss, in Joules, to a specific zone due to duct vapor diffusion summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Sensible Heat Gain Rate [W]

This is the average total sensible heat gain rate, in Watts, in a specific zone caused by the forced air distribution system. The total sensible gain rate is the sum of duct leakage sensible gain rate and duct conduction sensible gain rate. This value is averaged over the reporting period. The multizone airflow sensible gain rate is excluded in this output variable. The output of multizone airflow sensible gain is reported in the previously-described output variables AFN Zone Infiltration Sensible Heat Gain Rate and AFN Zone Mixing Sensible Heat Gain Rate. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Sensible Heat Gain Energy [J]

This is the total sensible heat gain, in Joules, in a specific zone caused by the forced air distribution system. The total sensible gain is the sum of duct leakage sensible gain and duct conduction sensible gain. This value is summed over the reporting period. The multizone airflow sensible gain is excluded in this output variable. The output of multizone airflow sensible gain is reported in the previously-described output variables AFN Zone Infiltration Sensible Heat Gain Energy and AFN Zone Mixing Sensible Heat Gain Energy. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Sensible Heat Loss Rate [W]

This is the average total sensible heat loss rate, in Watts, in a specific zone caused by the forced air distribution system. The total sensible loss rate is the sum of duct leakage sensible loss rate and duct conduction sensible loss rate. This value is averaged over the reporting period. The multizone airflow sensible loss rate is excluded in this output variable. The output of multizone airflow sensible loss rate is reported in the previously-described output variables AFN Zone Infiltration Sensible Heat Loss Rate and AFN Zone Mixing Sensible Heat Loss Rate. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Sensible Heat Loss Energy [J]

This is the total sensible heat loss, in Joules, in a specific zone caused by the forced air distribution system. The total sensible loss is the sum of duct leakage sensible loss and duct conduction sensible loss. This value is summed over the reporting period. The multizone airflow sensible loss is excluded in this output variable. The output of multizone airflow sensible loss is reported in the previously-described output variables AFN Zone Infiltration Sensible Heat Loss Energy and AFN Zone Mixing Sensible Heat Loss Energy. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Latent Heat Gain Rate [W]

This is the average total latent heat gain rate, in Watts, in a specific zone caused by the forced air distribution system. The total latent gain rate is the sum of duct leakage latent gain rate and duct conduction latent gain rate. This value is averaged over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Latent Heat Gain Energy [J]

This is the total latent heat gain, in Joules, in a specific zone caused by the forced air distribution system. The total latent gain is the sum of duct leakage latent gain and duct diffusion latent gain. This value is summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Latent Heat Loss Rate [W]

This is the average total latent heat loss rate, in Watts, in a specific zone caused by the forced air distribution system. The total latent loss rate is a sum of duct leakage latent loss rate and duct diffusion latent loss rate. This value is averaged over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Distribution Latent Heat Loss Energy [J]

This is the total latent heat loss, in Joules, in a specific zone caused by the forced air distribution system. The total latent loss is the sum of duct leakage latent loss and duct diffusion latent loss. This value is summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

**NOTE:** The following output variables should not be confused with similar output variables for the infiltration, mixing, and cross mixing objects (Ref. Infiltration Output, Mixing Output, or Cross Mixing Output). The output variables described below refer to infiltration, mixing, and cross-mixing when an Airflow Network Simulation is performed. The following output variables are always used to describe infiltration, mixing, and cross mixing when the AirflowNetwork Control field in the AirflowNetwork:SimulationControl object is set to “MultizoneWithoutDistribution” or “MultizoneWithDistribution”. In this case the output variables for the infiltration, mixing, and cross mixing objects will always be 0.

In contrast, the following output variables are only used to describe infiltration, mixing, and cross mixing when the AirflowNetwork Control field in the AirflowNetwork:SimulationControl object is set to “MultizoneAirflowWithDistributionOnlyDuringFanOperation” and the fan is operating. When the fan is not operating, the output variables for the infiltration, mixing, and cross mixing objects are used.

In the case where the AirflowNetwork Control field in the AirflowNetwork:SimulationControl object is set to “NoMultizoneOrDistribution”, the following output variables are not used and the output variables for the infiltration, mixing, and cross mixing objects are used instead.

#### AFN Zone Infiltration Sensible Heat Gain Energy [J]

The total convective sensible heat gain, in Joules, to the zone air corresponding to the Zone Infiltration Volume summed over the reporting period. This value is calculated for each timestep when the outdoor dry-bulb temperature is higher than the zone temperature, otherwise the sensible gain is set to 0. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Infiltration Sensible Heat Loss Energy [J]

The total convective sensible heat loss, in Joules to the zone air corresponding to the Zone Infiltration Volume summed over the reporting period. When a Fan:OnOff object is used, the reported value is for the system on cycle.

#### AFN Zone Infiltration Volume [m3]

The volume of outdoor air flow into the zone from window/door openings and cracks in the exterior surfaces of the zone (i.e., the sum of ventilation and crack flows from the exterior into the zone). The zone air density is used to calculate the zone infiltration volume based on the mass flow rate. Note that AirflowNetwork Zone Infiltration Volume will be zero if all of the flows through the zone’s exterior surfaces are out of the zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the infiltration volume calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Infiltration Mass [kg]

The mass of air corresponding to the AirflowNetwork Zone Infiltration Volume. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the infiltration mass calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Infiltration Air Change Rate [ach]

The number of air changes per hour produced by outdoor air flow into the zone from window/door openings and cracks in the exterior surfaces of the zone (i.e. the sum of ventilation and crack flows from the exterior into the zone). The target zone air density is used to calculate the zone infiltration air change rate based on the mass flow rate Note that, like Zone Infiltration Volume, Zone Infiltration Air Change Rate will be zero if all flows through the zone’s exterior surfaces are out of the zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the infiltration air change rate calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Mixing Volume [m3]

This is a measure of interzone air flow for each thermal zone. It is the volume of air flow into the zone from adjacent zones through window/door openings and cracks in the interior heat transfer surfaces of the zone. The target zone air density is used to calculate the zone mixing volume based on the mass flow rate. This variable does not include flows that are from the zone to adjacent zones. Note that Zone Mixing Volume will be zero if all flows through the zone’s interior surfaces are out of the zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the mixing volume calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Mixing Mass [kg]

The mass of air corresponding to the AFN Zone Mixing Volume. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the mixing mass calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Mixing Mass Flow Rate [kg/s]

This is a sum of mass flow rates from adjacent zones to the receiving zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the mixing mass flow rate calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Outdoor Air CO2 Mass Flow Rate [kg/s]

This is a sum of mass flow rates from outdoors multiplied by the outdoor carbon dioxide concentration level to the receiving zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the outdoor mass flow rate calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Outdoor Air Generic Air Contaminant Mass Flow Rate [kg/s]

This is a sum of mass flow rates from outdoors multiplied by the outdoor generic air contaminant concentration level to the receiving zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the outdoor mass flow rate calculated during the fan on and off periods for the simulation timestep

#### AFN Zone Outdoor Air Mass Flow Rate [kg/s]

This is a sum of mass flow rates from outdoors to the receiving zone. When a Fan:OnOff object is used, the reported value is weighted by the system fan part-load ratio using the outdoor mass flow rate calculated during the fan on and off periods for the simulation timestep.

#### AFN Zone Total CO2 Mass Flow Rate [kg/s]

This is a sum of mass flow rates from adjacent zones or outdoors multiplied by the carbon dioxide concentration differences between the corresponding zone and the receiving zone.

#### AFN Zone Total Generic Air Contaminant Mass Flow Rate [kg/s]

This is a sum of mass flow rates from adjacent zones or outdoors multiplied by the generic contaminant concentration differences between the corresponding zone and the receiving zone.

The following output variables are reported only when an AirflowNetwork:OccupantVentilationControl object is used:

#### AFN Surface Venting Window or Door Opening Factor at Previous Time Step []

The value of the venting opening factor for a particular window or door at the previous time step. When the window or door is venting, this is the input value of the opening factor (see AirflowNetwork:Multizone:Surface, Window/Door Opening Factor) times the multiplier for venting modulation (see description of next output variable, “Opening Factor Multiplier for AirflowNetwork Venting Modulation”). For example, if the input Window/Door opening factor is 0.5 and the modulation multiplier is 0.7, then the value of this output variable will be 0.5x0.7 = 0.35.

#### AFN Surface Opening Elapsed Time [min]

This output is the opening elapsed time in the units of minutes since the window opened.

#### AFN Surface Closing Elapsed Time [min]

This output is the opening elapsed time in the units of minutes since the windows closed.

#### AFN Surface Opening Status at Previous Time Step []

This is the window or door opening factor control status at the previous time step using an AirflowNetwork:OccupantVentilationControl object, which can have three integer values: 0, 1, and 2. A 0 value indicates no occupant ventilation control. The opening factor is determined by the Ventilation Control Mode field. A value of 1 indicates that a window or door is allowed to open. The value of 1 is determined when the opening elapsed time is less than the minimum opening time. A value of 2 denotes that a window or door is forced to close. The value of 2 is determined when the closing elapsed time is less than the minimum closing time.

#### AFN Surface Opening Status []

This is the window or door opening factor control status at the current time step using an AirflowNetwork:OccupantVentilationControl object, which can have three integer values: 0, 1, and 2. A 0 value indicates no occupant ventilation control. The opening factor is determined by the Ventilation Control Mode field. A value of 1 indicates that a window or door is allowed to open. The value of 1 is determined when the opening elapsed time is less than the minimum opening time. A value of 2 denotes that a window or door is forced to close. The value of 2 is determined when the closing elapsed time is less than the minimum closing time.

#### AFN Surface Opening Probability Status []

This is the opening probability status at the current time step using an AirflowNetwork:OccupantVentilationControl object, which can have three integer values: 0, 1, and 2. A 0 value indicates no opening probability control action. A value of 1 indicates that a window or door is forced to open when the opening status is 0. A value of 2 denotes that the status at the previous time step will be kept.

#### AFN Surface Closing Probability Status []

This is the closing probability status at the current time step using an AirflowNetwork:OccupantVentilationControl object, which can have three integer values: 0, 1, and 2. A 0 value indicates no closing probability control action. A value of 1 indicates that a window or door is forced to close when the opening status is 0. A value of 2 denotes that the status at the previous time step will be kept.