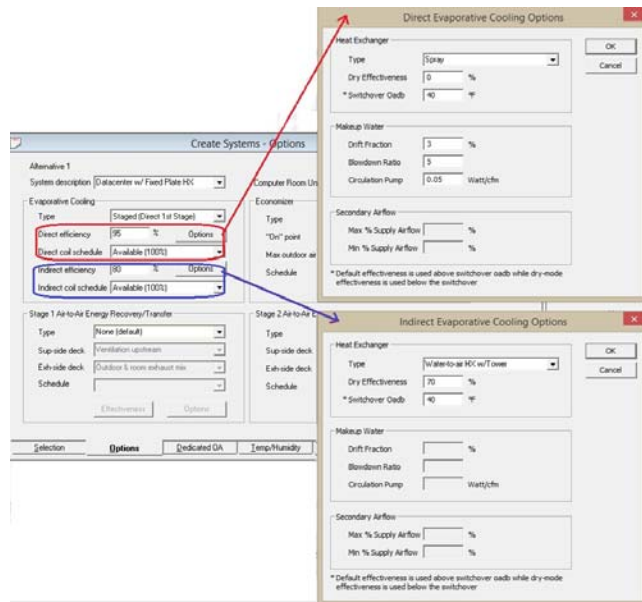


Standalone Evaporative Cooling on ROA deck

General Overview

The standalone evaporative cooling configuration assumes that the direct and/or indirect evaporative cooling device is located on the ROA deck immediately upstream of the main cooling coil. The indirect evaporative heat exchangers assume the exhaust-side (scavenger) airstream is always outside air. The direct evaporative heat exchangers do not have or need a scavenger airstream to operate. On the Change Load Parameters screen, the checkbox “Allow Evaporative Cooling at Design” can be used to turn off the standalone evaporative cooling during the design simulation.



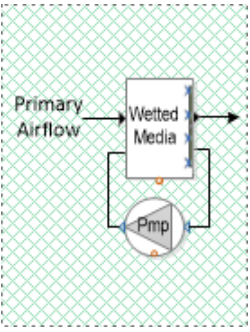
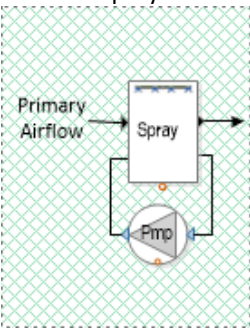
Direct Evaporative Heat Exchangers

Direct evaporative heat exchangers can be configured so the evaporation occurs in the primary airstream, meaning that moisture will always be added to the primary air. Therefore, these heat exchangers do not need a separate scavenger airstream. Also, since the supply air will likely always be above the supply setpoint temperature (generally, $S_{adbc} - \text{supply fan heat}$), there is little risk of freezing and so the evaporative cooling effect is available year round. However, the addition of moisture to the supply airstream can lead to excessively high relative humidity in the rooms which can be detrimental to both equipment and occupants.

Heat Exchanger Types: Wetted Media and Spray. These evaporative heat exchangers include either a spray coil or wetted media from which water evaporates into the primary airstream. The amount of heat removed from the air equals the amount of heat absorbed by the water (i.e., heat of vaporization). Only part of the water exposed to the air evaporates; when equilibrium is reached, the circulated water will approach the wet bulb temperature of the entering air.

Table 1 below lists the “Direct” evaporative heat exchangers types available in Trace when located in the supply airflow directly upstream of the main cooling coil.

Table 1. Direct Evap HX¹

| Direct Evaporative HX Type | Optional Scavenger Airflow | | HX Effectiveness | | | Makeup Water | | |
|---|----------------------------|-----------------|---|---|--|--|--|--|
| | Max % of Supply | Min % of Supply | % Default Effectiveness | % Dry Effectiveness | Switchover Oadb (°F) | Drift Loss Fraction (%) | Blowdown Ratio | Circ Pump Pwr (W/cfm) |
| <p>Wetted Media</p>  | N/A | N/A | <p>When Oadb > Switchover_{Db}:</p> $\text{SupLv}_{g_{Db}} = \text{SupEnt}_{Db} - (\text{EFF}_{\text{Def}}/100) * (\text{SupEnt}_{Db} - \text{Oawb})$ <p>Typical EFF_{Def} = 90 to 95%</p> | <p>When Oadb < Switchover_{Db}:</p> $\text{SupLv}_{g_{Db}} = \text{SupEnt}_{Db} - (\text{EFF}_{\text{Dry}}/100) * (\text{SupEnt}_{Db} - \text{Oawb})$ <p>If EvapHX in OA airstream, set EFF_{Dry} to 0% to force shutoff of HX below SwitchOver_{Db}</p> | <p>Use to switch between EFF_{Def} and EFF_{Dry}.</p> <p>Note: for this direct evap HX, EFF_{Dry} does not represent Effect in dry mode but wet Effect below the SwitchOver_{Db}</p> | <p>Use this field to model additional water consumed by the evap cooler from drift.</p> <p>Typical: 0.01- 0.5%</p> | <p>Use this field to model additional water consumed by the evap cooler from blowdown.</p> <p>Typical: 3-7</p> | <p>Circulation pump modulates to maintain desired evap cooler leaving setpoint db. Auto shutoff if evap cooler entering wb > setpoint db.</p> <p>Typical: 0.05 Watt/cfm</p> |
| <p>Spray</p>  | N/A | N/A | <p>When Oadb > Switchover_{Db}:</p> $\text{SupLv}_{g_{Db}} = \text{SupEnt}_{Db} - (\text{EFF}_{\text{Def}}/100) * (\text{SupEnt}_{Db} - \text{Oawb})$ <p>Typical EFF_{Def} = 90 to 95%</p> | <p>When Oadb < Switchover_{Db}:</p> $\text{SupLv}_{g_{Db}} = \text{SupEnt}_{Db} - (\text{EFF}_{\text{Dry}}/100) * (\text{SupEnt}_{Db} - \text{Oawb})$ <p>If EvapHX in OA airstream, set EFF_{Dry} to 0% to force shutoff of HX below SwitchOver_{Db}</p> | <p>Use to switch between EFF_{Def} and EFF_{Dry}.</p> <p>Note: for this direct evap HX, EFF_{Dry} does not represent Effect in dry mode but wet Effect below the SwitchOver_{Db}</p> | <p>Use this field to model additional water consumed by the evap cooler from drift.</p> <p>Typical: 0.01- 0.5%</p> | <p>Use this field to model additional water consumed by the evap cooler from blowdown.</p> <p>Typical: 3-7</p> | <p>Circulation pump modulates to maintain desired evap cooler leaving setpoint db. Auto shutoff if evap cooler entering wb > setpoint db.</p> <p>Typical: 0.05 Watt/cfm</p> |

¹When used in the primary airstream, not the exhaust-side airstream.

Indirect Evaporative Heat Exchangers

Indirect evaporative heat exchangers are configured so the evaporative heat exchanger is located in a separate (scavenger) outside air stream in order not to introduce outside contaminants or moisture into the primary air stream.

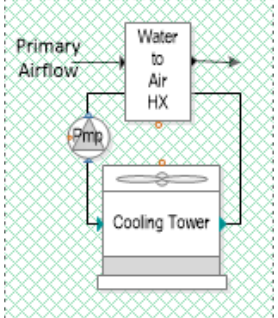
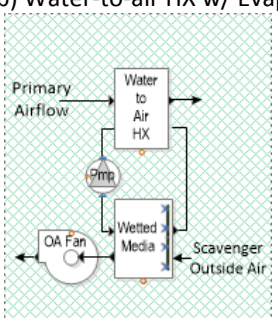
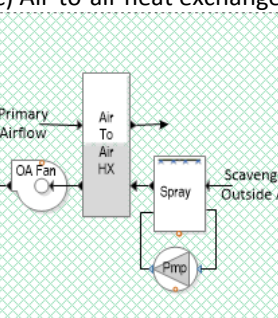
Water-to-air HX. In this configuration, a water-to-air coil is located in the primary air stream which operates like a normal finned tubed cooling coil except that the “chilled” water is provided by a cooling tower or other evaporative cooling apparatus such as wetted media. Water piped through either the tower or evaporative media is cooled by evaporation into ambient air blown over their heat exchanger surfaces. A cooling tower can generally operate at lower ambient temperatures than the wetted media because a closed tower can use glycol mixture for its transfer fluid.

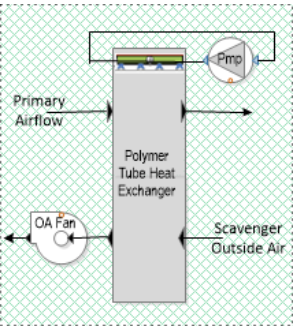
Air-to-air HX. An air-to-air heat exchanger (such as a sensible wheel, heat pipe or fixed-plate HX) transfers heat directly from the primary airstream to the secondary (scavenger) airstream. The evaporative component is separate and is used to precool the scavenger airstream before it interacts with the secondary side of the air-to-air heat exchanger.

Wetted plate/tube HX. With a wetted plate/tube heat exchanger, e.g., Munters Oasis, outdoor scavenger air is drawn across the exterior of elliptical tubes, which are wetted by a recirculation

water pump. With scavenger air flowing over the wet exterior tube surfaces, evaporative heat transfer cools the hotter primary air flowing through the inside of the tubes.

Table 2 below lists the various “Indirect” evaporative heat exchangers available in Trace 700.

| Indirect Evaporative HX Type | Optional Scavenger Airflow | | HX Effectiveness | | | Makeup Water | | |
|---|---|--|--|--|---|---|---|---|
| | Max % of Supply | Min % of Supply | % Default Effectiveness | % Dry Effectiveness | Switchover Oadb (°F) | Drift Loss Fraction (%) | Blowdown Ratio | Circ Pump Pwr (W/cfm) |
| <p>a) Water-to-air HX w/ Tower</p>  | N/A | N/A | <p>When Oadb > Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Def}}/100) * (\text{SupEnt}_{\text{Db}} - \text{TwrWaterLv})$ <p>Typical EFF_{Def} = 60 to 80%</p> | <p>When Oadb < Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Dry}}/100) * (\text{SupEnt}_{\text{Db}} - \text{TwrWaterLv})$ <p>Set EFF_{Dry} to 0% to force shutoff of HX below SwitchOver_{Db}</p> | Use to switch between EFF _{Def} and EFF _{Dry} . | N/A | N/A | N/A |
| <p>b) Water-to-air HX w/ Evap</p>  | <p>MaxSvgAirflow= (MaxPct/100)* SupSideAirflow</p> <p>The scavenger airflow is modulated between the max and min scavenger airflow settings to achieve the primary air leaving dry bulb setpoint.</p> | <p>MinSvgAirflow= (MinPct/100)* SupSideAirflow</p> <p>To model the scavenger OA fan energy consumption, choose an Auxiliary Fan on the Create Systems – Fan Overrides screen</p> | <p>When Oadb > Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Def}}/100) * (\text{SupEnt}_{\text{Db}} - \text{Oawb})$ <p>Typical EFF_{Def} = 60 to 80%</p> | <p>When Oadb < Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Dry}}/100) * (\text{SupEnt}_{\text{Db}} - \text{Oadb})$ <p>If EvapHX in OA airstream, set EFF_{Dry} to 0% to force shutoff of HX below SwitchOver_{Db}</p> | Use to switch between EFF _{Def} and EFF _{Dry} . | Use this field to model additional water consumed by the evap cooler from drift. Typical: 0.01- 0.5% | Use this field to model additional water consumed by the evap cooler from blowdown. Typical: 3-7 | Scavenger fan is modulated first with pump at max. When svg fan is at its minimum, then circulation pump modulates to maintain desired evap cooler leaving setpoint db. Pump shuts off when HX runs in dry mode or when Oawb > setpoint db. |
| <p>c) Air-to-air heat exchanger</p>  | <p>MaxSvgAirflow= (MaxPct/100)* SupSideAirflow</p> <p>The scavenger airflow is modulated between the max and min scavenger airflow settings to achieve the primary air leaving dry bulb setpoint</p> | <p>MinSvgAirflow= (MinPct/100)* SupSideAirflow</p> <p>To model the scavenger OA fan energy consumption, choose an Auxiliary Fan on the Create Systems – Fan Overrides screen</p> | <p>When Oadb > Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Def}}/100) * (\text{SupEnt}_{\text{Db}} - \text{Oawb})$ <p>Typical EFF_{Def} = 60 to 80%</p> | <p>When Oadb < Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Dry}}/100) * (\text{SupEnt}_{\text{Db}} - \text{Oadb})$ <p>EFF_{Dry} means the evaporative cooling HX's circulation pump is off but the air-to-air HX can still operate in dry mode.</p> | Use to switch between EFF _{Def} and EFF _{Dry} . | Use this field to model additional water consumed by the evap cooler from drift. Typical: 0.01- 0.5% | Use this field to model additional water consumed by the evap cooler from blowdown. Typical: 3-7 | Scavenger fan is modulated first with circ pump at max. When svg fan is at its minimum, then circ pump modulates to maintain desired evap cooler leaving setpoint db. Pump shuts off when HX runs in dry mode or when Oawb > setpoint db. |
| <p>d) Wetted plate/tube heat exchanger</p> | <p>MaxSvgAirflow= (MaxPct/100)* SupSideAirflow</p> <p>The scavenger airflow is modulated between the max and min scavenger airflow settings to achieve the primary air</p> | <p>MinSvgAirflow= (MinPct/100)* SupSideAirflow</p> <p>To model the scavenger OA fan energy consumption, choose an Auxiliary Fan on the Create Systems – Fan</p> | <p>When Oadb > Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Def}}/100) * (\text{SupEnt}_{\text{Db}} - \text{Oawb})$ <p>Typical EFF_{Def} = 60 to 80%</p> | <p>When Oadb < Switchover_{Db}:</p> $\text{SupLv}_{\text{Db}} = \text{SupEnt}_{\text{Db}} - (\text{EFF}_{\text{Dry}}/100) * (\text{SupEnt}_{\text{Db}} - \text{Oadb})$ <p>EFF_{Dry} means the evaporative cooling HX's circulation pump is off but the wetted plate/tube HX</p> | Use to switch between EFF _{Def} and EFF _{Dry} . | Use this field to model additional water consumed by the evap cooler from drift. Typical: 0.01- 0.5% | Use this field to model additional water consumed by the evap cooler from blowdown. Typical: 3-7 | Scavenger fan is modulated first with circ pump at max. When svg fan is at its minimum, then circ pump modulates to maintain desired evap cooler leaving setpoint db. Pump shuts off when HX runs |

| | | | | | | | | |
|---|----------------------------------|-------------------------|--|--------------------------------------|--|--|--|---------------------|
|  | <p>leaving dry bulb setpoint</p> | <p>Overrides screen</p> | | <p>can still operate in dry mode</p> | | | | <p>in dry mode.</p> |
|---|----------------------------------|-------------------------|--|--------------------------------------|--|--|--|---------------------|

Appendix: Direct and Indirect Evaporative Cooling Examples

1) Heat Pipe or Fixed Plate HX with supply-side on ROA deck and evaporative precool of exhaust side

In this configuration, the supply side of an air-to-air heat exchanger (heat pipe, flat plate or wheel) is located upstream of the main cooling coil. The exhaust side of the HX transfers heat to a scavenger outside air stream pretreated by a separate evaporative HX. The example below is shown as a completely recirculated system typical of data centers but a mixed air ventilation deck could be added to provide airside economizer operation for part of the year.

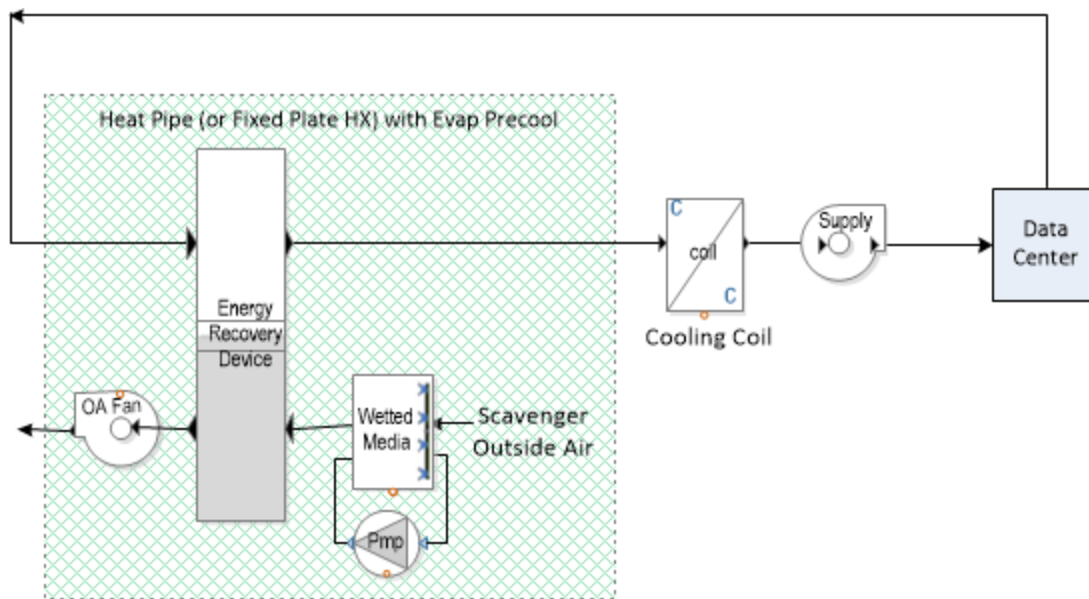
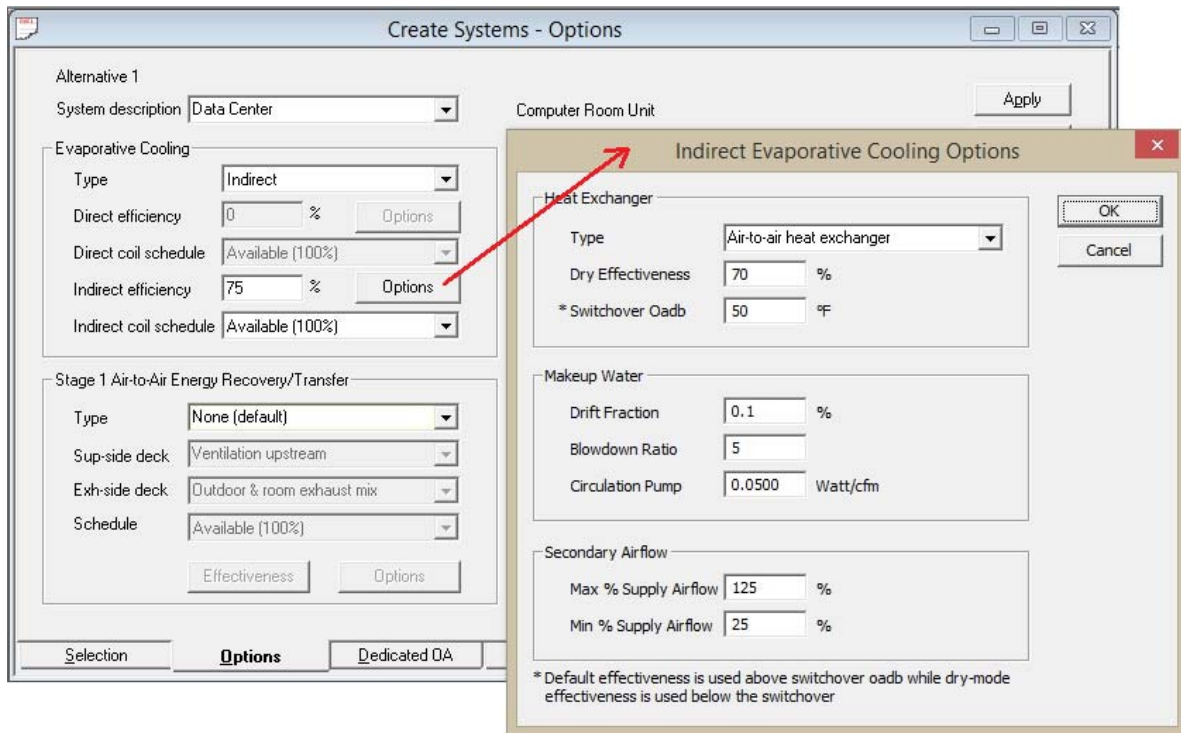


Figure 1: Diagram of Fixed Plate HX on supply deck with evaporative precooling of exhaust-side airflow

In Trace, this configuration can be created via the Create Systems – Options dialog using the standalone Evaporative Cooling:



Clicking on the standalone evaporative cooling “Options” button next to “Indirect Efficiency” field allows you to change the defaults. Per the figure above, here are the inputs that apply to this configuration:

Heat Exchanger Type: Air-to-air heat exchanger

Indirect Efficiency: refers to the overall wet-mode effectiveness at rated supply airflow

Dry Effectiveness: refers to the overall dry-mode effectiveness at rated supply airflow

Switchover Oadb: the water circulation pump will not operate below this Oadb which causes the HX to operate in dry mode. Above this Oadb, the HX can operate in wet mode.

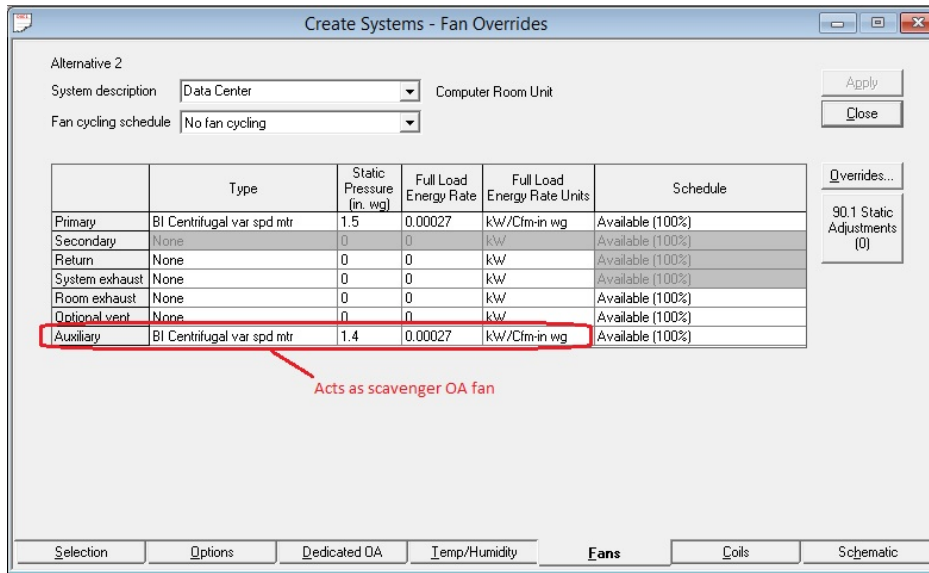
Makeup Water Drift and Blowdown Ratio: used to model additional water consumed by the cooler from drift and blowdown

Circulation Pump: power per design scavenger OA airflow. Operates at its design value whenever the HX is in wet mode.

Static Pressure Note: be sure to include the supply-side static pressure drop across the HX by including it with the primary fan’s static pressure via the Create Systems – Fan Overrides screen. In a similar manner, be sure to include the exhaust-side (scavenger OA) static pressure drop by defining it in the auxiliary fan’s static pressure field via the Create Systems – Fan Overrides screen.

Controls. The controls are designed to minimize scavenger fan energy consumption rather than minimize water consumption. The scavenger airflow is first modulated between the max and min scavenger airflow settings to achieve the primary air leaving dry bulb setpoint. If the HX is operating in wet mode, the circulation pump (and associated water flow) operates at its maximum. Once the scavenger fan has slowed down to its minimum speed to prevent overcooling, the circulation pump modulates, if necessary, to maintain desired HX leaving setpoint. The circulation pump shuts off when the HX runs in dry mode or when $O_{awb} > \text{primary air leaving dry bulb setpoint}$ or when $O_{adb} < \text{Switchover Db}$.

Next, the scavenger OA fan should be specified on the Create Systems – Fan Overrides screen as noted in the figure below:



To save fan energy, the scavenger airflow is modulated between the Minimum and Maximum OA % of Supply values to maintain target supply air dry bulb. If both Minimum and Maximum OA % of Supply are set to the same value, then the scavenger fan is constant volume and the ERD is modulated by reducing or shutting down the evaporative cooler first.

2) Polymer tube HX with supply-side on ROA deck with exhaust side using scavenger outside air

In this configuration, the supply side of a Polymer tube HX is located upstream of the main cooling coil. The exhaust side of the HX transfers heat to a scavenger outside air stream. With this design, outdoor scavenger air is drawn across the exterior of elliptical tubes, which are wetted by a recirculation water pump. The example below is shown as a completely recirculated system typical of data centers but a mixed air ventilation deck could be added to provide airside economizer operation for part of the year.

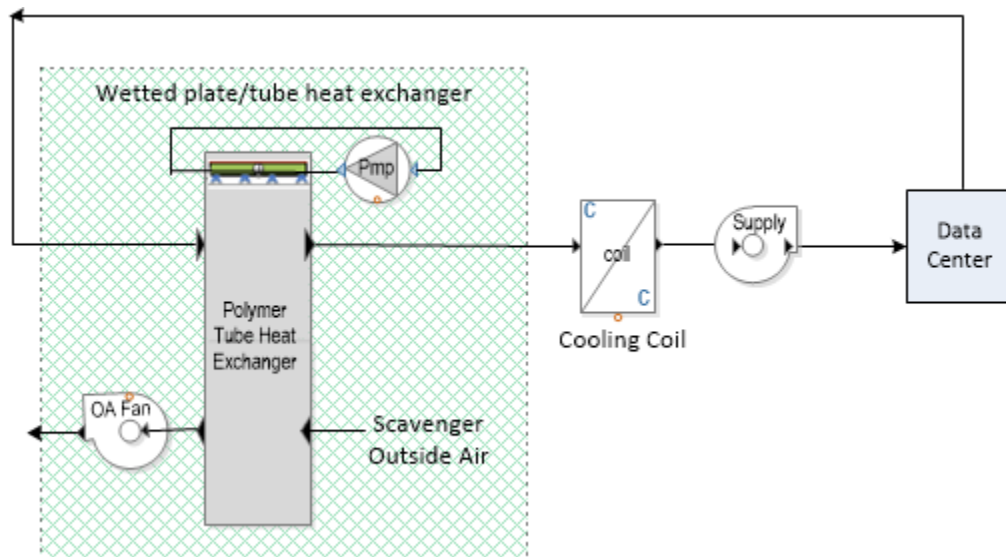
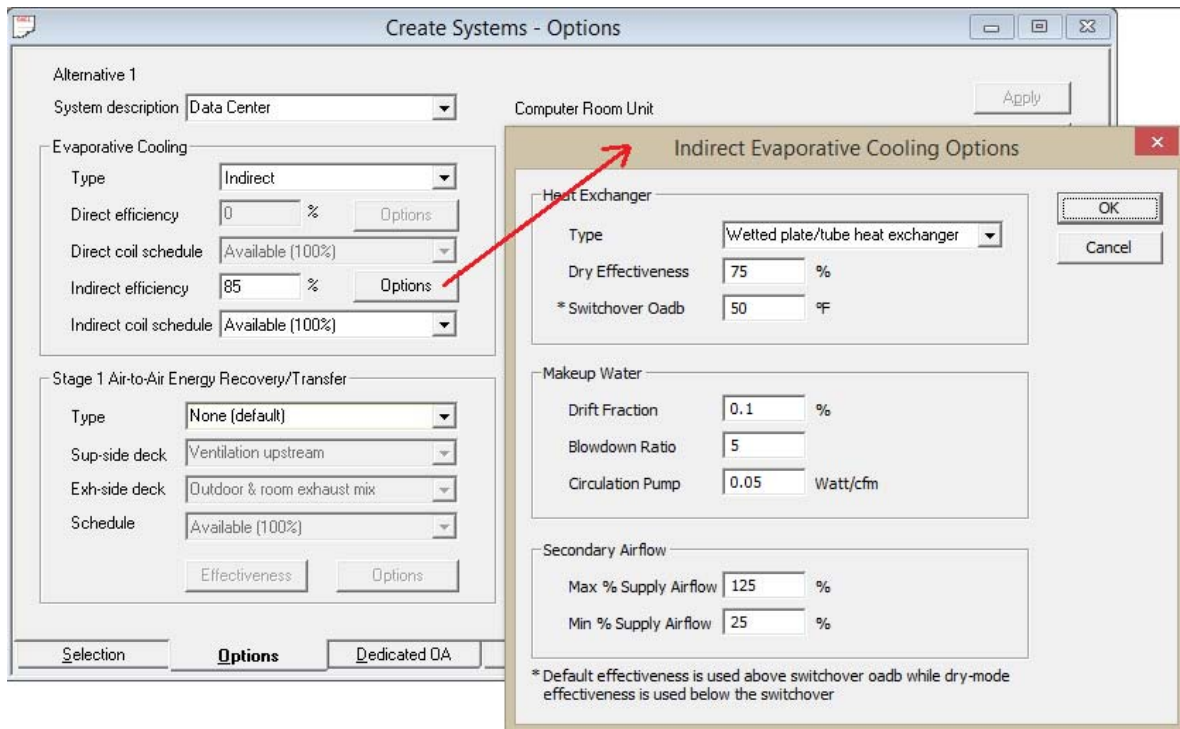


Figure 2: Diagram of Wetted plate/tube HX on the supply deck with scavenger outside air on the exhaust deck

In Trace, this configuration can be created via the Create Systems – Options dialog:



Clicking on the standalone evaporative cooling “Options” button next to “Indirect Efficiency” field allows you to change the defaults. Per the figure above, here are the inputs that apply to this configuration:

Heat Exchanger Type: Wetted plate/tube heat exchanger

Indirect Efficiency: refers to the overall wet-mode effectiveness at rated supply airflow

Dry Effectiveness: refers to the overall dry-mode effectiveness at rated supply airflow

Switchover Oadb: the water circulation pump will not operate below this Oadb which causes the HX to operate in dry mode. Above this Oadb, the HX can operate in wet mode.

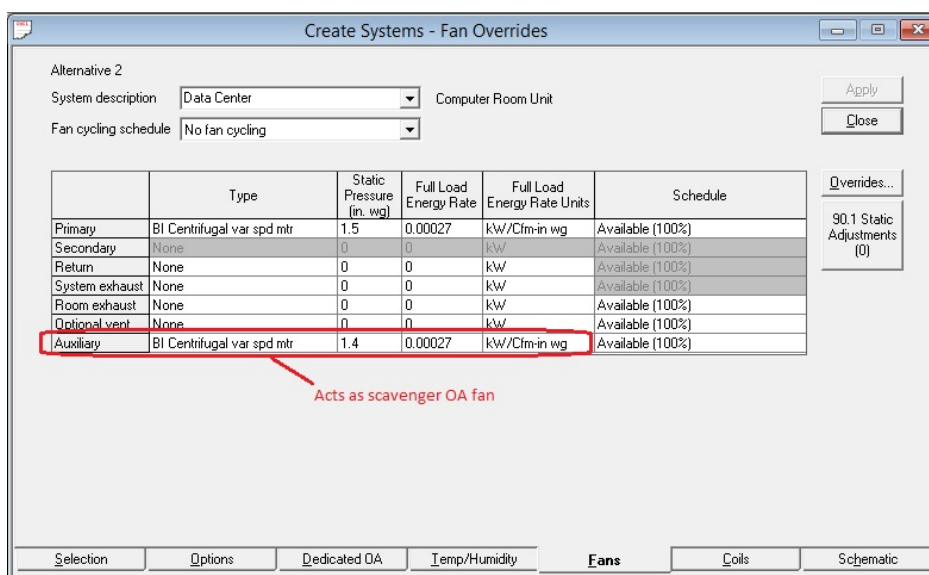
Makeup Water Drift and Blowdown Ratio: used to model additional water consumed by the cooler from drift and blowdown

Circulation Pump: power per design scavenger OA airflow. Operates at its design value whenever the HX is in wet mode.

Static Pressure Note: be sure to include the supply-side static pressure drop across the HX by including it with the primary fan’s static pressure via the Create Systems – Fan Overrides screen. In a similar manner, be sure to include the exhaust-side (scavenger OA) static pressure drop by defining it in the auxiliary fan’s static pressure field via the Create Systems – Fan Overrides screen.

Controls. The controls are designed to minimize scavenger fan energy consumption rather than minimize water consumption. The scavenger airflow is first modulated between the max and min scavenger airflow settings to achieve the primary air leaving dry bulb setpoint. If the HX is operating in wet mode, the circulation pump (and associated water flow) operates at its maximum. Once the scavenger fan has slowed down to its minimum speed to prevent overcooling, the circulation pump modulates, if necessary, to maintain desired HX leaving setpoint. The circulation pump shuts off when the HX runs in dry mode or when Oawb > primary air leaving dry bulb setpoint or when Oadb < Switchover Dry Bulb

Next, the scavenger OA fan is specified on the Create Systems – Fan Overrides screen as noted in the figure below:



The controls will try to minimize the scavenger OA fan energy consumption by initially setting the

scavenger airflow to the Minimum % of Supply Airflow value. If in wet mode, the necessary amount of water is sprayed into the scavenger airstream to meet the heat exchanger leaving setpoint. If the leaving heat exchanger dry bulb setpoint cannot be met, then the scavenger OA airflow is increased up to its “Maximum % of Supply Airflow” value.

3) Indirect Evaporative Cooling via Water-to-Air HX with Cooling Tower

In this configuration, a water-to-air HX is located upstream of the main cooling coil on the supply deck. The water-to-air HX is similar to a regular finned tube water cooling coil except that the “chilled” water comes from a cooling tower rather than a chiller. The example below is shown with a mixed air ventilation deck to provide airside economizer operation for part of the year.

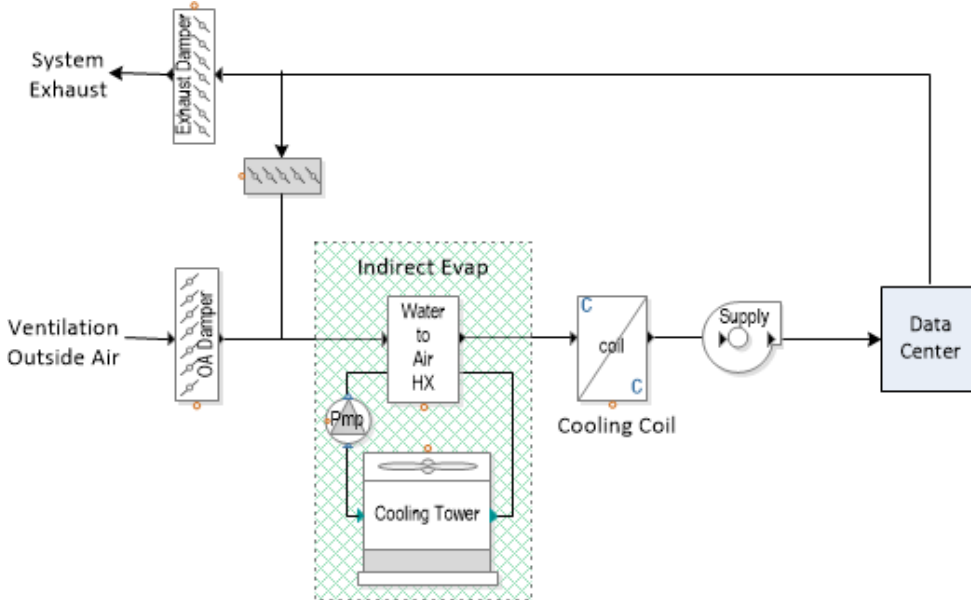
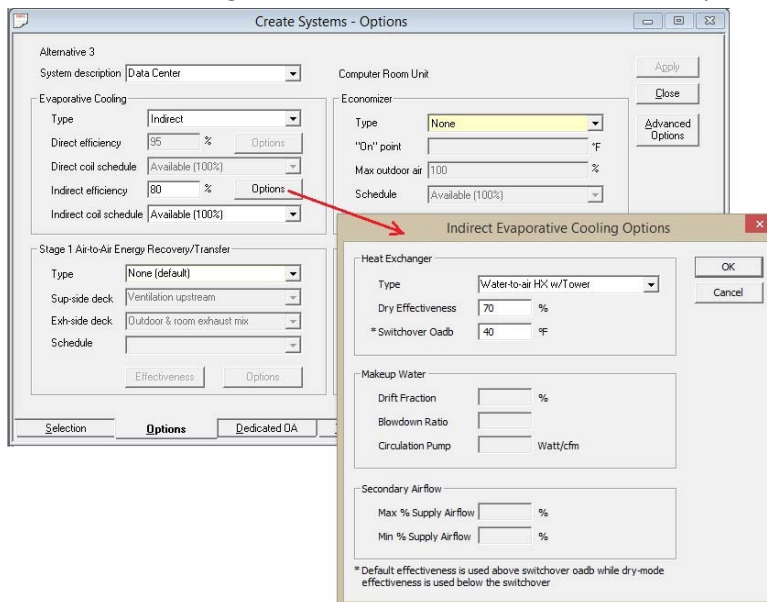


Figure 3: Diagram of indirect evaporative cooling via a water-to-air HX on the ROA deck

In Trace, this configuration can be created via the Create Systems – Options dialog:



Per the figure above, here are the inputs that apply to this configuration:

Heat Exchanger Type: Water-to-air HX w/Tower

Indirect Efficiency: refers to the effectiveness above the Switchover Oadb

Dry Effectiveness: refers to the effectiveness below the Switchover Oadb

Switchover Oadb: used to determine the value of the HX effectiveness. Above this value, the indirect effectiveness is set equal to the “Indirect Efficiency” field; below this value, the indirect effectiveness is set equal to the “Dry Effectiveness” field

Note: When the Heat Exchanger Type is “Water-to-air HX w/Tower”, the makeup water is calculated according to the cooling tower chosen as the Heat Rejection Type on the Create Plants – Cooling Equipment screen. The Secondary Airflow inputs are disabled because the cooling tower is modeled separately in the Equipment section

The cooling tower and associated pump attached to the water-to-air HX need not be specified for design or system simulation but are needed for the equipment simulation. On the Create Plants – Cooling equipment screen, create a separate cooling plant with:

- Category set to “Water-cooled chiller”
- Equipment Type set to “Indirect Evaporative Cooling”
- Choose a Heat Rejection Type that matches your cooling tower or fluid cooler
- Leave cooling capacity blank and set cooling energy rate to zero
- Choose a Condenser Water Pump and set its Full Load Consumption rate

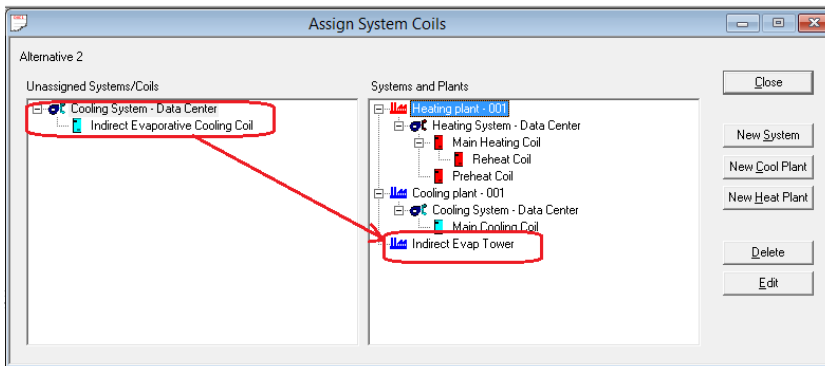
Operating mode table:

| Operating mode | Capacity | Energy rate |
|-------------------------------|----------|-------------|
| Cooling | tons | 0 kW |
| Heat recovery | tons | kW/ton |
| Tank charging | tons | kW/ton |
| Tank charging & heat recovery | tons | kW/ton |

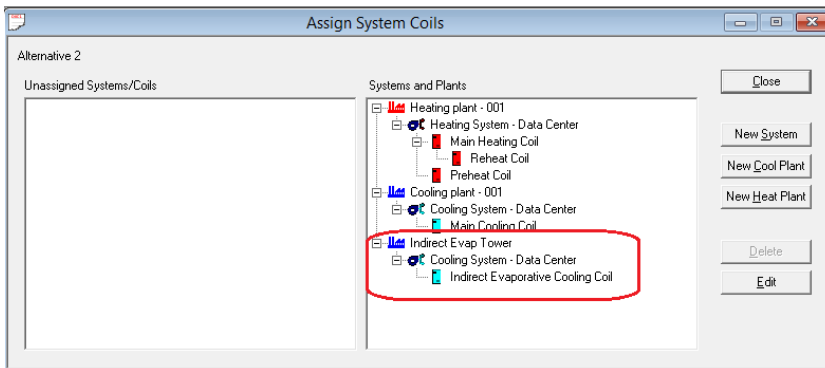
Pumps table:

| Pumps | Type | Full load consumption |
|--------------------------------|----------------------------------|-----------------------|
| Primary chilled water | None | 0 ft water |
| Condenser water | Indirect Evap Cooling water pump | 10 ft water |
| Heat recovery or aux condenser | None | 0 ft water |

Second, on the Assign System Coils screen, attach the Indirect Evaporative Cooling Coil to the above cooling plant as noted below:

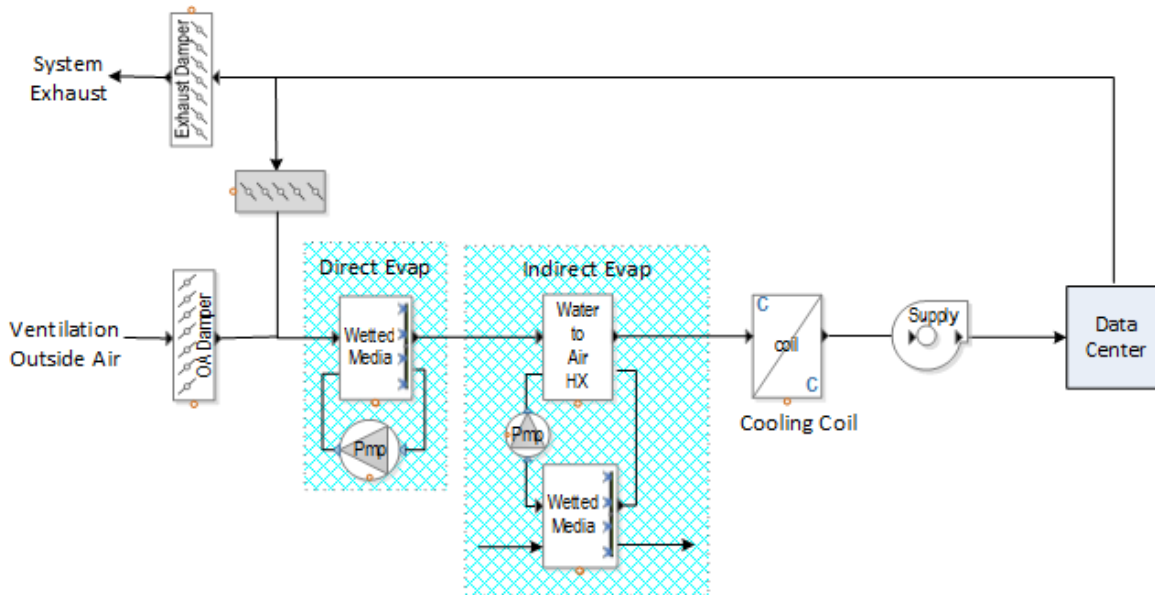


which becomes:

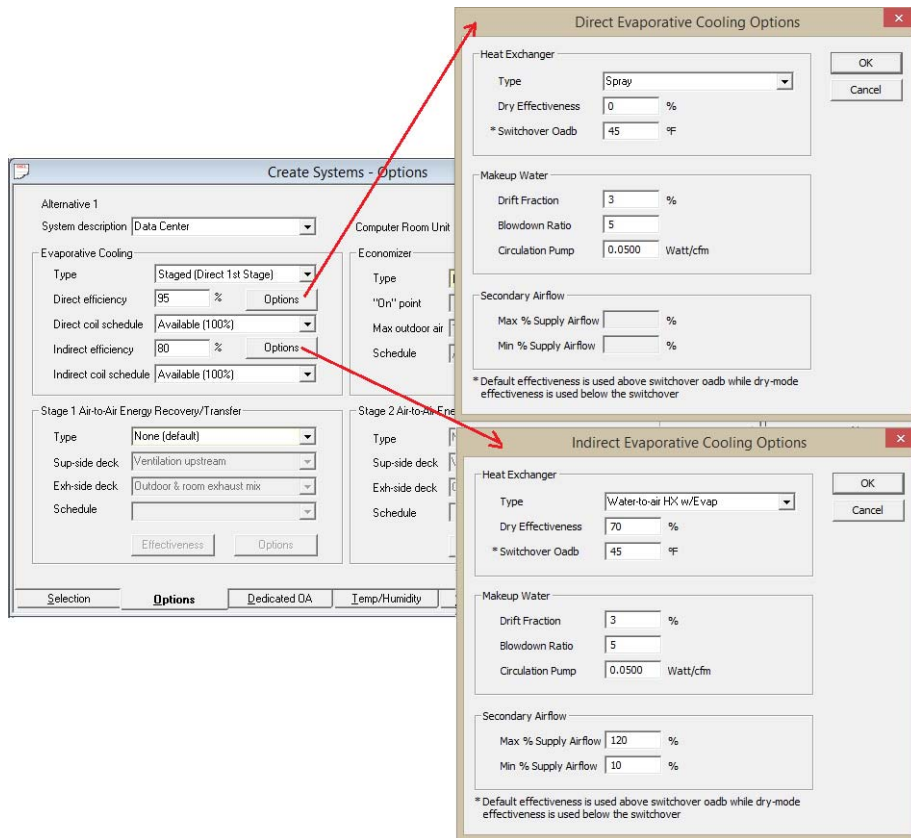


4) Staged Direct (Wetted Media) and Indirect Evaporative (Water-to-air HX) in ROA deck

In this configuration, a direct evaporative heat exchanger is placed upstream of an indirect evaporative heat exchanger located upstream of the main cooling coil on the ROA deck. The example below is shown with a mixed air ventilation deck to provide airside economizer operation for part of the year.

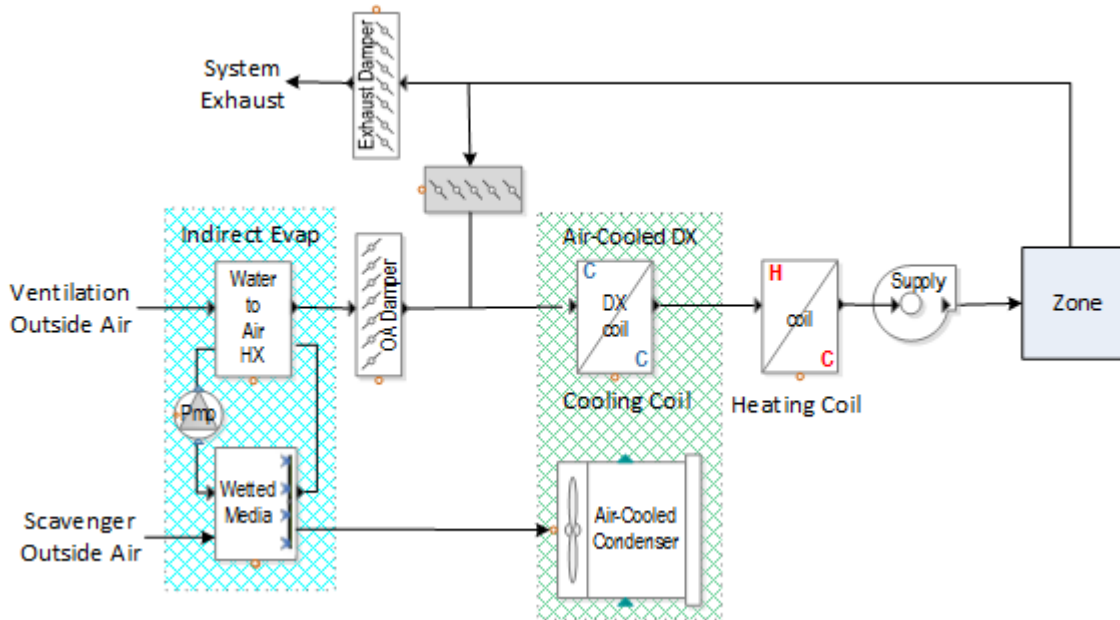


This can be modelled by using the standalone Evaporative Cooling Options as shown below:



5) Indirect Evaporative (Water-to-air) Heat Exchanger in ventilation deck (DualCool system)

This configuration is not used for data centers but was added to implement the DualCool addon to DX Rooftops. In this configuration, a water-to-air heat exchanger integrated with a separate evaporative media coil is placed in the ventilation deck. A submersible pump moves cool water from the reservoir beneath the evaporative media to, and through, the vent air pre-cooling coil, and then back to a distribution tube above the evaporative media. Water flowing by gravity downward through the wetted media cools the air entering the large condenser coil through which refrigerant is discharging heat to the outdoor air.



The Stage 1 Air-to-Air Energy Recovery/Transfer Type is a standard library member called “DualCool (OA Evap Precooling)” and would be defined on the Create System – Options screen via the Stage 1 or Energy Recovery :

Energy Recovery Library

| | | |
|--|---|---|
| <p>Equipment type: DualCool</p> <p><input type="radio"/> Energy recovery <input checked="" type="radio"/> Desiccant dehumidification</p> <p>Supply Side</p> <p>Desiccant type: None</p> <p>Desiccant cntl: Not Applicable</p> <p>Deck location: Ventilation upstream <small>Allowed Locations</small></p> <p>Static pressure drop: 0 in. wg</p> <p>Bypass dampers?: <input type="radio"/> Yes <input checked="" type="radio"/> No</p> <p>Design Air Leaving</p> <p>Dry bulb: °F</p> <p>Humidity ratio: gr/lb</p> <p>Coolant</p> <p>Type: N/A</p> <p>Approach: 10 °F</p> <p>Econ lockout?: <input checked="" type="radio"/> Yes <input type="radio"/> No</p> | <p>Comments: DualCool indirect evaporative unit with evap condenser</p> <p>Parasitic energy: 0 kW</p> <p>Exhaust Side</p> <p>Level location: Same level as conditioner</p> <p>Deck location: Ventilation upstream <small>Allowed Locations</small></p> <p>Static pressure drop: 0 in. wg</p> <p>Bypass dampers?: <input type="radio"/> Yes <input checked="" type="radio"/> No</p> <p>Heat source: °F</p> <p>Integral heat: <input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> NA</p> <p>Evap Precooler: Water-to-air HX w/Evap</p> <p>Default Effectiveness: 66 % Dry Eff: 0 %</p> <p>Min OA % of Supply: 20 % Max OA: 100 %</p> <p>* Switchover Oadb: 70 °F</p> <p>Makeup Water</p> <p>Drift Loss Fraction: 3 % Blowdown: 5</p> <p>Circulation Pump: 0.05 Watt/cfm</p> <p><small>* Default effectiveness is used above switchover oadb while dry-mode effectiveness is used below the switchover oadb.</small></p> | <p>Save</p> <p>Close</p> <p>New</p> <p>Copy</p> <p>Delete</p> |
|--|---|---|

Note how the Dry Effectiveness has been set to 0 and the Switchover Oadb to 70F. This means the evaporative circulation pump is shut off when the outside air temperature falls below 70F.

Also, note how the Supply and Exhaust-deck locations are both “Ventilation Upstream” which forces the Water-to-air heat exchanger onto the ventilation deck. If the Exhaust Deck location of “Outside Air” had been chosen instead, this would not have worked.

Third, because the evaporative media is precooling the condenser air, this must be accounted for in the Cooling Equipment library member attached to this system by specifying the Evaporative Precooling Flag = Yes and Evap Precool Effectiveness = 65% as noted below:

Chilled water temp. Design leaving 44 °F Condenser temp. Design entering 95 °F
Difference 10 °F Minimum operating 50 °F
Difference 10 °F
Load shedding economizer No
Fuel source Utility
Fuel type Electric
Evaporative precooling Yes
Evap precool effectiveness 65 %
Plate and frame heat exchanger approach 3 °F
Optimal unloading part load ratio %
Thermal storage type None
Heat rejection type Included In Compressor Power

Reject condenser heat To reference type Heat rejection equipment
At hot water temp. °F

Evaporator and Condenser Water Leaving Reset Options

| | Reset Based On | Reset Curve | Max Reset TD |
|-----------------|----------------|-------------|--------------|
| Chilled Water | None | None | °F |
| Condenser Water | None | None | 0 °F |

Free Cooling

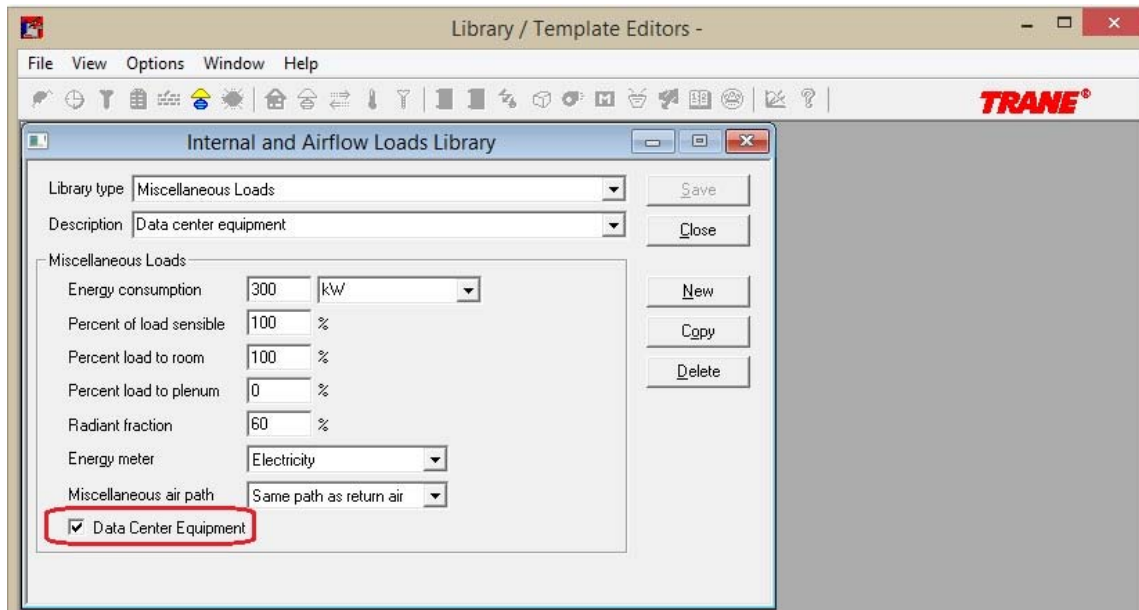
Type None
Fluid cooler type
Free cooling pump None
Pump head 0 kW
Refrig Economizer Unloading Curve None

| Miscellaneous accessories | |
|---------------------------|----------------------|
| 1 | IPAK Controls 0.7 KW |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |

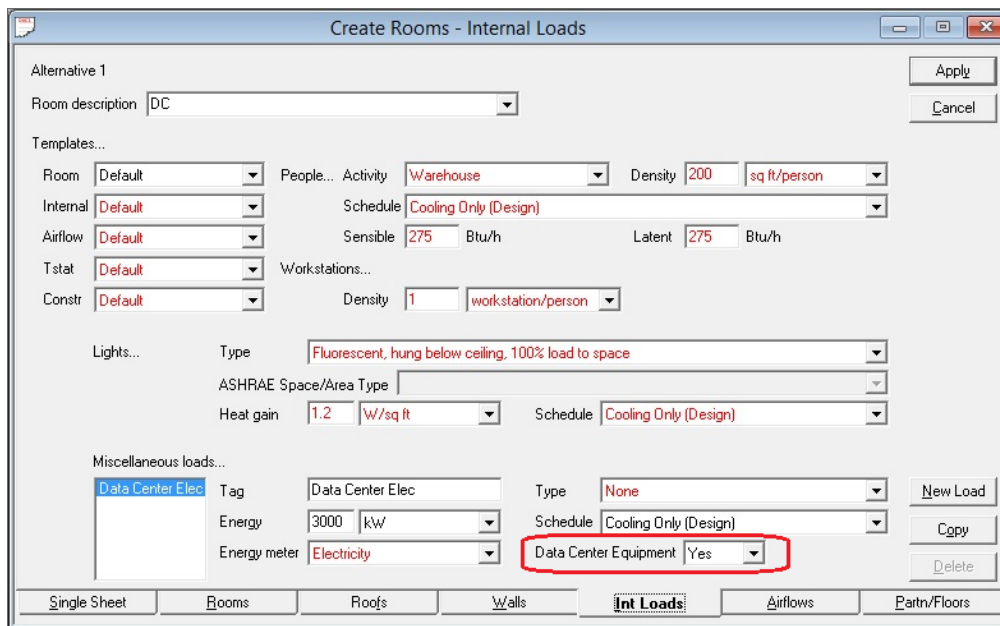
Main Options Graph

6) Specifying Data Center electrical as a separate line item in the Equipment Energy Consumption rpt

In the Editors library, a miscellaneous electric load can be identified as originating from a data center with a simple yes/no dropdown:



In the Trace, on the Create Rooms – Internal Loads screen, a miscellaneous electric load can be identified as originating from a data center with a simple yes/no dropdown. Note: dropdown will initially reflect the Miscellaneous Loads library member selected.



The Equipment Energy Consumption report will then break out the data center electric separately from the Miscellaneous Electric line item as shown below.

| |
|---|
| EQUIPMENT ENERGY CONSUMPTION By SEI |
|---|

Alternative: 1 ACC + Fixed Plate HX

| Equipment - Utility | ----- Monthly Consumption ----- | | | | | | | | | | | | Total |
|---------------------------|---------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | |
| Lights | | | | | | | | | | | | | |
| Electric (kWh) | 15,936.5 | 14,394.2 | 15,936.5 | 15,422.4 | 15,936.5 | 15,422.4 | 15,936.5 | 15,936.5 | 15,422.4 | 15,936.5 | 15,422.4 | 15,936.5 | 187,638.9 |
| Peak (kW) | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 | 21.4 |
| Misc. Ld | | | | | | | | | | | | | |
| Electric (kWh) | 262,260.0 | 236,880.0 | 262,260.0 | 253,800.0 | 262,260.0 | 253,800.0 | 262,260.0 | 262,260.0 | 253,800.0 | 262,260.0 | 253,800.0 | 262,260.0 | 3,087,900.0 |
| Peak (kW) | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 | 352.5 |
| Data center misc electric | | | | | | | | | | | | | |
| Electric (kWh) | 2,232,000.0 | 2,016,000.0 | 2,232,000.0 | 2,160,000.0 | 2,232,000.0 | 2,160,000.0 | 2,232,000.0 | 2,232,000.0 | 2,160,000.0 | 2,232,000.0 | 2,160,000.0 | 2,232,000.0 | 26,280,000.0 |
| Peak (kW) | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 | 3,000.0 |

Note: Trace700 does not provide a way to separate out data center electrical losses, PUE, CUE or WUE.

7) Schedule lockouts

Schedule lockouts can be used to limit direct and/or indirect evaporative coil or Energy Recovery operation within a specific Oadb range:

- a) In Schedule Library, create a Utilization Schedule for a specific range

Schedule Library

Schedule type: Utilization
 Description: Avail between Oadb 16C to 22C
 Simulation type: Reduced year
 Full year (day types only)
 Full year (all days)
 Comments: Ex. of how to force a coil off if Oadb < 16C or Oadb > 22C

January - December Cooling design to Sunday Heating design

Del Definition

Reset and lockout table

| % | Sensor type | Op | Reset | Offset | And |
|---|----------------------------------|----|-------|--------|-----|
| 0 | Outdoor air dry bulb temperature | < | 16 °C | | |
| 0 | Outdoor air dry bulb temperature | > | 22 °C | | |

NOTE: The reset and lockouts are available for the following: Design phase infiltration, ventilation, reheat minimum, and all system simulation schedules.

Schedule Graphs

- b) In Trace Create Systems – Options screen, select the above custom schedule for the respective coil

Create Systems - Options

Alternative 1
System description: CRAH DC

Computer Room Unit

Evaporative Cooling

Type: Direct

Direct efficiency: 100 %

Direct coil schedule: Avail between Oadb 16C to 22

Indirect efficiency: 95 %

Indirect coil schedule: Available (100%)

Economizer

Type: Dry Bulb

"On" point: 72 °F

Max outdoor air: 100 %

Schedule: Available (100%)

Stage 1 Air-to-Air Energy Recovery/Transfer

Type: None (default)

Sup-side deck: Ventilation upstream

Exh-side deck: Outdoor & room exhaust mix

Schedule: Available (100%)

Stage 2 Air-to-Air Energy Recovery/Transfer

Type: None (default)

Sup-side deck: Ventilation upstream

Exh-side deck: Outdoor & room exhaust mix

Schedule: Available (100%)

Buttons: Effectiveness, Options

Buttons: Effectiveness, Options

Buttons: Selection, **Options**, Dedicated OA, Temp/Humidity, Fans, Coils, Schematic

Buttons: Apply, Cancel, Advanced Options

8) Suggested Defaults

| | Evaporative HX Type | | | | | |
|-----------------------------------|---------------------|--------------|--------------------------|-------------------------|---------------------------|----------------------------------|
| | Spray | Wetted media | Water-to-air HX w/ Tower | Water-to-air HX w/ Evap | Air-to-air heat exchanger | Wetted plate/tube heat exchanger |
| Optional Scavenger Airflow | | | | | | |
| Max OA% of Supply, % | n/a | n/a | n/a | 125 | 125 | 125 |
| Min OA% of Supply, % | n/a | n/a | n/a | 25 | 25 | 25 |
| HX Effectiveness | | | | | | |
| Default Effectiveness, % | 95 | 95 | 80 | 70 | 80 | 85 |
| Dry Effectiveness, % | 0 | 0 | 70 | 0 | 70 | 75 |
| Switchover Oadb, F | 40 | 40 | 45 | 60 | 50 | 50 |
| Makeup Water | | | | | | |
| Drift Loss Fraction, % | 0.1 | 0.1 | n/a | 0.1 | 0.1 | 0.1 |
| Blowdown Ratio | 5 | 5 | n/a | 5 | 5 | 5 |
| Circulation Pump Power, W/cfm | 0.05 | 0.05 | n/a | 0.05 | 0.05 | 0.05 |