TYPE 648: AIR RETURN PLENUM WITH UP TO 100 PORTS

General Description

Type648 models a return air plenum. Up to 100 individual flows of air are mixed together to determine the properties of the air exiting the plenum. The limit of 100 inlet flows can be modified in the Fortran source code.

Nomenclature

ω_{out}	[kgH_2O/kgAir]	Absolute humidity ratio of air exiting the plenum as calculated from mixing equations.
$nPorts$	[-]	Number of inlet air ports.
$\dot{m}_i$	[kg/hr]	Mass flow rate of air entering the plenum through inlet port i.
$\omega_{in,i}$	[kgH_2O/kgAir]	Absolute humidity ratio of air entering the plenum through inlet port i.
$\dot{m}_{out}$	[kg/hr]	Mass flow rate of air exiting the plenum.
h_{out}	[kJ/kg]	Enthalpy of air exiting the plenum as calculated from mixing equations.
$h_{in,i}$	[kJ/kg]	Enthalpy of air entering the plenum through inlet port i.
$\dot{m}_{cond}$	[kg/hr]	Mass flow rate of condensate exiting the plenum.
$\omega_{returned}$	[kgH_2O/kgAir]	Absolute humidity ratio of air exiting the plenum as returned from the TRNSYS psychrometrics subroutine.

Detailed Description

At each time step, Type648 mixes all incoming air streams. Each air stream is described to the model with air pressure, temperature, flow rate, relative humidity and absolute humidity ratio. Depending upon the mode in which Type648 is operating, the value of either the relative humidity or the humidity ratio input is ignored. The component takes a single value of pressure drop across the plenum as an input as well. Type648 passes pressure, temperature and either relative humidity or humidity ratio to the TRNSYS PSYCHROMETRICS routine, which returns values of temperature, humidity ratio, relative humidity, and enthalpy. If saturated conditions were passed to the PSYCHROMETRICS routine, PSYCHROMETRICS returns the saturated humidity ratio and relative humidity corresponding to the specified temperature. This means that the humidity ratio and relative humidity used in calculations may be slightly different than those passed to the model by the user. If the air condition is saturated at any point in the simulation, the PSYCHROMETRCS routine prints a warning in the TRNSYS list file.

The outlet flow rate of air exiting the mixing plenum is determined as the sum of the inlet air flows. If this sum is zero (no flow) then the temperature, pressure, humidity ratio, and relative humidity of the air at the plenum outlet are set to the corresponding values of the first specified inlet port. The mass flow rate of condensate is set to zero for this case even if saturated inlet conditions occurred at port 1.

If flow is positive through the plenum, the absolute pressure of air at the plenum outlet is set to the minimum pressure of the inlet air streams minus the plenum pressure drop specified as an input to the model.

The humidity ratio and enthalpy of the mixed air streams are calculated from equations 648.1a and 648b.

$$\omega_{out} = \frac{\sum_{i=1}^{nPorts} \dot{m}_i \omega_{in,i}}{\dot{m}_{out}} \quad \text{(Eq. 648.1a)}$$

$$h_{out} = \frac{\sum_{i=1}^{nPorts} \dot{m}_i h_{in,i}}{\dot{m}_{out}} \quad \text{(Eq. 648.1b)}$$

With these conditions known, PSYCHROMETRICS is called with outlet pressure, enthalpy, and humidity ratio to determine the remaining air outlet conditions, namely temperature and a modified humidity ratio. Again the humidity ratio is reduced to the saturation line value if PSYCHROMETRICS is called with saturated conditions. The difference between the humidity ratio used in the call to PSYCHROMETRICS and the humidity ratio returned from PSYCHROMETRICS is used to calculate the flow rate of condensate that potentially results from mixing the inlet air streams as shown in equation 648.2.

$$\dot{m}_{cond} = \dot{m}_{out}\left(\omega_{out} - \omega_{returned}\right) \quad \text{(Eq. 648.2)}$$