Group – Zone HVAC Equipment

SwimmingPool:Indoor

The Indoor Swimming Pool object is used to describe the indoor swimming pools that are exposed to the internal environment. There are several rules that should be noted regarding the specification of an indoor pool in EnergyPlus. First, the pool is linked to a surface that must be a floor. The pool is assumed to cover the entire floor to which it is linked. If the pool only covers part of the floor in the actual building, then the user must break the floor up into multiple sections.

As pools attempt to achieve a particular water temperature and have a variety of heat losses, heating equipment is necessary to maintain the proper setpoint temperature. In EnergyPlus, the pool itself becomes part of the demand side of a plant loop with heating equipment on the supply side providing whatever heating is needed to maintain the desired temperature. This heating equipment as well as the loop connections must be entered separately and the input shown in this section only details what is needed to specify the pool itself.

The following information is useful for defining and modeling an indoor pool in EnergyPlus. For more information on the algorithm used for this model or details on some of the input parameters, please reference the indoor pool section of the EnergyPlus Engineering Reference document.

***Field: Name***

This is a unique name associated with the indoor swimming pool.

***Field: Surface Name***

This is the name of the surface (floor) where the pool is located. Pools are not allowed on any surfaces other than a floor.

***Field: Average Depth***

This field is the average depth of the pool in meters. If the pool has variable depth, the average depth should be specified to achieve the proper volume of water in the pool.

***Field: Activity Factor Schedule Name***

This field references a schedule that contains values for pool activity. This parameter can be varied using the schedule named here, and it has an impact on the amount of evaporation that will take place from the pool to the surrounding zone air. For example values of the activity factor and what impact it will have on the evaporation of water from the pool, please refer to indoor swimming pool section of the EnergyPlus Engineering Reference document. If left blank, the activity factor will be assumed to be unity.

***Field: Make-up Water Supply Schedule Name***

The scheduled named by this field establishes a cold water temperature [C] for the water that replaces the water which is lost from the pool due to evaporation. If blank, water temperatures are calculated by the Site:WaterMainsTemperature object. This field (even if blank) overrides the Cold Water Supply Temperature Schedule in all of the listed WaterUse:Equipment objects.

***Field: Cover Schedule Name***

This schedule defines when the pool water cover is available and affects the evaporation, convection, and radiation rate calculations. A schedule value of 0.0 means that the pool is not covered. A schedule value of 1.0 means the pool is 100% covered. The pool may be fully covered, fully open (uncovered), or partially covered (a value between 0.0 and 1.0). The user also has the option to control the evaporation, convection, short-wavelength radiation, and long-wavelength radiation factors when the pool is covered. These terms are discussed in the next four fields.

***Field: Cover Evaporation Factor***

This input field can optionally be used to modify the pool evaporation rate and is used in conjunction with the pool cover factor defined by the Pool Cover Schedule field (see above). The value for this parameter can normally range from 0.0 to 1.0, where 1 means that the pool cover completely eliminates evaporation from the pool surface, 0 means the pool cover has no effect on evaporation, and fractions in between 0 and 1 result in a fractional reduction in evaporation by the pool cover. So, if this parameter is 0.5 and the pool is 50% covered, the overall reduction in evaporation from a fully uncovered pool is 25% or 0.25.

***Field: Cover Convection Factor***

This input field can optionally be used to modify the pool convection rate and is used in conjunction with the pool cover factor defined by the Pool Cover Schedule field (see above). The value for this parameter can normally range from 0.0 to 1.0, where 1 means that the pool cover completely eliminates convection from the pool surface, 0 means the pool cover has no effect on convection, and fractions in between 0 and 1 result in a fractional reduction in convection by the pool cover. So, if this parameter is 0.5 and the pool is 50% covered, the overall reduction in convection from a fully uncovered pool is 25% or 0.25.

***Field: Cover Short-Wavelength Radiation Factor***

This input field can optionally be used to modify the pool short-wavelength radiation rate and is used in conjunction with the pool cover factor defined by the Pool Cover Schedule field (see above). The value for this parameter can normally range from 0.0 to 1.0, where 1 means that the pool cover completely eliminates short-wavelength radiation from the pool surface, 0 means the pool cover has no effect on short-wavelength radiation, and fractions in between 0 and 1 result in a fractional reduction in short-wavelength radiation by the pool cover. So, if this parameter is 0.5 and the pool is 50% covered, the overall reduction in short-wavelength radiation from a fully uncovered pool is 25% or 0.25. Note that with radiation terms that whatever portion of the short-wavelength radiation is blocked by the cover is transferred via convection to the surrounding zone air.

***Field: Cover Long-Wavelength Radiation Factor***

This input field can optionally be used to modify the pool long-wavelength radiation rate and is used in conjunction with the pool cover factor defined by the Pool Cover Schedule field (see above). The value for this parameter can normally range from 0.0 to 1.0, where 1 means that the pool cover completely eliminates long-wavelength radiation from the pool surface, 0 means the pool cover has no effect on long-wavelength radiation, and fractions in between 0 and 1 result in a fractional reduction in long-wavelength radiation by the pool cover. So, if this parameter is 0.5 and the pool is 50% covered, the overall reduction in long-wavelength radiation from a fully uncovered pool is 25% or 0.25. Note that with radiation terms that whatever portion of the long-wavelength radiation is blocked by the cover is transferred via convection to the surrounding zone air.

***Field: Pool Water Inlet Node***

This input is the name of the node on the demand side of a plant loop that leads into the pool. From the standpoint of an EnergyPlus input file, the pool sits on a plant demand loop, and the pump and heater reside on the plant supply loop. The pool heater and pump must be defined by other existing EnergyPlus input.

***Field: Pool Water Outlet Node***

This input is the name of the node on the demand side of a plant loop that leads out of the pool. From the standpoint of an EnergyPlus input file, the pool sits on a plant demand loop, and the pump and heater reside on the plant supply loop. The pool heater and pump must be defined by other existing EnergyPlus input.

***Field: Pool Water Maximum Flow Rate***

This input is the maximum water volumetric flow rate in m3/s going between the pool and the water heating equipment. This along with the pool setpoint temperature and the heating plant equipment outlet temperature will establish the maximum heat addition to the pool. This flow rate to the pool will be varied in an attempt to reach the desired pool water setpoint temperature (see Setpoint Temperature Schedule below).

***Field: Pool Miscellaneous Equipment Power***

This input defines the power consumption rate of miscellaneous equipment such as the filtering and chlorination technology associated with the pool. The units for this input are in power consumption per flow rate of water through the pool from the heater or W/(kg/s). This field will be multiplied by the flow rate of water through the pool to determine the power consumption of this equipment. Any heat generated by this equipment is assumed to have no effect on the pool water itself.

***Field: Setpoint Temperature Schedule***

Pools attempt to maintain a particular water temperature. In EnergyPlus, this field defines the setpoint temperature for the desired pool water temperature. It is input as a schedule to allow the user to vary the pool setpoint temperature as desired. The equipment defined to provide heating for the pool will deliver the necessary hot water to the pool, up to the capacity of that equipment defined by other input by the user.

***Field: Maximum Number of People***

This field defines the maximum occupancy of people actually in the pool and thus will be used with the next two inputs to determine how much heat people contribute to the pool heat balance. People who are not in the pool should be modeled separately using the standard People description for zones.

***Field: People Schedule***

This field defines a schedule that establishes how many people are in the pool at any given time. The current value of this schedule is multiplied by the maximum number of people in the previous field determines how many people are currently in the pool.

***Field: People Heat Gain Schedule***

This field defines the amount of heat given off by an average person in the pool in Watts. This field is a schedule so that this heat gain can be allowed to vary as the type of activity in a pool can vary greatly and thus the amount of heat gain per person also varies. This parameter times the number of people in the pool determines how much heat is added to the pool. All heat given off by people is added to the heat balance of the pool water.

The IDD definition of the object is as follows:

SwimmingPool:Indoor,

A1, \field Name

\required-field

\type alpha

A2, \field Surface Name

\required-field

\note To be matched with a construction in this input file

\type object-list

\object-list ConstructionNames

\reference SurfaceNames

\reference SurfAndSubSurfNames

\reference AllHeatTranSurfNames

\reference HeatTranBaseSurfNames

\reference OutFaceEnvNames

\reference AllHeatTranAngFacNames

\reference RadGroupAndSurfNames

\reference SurfGroupAndHTSurfNames

\reference AllShadingAndHTSurfNames

N1, \field Average Depth

\required-field

\type real

\units m

A3, \field Activity Factor Schedule Name

\required-field

\type object-list

\object-list ScheduleNames

A4, \field Make-up Water Supply Schedule Name

\required-field

\type object-list

\object-list ScheduleNames

A5, \field Cover Schedule Name

\required-field

\type object-list

\object-list ScheduleNames

N2, \field Cover Evaporation Factor

\type real

\minimum 0.0

\maximum 1.0

\default 0.0

N3, \field Cover Convection Factor

\type real

\minimum 0.0

\maximum 1.0

\default 0.0

N4, \field Cover Short-Wavelength Radiation Factor

\type real

\minimum 0.0

\maximum 1.0

\default 0.0

N5, \field Cover Long-Wavelength Radiation Factor

\required-field

\type real

\minimum 0.0

\maximum 1.0

\default 0.0

A6, \field Pool Water Inlet Node

\required-field

\type node

A7, \field Pool Water Outlet Node

\required-field

\type node

N6, \field Pool Heating System Water Maximum Flow Rate

\type real

\units m3/s

\minimum 0.0

N7, \field Pool Miscellaneous Equipment Power

\units W/(kg/s of pool water flow)

\type real

\minimum 0.0

A8, \field Setpoint Temperature Schedule

\required-field

\type object-list

\object-list ScheduleNames

N8, \field Maximum Number of People

\required-field

\minimum 0.0

A9, \field People Schedule

\type object-list

\object-list ScheduleNames

A10; \field People Heat Gain Schedule

\type object-list

\object-list ScheduleNames

An example of an indoor swimming pool definition is:

SwimmingPool:Indoor,

Test Pool, !- Name

F1-1, !- Surface Name

1.5, !- Average Depth {m}

PoolActivitySched, !- Pool Activity Schedule

MakeUpWaterSched, !- MakeUp Water Temperature Schedule

PoolCoverSched, !- Pool Cover Schedule

0.0, !- Cover Evaporation Factor

0.2, !- Cover Convection Factor

0.9, !- Cover Short-Wavelength Radiation Factor

0.5, !- Cover Long-Wavelength Radiation Factor

Pool Water Inlet Node, !- Water Inlet Node (Plant/Heater)

Pool Water Outlet Node, !- Water Outlet Node (Plant/Heater)

0.1, !- Maximum flow rate from water heating system {m3/s}

0.6, !- Miscellaneous Equipment Power Factor

PoolSetpointTempSched, !- Pool Water Setpoint Temperature Schedule

15, !- Maximum Number of People in Pool

PoolOccupancySched, !- Pool People Schedule

PoolOccHeatGainSched; !- Pool People Heat Gain Schedule

SwimmingPool:Indoor Outputs

HVAC, Average, Indoor Pool Makeup Water Rate [m3/s]

HVAC, Sum, Indoor Pool Makeup Water Volume [m3]

HVAC, Average, Indoor Pool Makeup Water Temperature [C]

HVAC, Average, Indoor Pool Water Temperature [C]

HVAC, Average, Indoor Pool Inlet Water Temperature [C]

HVAC, Average, Indoor Pool Inlet Water Mass Flow Rate [kg/s]

HVAC, Average, Indoor Pool Miscellaneous Equipment Power [W]

HVAC, Sum, Indoor Pool Miscellaneous Equipment Energy [J]

HVAC, Average, Indoor Pool Heating Rate [W]

HVAC, Sum, Indoor Pool Heating Energy [J]

HVAC, Average, Indoor Pool Radiant to Convection by Cover [W]

HVAC, Average, Indoor Pool People Heat Gain [W]

HVAC, Average, Indoor Pool Current Activity Factor []

HVAC, Average, Indoor Pool Current Cover Factor []

HVAC, Average, Indoor Pool Evaporative Heat Loss Rate [W]

HVAC, Sum, Indoor Pool Evaporative Heat Loss Energy [J]

***Indoor Pool Makeup Water Rate [m3/s]***

The water consumption rate for the makeup water of indoor swimming pool.

***Indoor Pool Makeup Water Volume [m3]***

The water consumption for the makeup water of indoor swimming pool.

***Indoor Pool Makeup Water Temperature [C]***

The temperature of the makeup water of indoor swimming pool.

***Indoor Pool Water Temperature [C]***

The average calculated pool water temperature during the simulation at the time frequency requested.

***Indoor Pool Inlet Water Temperature [C]***

The temperature of the water being sent to the pool from the plant heating equipment.

***Indoor Pool Inlet Water Mass Flow Rate [kg/s]***

The mass flow rate of water being sent to the pool from the plant heating equipment. Typically this water is being passed through a heater and miscellaneous equipment.

***Indoor Pool Miscellaneous Equipment Power [W]***

The miscellaneous equipment power includes the power consumption of pool filter and chlorinator in Watts.

***Indoor Pool Miscellaneous Equipment Energy [J]***

The miscellaneous equipment power consumption includes the energy consumption of pool filter and chlorinator in Joules.

***Indoor Pool Heating Rate [W]***

This is the rate of heating provided by the plant loop to the pool in Watts.

***Indoor Pool Heating Energy [J]***

This is the amount of heating provided by the plant loop to the pool in Joules over the time step requested.

***Indoor Pool Radiant to Convection by Cover [W]***

The pool cover may block some or all of short- and long-wavelength radiation incident on the pool. To account for this and to not have the cover result in energy that is not accounted for by the model, the radiation that is blocked by the cover is converted to a convective gain (or loss) to/from the zone air. This output field reports this value.

***Indoor Pool Current Activity Factor []***

This is the current activity factor as defined by the user input schedule.

***Indoor Pool Current Cover Factor []***

This is the current cover factor as defined by the user input schedule.

***Indoor Pool Evaporative Heat Loss Rate [W]***

This is the rate of evaporative heat loss (latent) to the zone from the pool in Watts.

***Indoor Pool Evaporative Heat Loss Energy [J]***

This is the amount of evaporative heat loss (latent) to the zone from the pool in in Joules over the time step requested.