Title 24: User Manual

IES Virtual Environment 2013, Title 24 Feature Pack

Integrated Environmental Solutions Limited

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1 Overview

IES VE 2013, Title 24 Feature pack uses CBECC-Com 2013-v1.0F to show compliance with the 2013 update to the *Non-Residential Building Energy Efficiency Standards*.

This user manual was written to accompany beta-test versions of the software released in May 2014 and provides detailed descriptions of the software's major features.

Additional help features will be added to future versions of the software.

1.1 Energy Commission Approval

<TO COME>

1.2 Installation

For general installation, please visit the IESVE website, support section, installation guide.

CBECC-Com v1f (build 568) must also be installed, from http://bees.archenergy.com/software.html

1.3 Software Capabilities

The IES Virtual Environment (VE) software's scope, features, and capabilities are listed below.

1.3.1 Scope

1. Newly constructed buildings
2. IES VE will produce results of the performance tests described in the *2013 Title 24 Nonresidential ACM Reference Manual*.

1.3.2 Site/Building

1. Include identifying information
2. Include other general information required for compliance forms
3. Include location information

1.3.3 Envelope

1. Provide a comprehensive list of accurately described opaque materials
2. Combine materials into constructions
3. Describe fenestration performance properties via the simplified approach (e.g., U-value, Solar Heat Gain Coefficient, Visible Transmittance)
4. Apply exterior insulated constructions to demising surfaces
5. Check that proposed exterior constructions meet mandatory U-value requirements
6. Remove user model building shades
7. Retain user model geometry
8. Adjust excess user model fenestration to standard design maximum WWR and SRR values

1.3.4 Lighting and Other Internal Loads

1. Replace user lighting systems with simple Light Power Density (LPD) values based on space function
2. Allow simple lighting inputs for LPD and lighting schedules without the need to specify details of an interior lighting system
3. Allow detailed lighting inputs for credits and allowances:
    - Lighting Controls and associated PAFs
    - Area Category Lighting Allowances
    - Tailored Lighting Allowances
4. Replace user occupancy and equipment loads with ACM-specified values
5. Replace user-specified infiltration rates with ACM values
6. Replace user-specified schedules with ACM schedules
7. Combine space-level data into zones

1.3.5 HVAC

1. Replace user-specified HVAC system with baseline system
    - Except data center, laboratory, kitchens
    - Baseline sizing run is autosized
    - Baseline run hard sized using baseline sizing results
2. Model user- specified HVAC systems with user-supplied sizing:
    - PSZ
    - SZVAV
    - PVAV
    - VAV
    - PTAC
    - PTHP
    - Fan-coil units (4 pipe)
    - Baseboard heating
    - Heating coils
        - Gas furnace
        - Hot water
        - Electric
        - DX (heat pump)
    - Cooling coils
        - Chilled water
        - DX
    - Boilers
        - Hot water
        - Gas
        - Oil

        - Electric
        - Natural draft
        - Mechanical draft
    - Chillers
        - Screw
        - Reciprocating
        - Centrifugal
        - Air-cooled
        - Water-cooled
    - Chilled water loop pumping
        - Primary only
        - Primary-secondary
    - Economizers
        - Non-integrated
        - Integrated
    - Economizer Controls
        - Fixed temperature
        - Differential temperature
        - Fixed enthalpy
        - Differential enthalpy

1.3.6 Domestic Water Heating

1. Storage water heaters
    - Gas
    - Electric
    - Oil

1.3.7 Output

1. Report simulation errors and warnings including useful descriptions
2. Report number of hours with setpoint not met by thermal zone
3. Report energy consumption by fuel and end-use
4. Report TDV energy by end use
5. Report TDV energy comparison of Proposed and Standard Design, including Compliance Margin
6. Generate “Perf-1” summary compliance form

1.3.8 Interface

1. Ability to access and modify parameters needed to simulate the above

1.3.9 Documentation

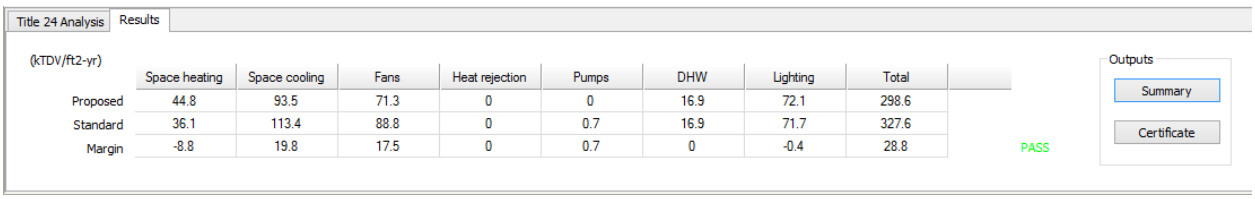
1. 2013 Title 24 Nonresidential ACM Reference Manual
2. EnergyPlus Technical Documentation
3. Release Note available with each IES VE version release

2 Standard Input/Output Reports

A variety of input and output reports are available to review the compliance analysis. These reports are described below.

2.1 Basic Output Results

At the completion of the analysis, the Basic Output Results screen (Figure 1) shows the energy use summary for the building and each end-use in terms of Site energy (by fuel type) and kTDV. This output screen also reports a summary of unmet load hours, a compliance margin for each end-use and the whole building, and an indication of whether the building passes or fails the compliance analysis.



Title 24 Analysis | Results

(kTDV/ft2-yr)

	Space heating	Space cooling	Fans	Heat rejection	Pumps	DHW	Lighting	Total
Proposed	44.8	93.5	71.3	0	0	16.9	72.1	298.6
Standard	36.1	113.4	88.8	0	0.7	16.9	71.7	327.6
Margin	-8.8	19.8	17.5	0	0.7	0	-0.4	28.8

PASS

Outputs: Summary, Certificate

Figure 1 - Basic Output Results

2.2 Certificate of Compliance Report

IES VE produces the Certificate of Compliance for the Nonresidential Performance Compliance Method, NRCC-PRF-01-E. Refer to section 8 for a detailed description of the report.

2.3 Analysis Results XML File

Additionally, a full summary of all building inputs and outputs used in the compliance analysis are generated during the analysis. This data is captured in an XML file called:

<project file name> - Analysis Results.XML

The AnalysisResults XML file is saved in the same folder location as the project .mit file.

The AnalysisResults XML file contains data for each model used in the analysis:

- The Original User Model
- The Proposed Design Model
- The Standard Design Model

Figure 2 below shows the organization of the XML file containing details for each of the three analysis models.

Figure 2 - AnalysisResults.XML: Three Analysis Models

Figure 3 shows an example of the analysis output results for the Proposed Model. The EUseSummary tag contains annual TDV energy results for each end use (which are reported in the Basic Output Results screen shown in Figure 1). The EnergyUse tag shows a detailed energy consumption summary for each building end-use. The data includes total TDV energy consumption, total site energy consumption, and a breakdown of TDV and site energy by each fuel type for that end use.

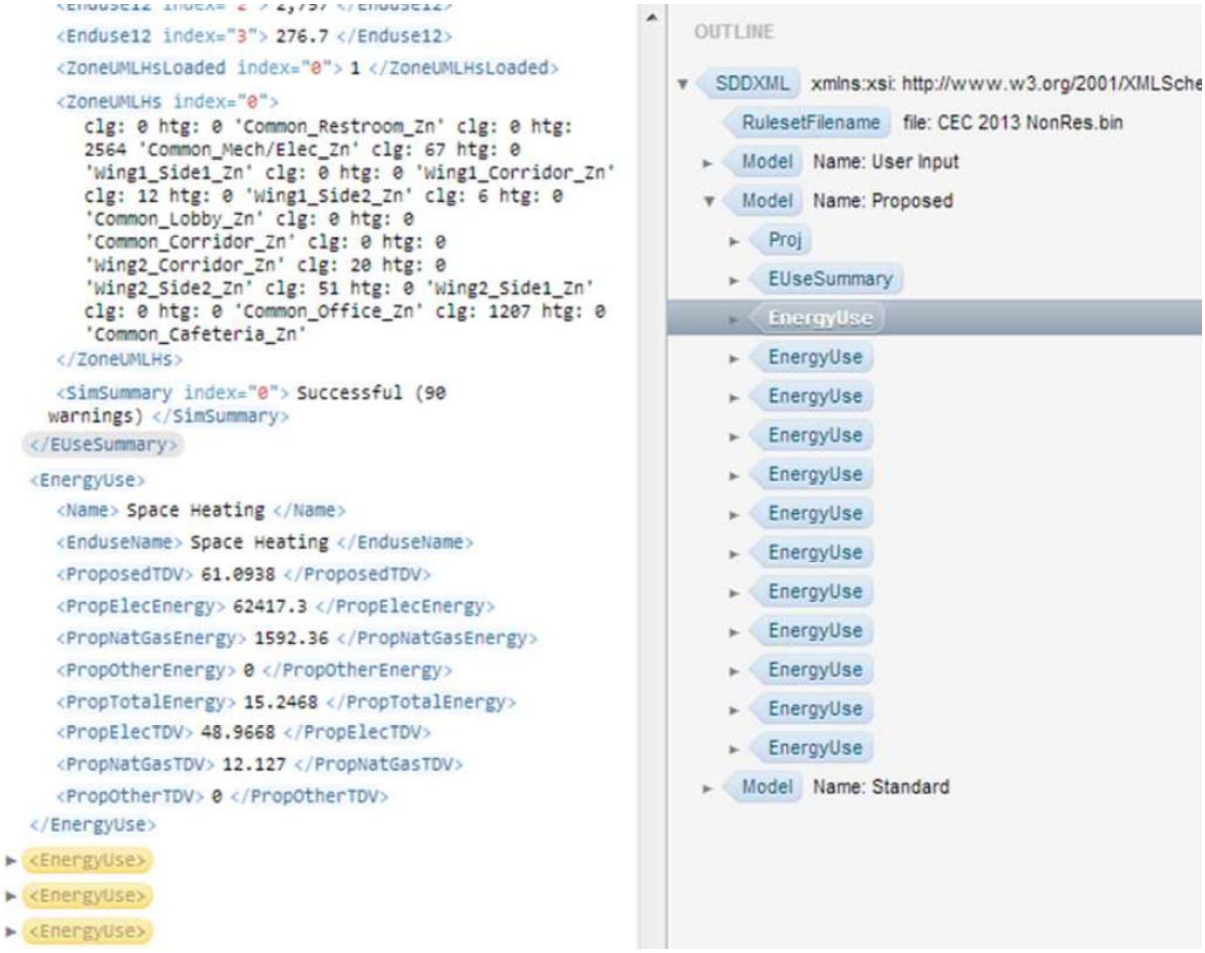


Figure 3 - Analysis Output Results for each End Use

Additionally, full reports of all building inputs for each analysis model are echoed in the AnalysisResults XML file. The organization of the input data follows the Standards Data Dictionary (SDD) data model structure. Figure 4 illustrates the XML format of the Building data.

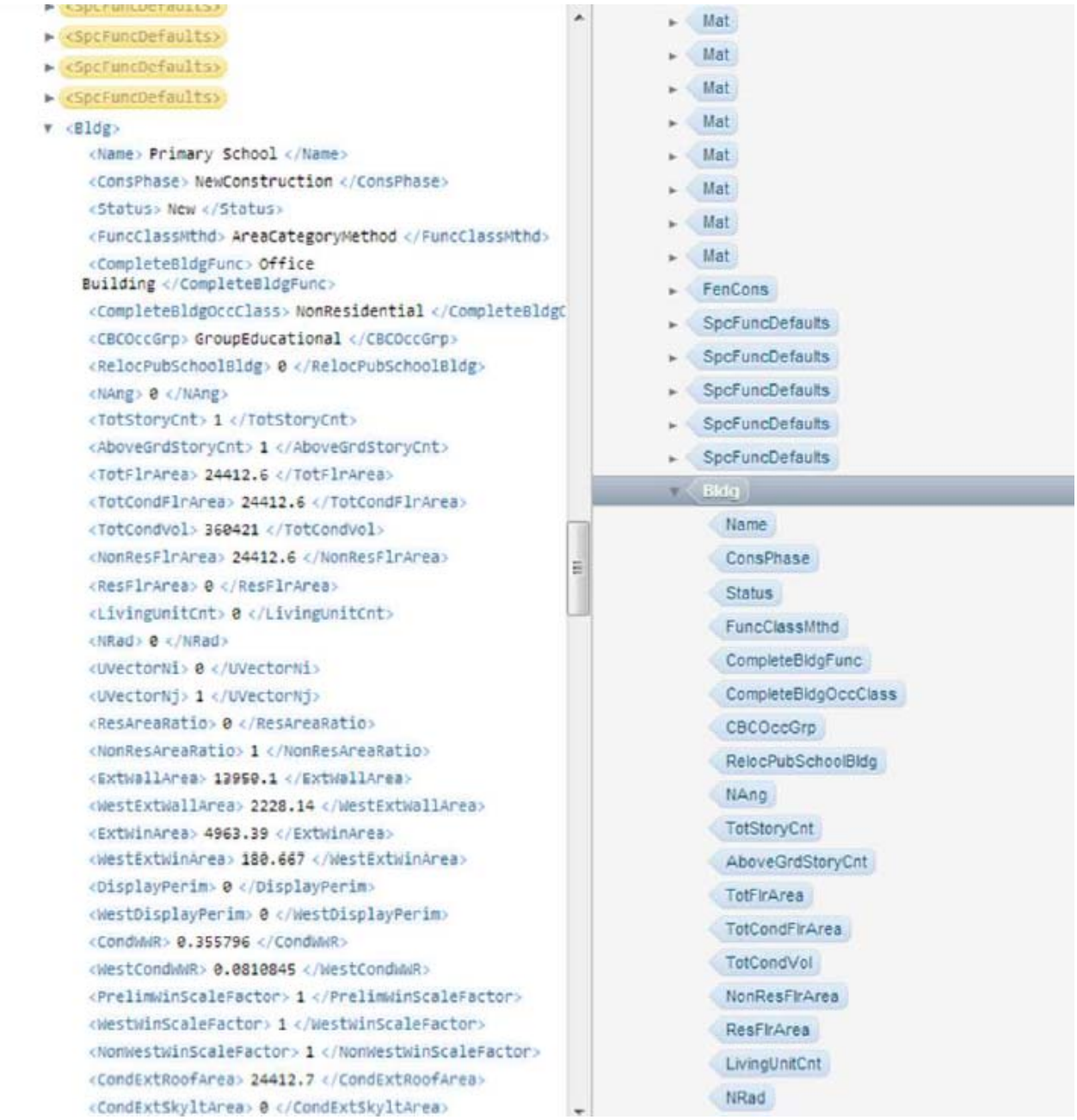


Figure 4 - Echo of All Building Inputs in the AnalysisResults XML File

2.4 Log File

A log file is associated with every IES VE project. It is located in the same folder as the project .mit file and is named: <project name>.log. The log file contains a history of analyses performed, and any errors or warnings that occurred during each analysis.

2.5 EnergyPlus Output Files

A set of EnergyPlus output files are generated during each simulation performed, and are listed below. For additional details on these EnergyPlus output files, please refer to the EnergyPlus documentation that can be found here:

http://apps1.eere.energy.gov/buildings/energyplus/energyplus documentation.cfm

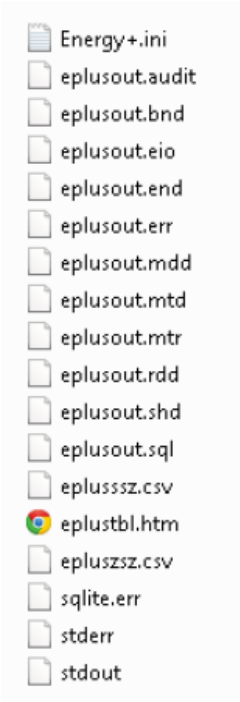


Figure 5 – EnergyPlus Output Files

2.6 Error Reporting

IES VE provides error messages if the compliance analysis fails. Each error message has a numerical code listed below.

1. pszBEMBasePathFile doesn't exist
2. pszRulesetPathFile doesn't
3. pszSimWeatherPath doesn't
4. pszDHWDLLPath specified, but doesn't
5. Invalid project log file name (too long)
6. Error writing to project log
7. Building model input/project file not found
8. Error reading/initializing model input/project file
9. Errors encountered evaluating input model defaulting rules
10. Errors encountered evaluating input model defaulting rules (multiple times)
11. Error(s) encountered performing required data & numeric range checks
12. Error(s) encountered checking input model for simulation compatibility

13. Error(s) encountered checking input model for code requirements
14. Error encountered initializing weather file locations and/or names
15. Error creating or accessing the analysis processing directory
16. Error generating Proposed Sizing model
17. Error generating Proposed (final) model
18. Error generating Standard Sizing model
19. Error generating Standard (final) model
20. Error initializing Standard Sizing model
21. Error initializing Standard (final) model
22. Analysis aborted - user chose not to overwrite SDD XML file
23. Error: Unable to write SDD XML file
24. Error(s) encountered simulating Proposed model
25. Error(s) encountered simulating Standard Sizing model
26. Error(s) encountered simulating Standard (final) model
27. Error(s) encountered retrieving Proposed model simulation results
28. Error(s) encountered retrieving Standard Sizing model simulation results
29. Error(s) encountered retrieving Standard (final) model simulation results
30. Proposed model zone(s) exceed unmet load hours limits
31. Error initializing building model database
32. Error loading analysis ruleset
33. User aborted analysis via progress dialog 'Cancel' button
34. Invalid results object types
35. Error copying results objects from a previous model
36. Error copying equipment sizes/flows from source model
37. Error(s) encountered reading building model (input/project) file
38. Error: EnergyPlus simulation engine not found.
39. Error: Version of EnergyPlus installed not compatible with analysis.
40. Error setting up check of weather & design day file hashes
41. DHW simulation not successful

(Return values in the range 101–200 describe issues encountered during/by simulation.)

101. SDD XML simulation input file not found
102. Simulation weather file not found
103. Simulation processing path not valid
104. Simulation executable path not valid
105. Simulation error output path/file not valid
106. User aborted analysis
131. Error encountered in OpenStudio loading SDD XML file
132. Error encountered in OpenStudio saving model to OSM file
133. Unable to locate EnergyPlus simulation SQL output file

134. OpenStudio Model not valid following simulation

135. OpenStudio Facility not valid following simulation

161. Error creating OpenStudio Model object

162. Fatal error(s) occurred in EnergyPlus simulation

163. EnergyPlus simulation did not complete successfully

181. User aborted analysis during building model simulation

3 Fixed and Restricted Inputs

IES VE utilizes fixed and restricted inputs for both the Standard Design, and elements of the Proposed Design as specified in the 2013 Nonresidential Alternative Calculation Methodology (NACM) Reference Manual.

A detailed summary of all fixed and restricted inputs can be found in the Nonresidential Alternative Calculation Method Reference Manual (NACM):

http://www.energy.ca.gov/2013publications/CEC-400-2013-004/CEC-400-2013-004-SD.pdf

4 Preparing Basic Input

4.1 Overview

In order to start a new project, the user must first prepare basic input into a model that describes his/her building project. This model is called the ***UserModel***. During the analysis calculation procedure, this model is used to automatically define the two compliance models:

1. The ***Proposed Design Model***—the Proposed Design model is very similar to the User Model; however, some inputs such as schedules, plug-loads, and others are replaced with prescribed values specified in the NACM.
2. The ***Standard (Baseline) Design Model***—the Standard Design model is generated according the Standard Design rules in the NACM. Users can think of this model as a hypothetical version of their building if it was designed to just meet the mandatory and prescriptive requirements of the Title 24 (Part 6) standards.

The workflow for preparing the User Model and performing compliance analysis is broken into several steps. While all data input, and the analysis procedure, can take place directly in the IES VE user interface, Trimble Sketchup can be used as an alternative way to prepare the geometry.

The workflow is illustrated in Figure 6. Additional details for each step in the workflow are also provided below.

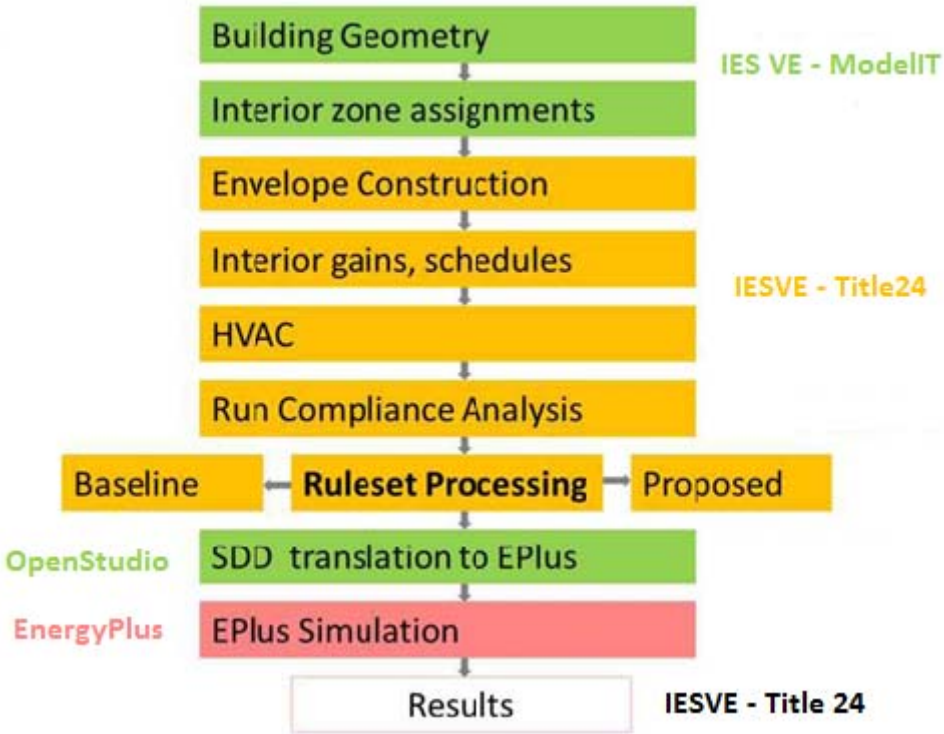


Figure 6 - Workflow for Non-Residential Compliance Analysis

4.2 Geometry

A buildings geometry can be entered via the IES VE module "ModelIT" or via the SketchUp Plugin.

4.2.1 ModelIT

Please refer to the ModelIT User Guide available in the IESVE Support User Guide section of the IESVE website.

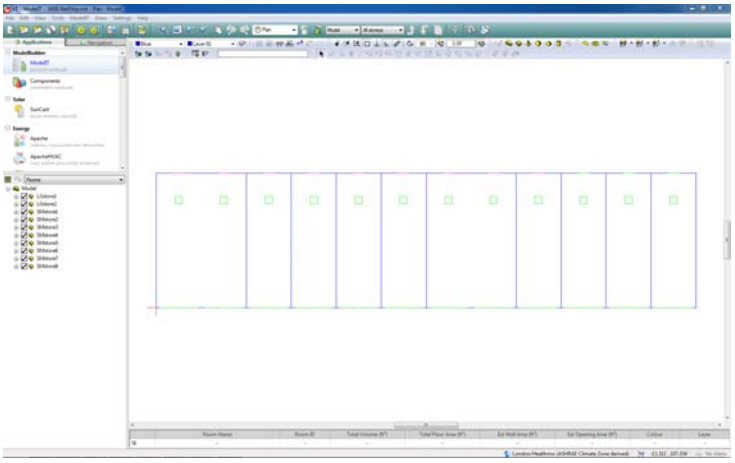


Figure 7 – ModelIT View

4.2.2 SketchUp Plugin

Please refer to the IESVE Plug-in for Trimble SketchUp User Guide available in the IESVE Support User Guide section of the IESVE website.

4.3 Title 24 Module

The Title 24 module can be selected from the applications list on the left hand side of the Virtual Environment.

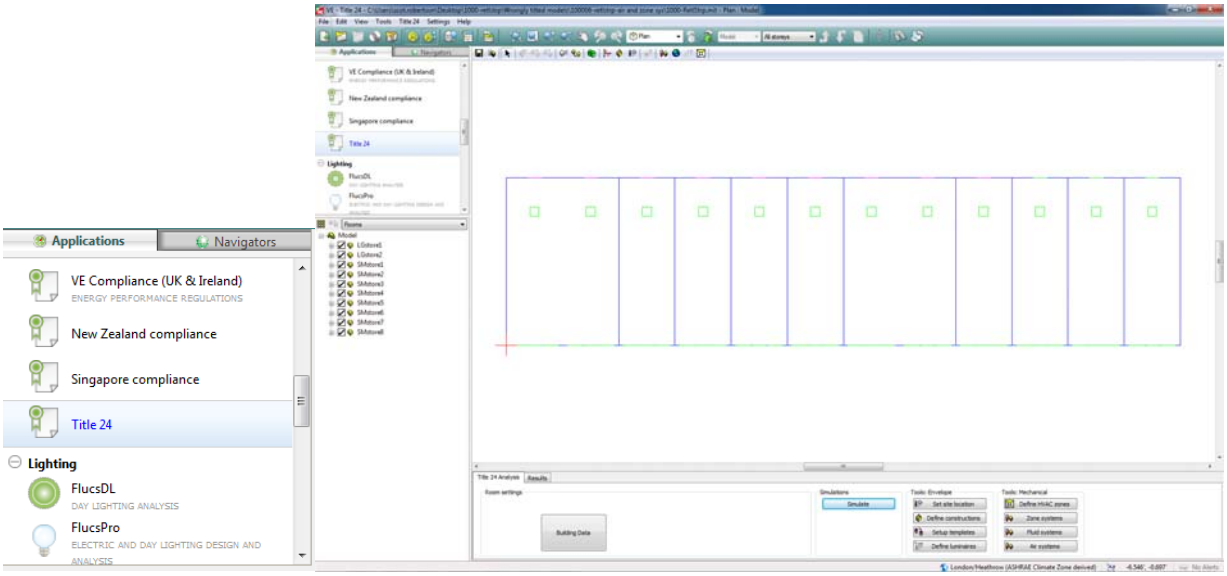


Figure 8 – Title 24 Module

4.3.1 Tool Bar

At the top of the screen, a toolbar can be seen (Figure 9). Table 1 lists the description of each icon in the toolbar. Those colored red are items that are pertinent to Title 24 modelling.

Figure 9 – Title 24 Tool Bar

Table 1 – Toolbar Icon Description

Icon	*Description*
	Save project files
	Export Room Data
	Select Object
	Assign Constructions (Please see Section 4.6)
	Edit Group Attributes
	Assign Thermal Template (Please see Section 4.8.1)
	Layer Properties
	Edit Selection Set Attributes
	Fuels Data
	Apache Profile Database Manager (Please see Section 4.7)
	Apache Construction Database Manager (Please see Section 4.6)
	Apache weather/location database manager
	Query (Please see Section 4.8.2)
	Apache Systems
	Renewables
	Edit Multiple Adjacencies (Please see Section 4.6)
	HVAC Zones (Please see Section 4.10)

4.3.2 Building Stories

The total number of stories, as displayed on the Building Data > Project Data tab (Section 4.4.1), is calculated based on the number of "Room Groups" in the "Floors" grouping scheme. The user should create a separate room group for each floor of their model and assign all thermal zones of a floor to the appropriate room group. Please refer to the ModelIT User Guide available in the IESVE Support User Guide section of the IESVE website for details on how to use "Room Groups".

4.4 Building Data

If no thermal zone is selected, the Building Data button can be seen at the bottom of the screen in the Room Settings section. This can be clicked to view the Project Data tab,Design Team tab and Exceptional conditions tab.

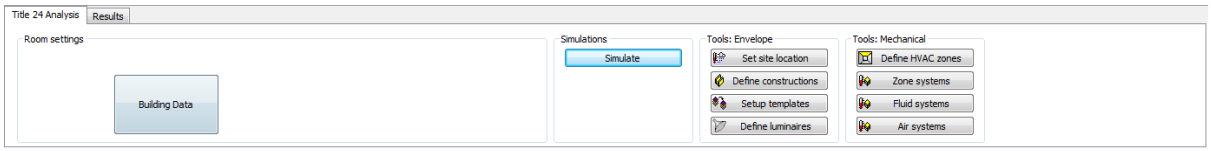


Figure 10 – Building Data Button

4.4.1 Project Data

To access this screen, click the Building Data button and select the Project Data tab. This tab will be selected by default once the Building Data button is clicked.

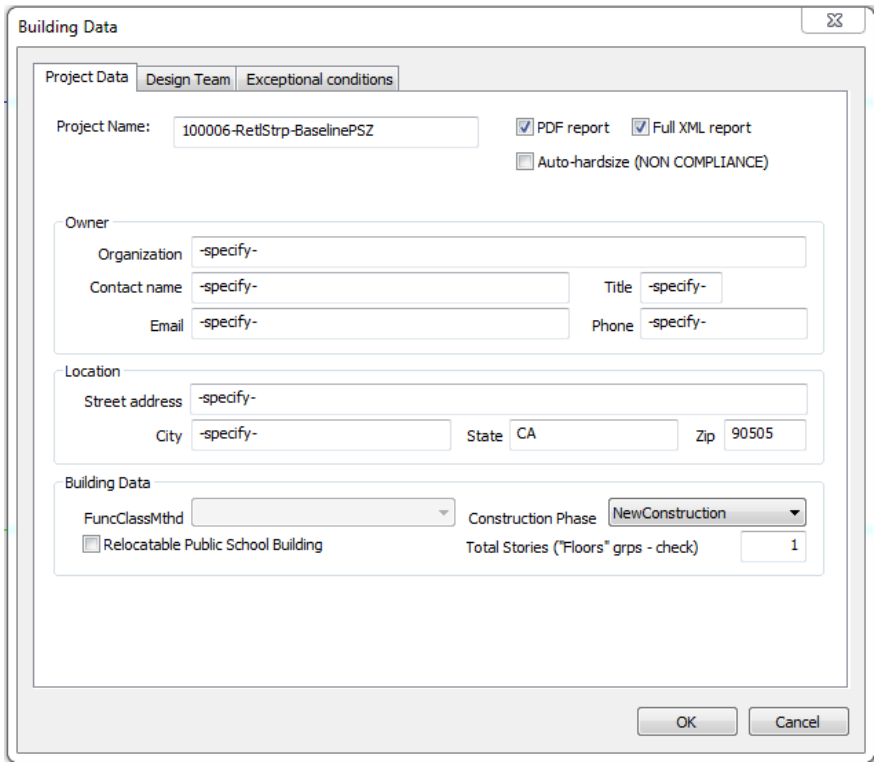


Figure 11 – Project Data Tab

Input summary for the Project Data screen:

- Project Name: Name used for the project, if one is applicable
- PDF Report: Creates the PDF report of the simulation once simulation is complete
- Full XML Report: Creates a full XML report of the simulation once simulation is complete
- Auto-Hardsize (NON Compliance): This Auto-hard size Proposed HVAC Components, Auto Populates Proposed HVAC Efficiencies (Air-Side Only), populates the Design Flow/Area and Design Flow/Ton.
    - **Please Note:** Title 24 Compliance requires that user model HVAC equipment have all capacity and efficiency inputs entered. For analysis that is not intended for compliance, these inputs may not be known. These inputs allow the user to activate rules of thumb to provide required equipment capacities, and to tailor these inputs if desired. However, if the box is checked, the run results cannot be used to show compliance with the energy code
- Owner section:
    - Organization: Building owning organization
    - Contact Name: Building owning organization primary contact name
    - Title: Building owning organization primary contact title
    - Email: Building owning organization primary contact email
    - Phone: Building owning organization primary contact phone
- Location section:
    - Street Address: Street address where the project is located
    - City: City where the project is located
    - State: State where the project is located
    - Zip Code: ZIP code where the project is located
- FuncClassMthd: The method of specifying functional area types. Identifies whether functional area types will be assigned using the Complete Building Method or the Area Category Method.
    - At least 80 percent of the building area is required to be of the selected occupancy.
- Construction Phase: A list categorizing the construction phase of the project. Options are Addition, Alteration, NewConstruction and Repair.
- Total Stories: The total number of stories in a building. Includes both above grade stories and any below grade stories (Please see Section 4.3.2)

4.4.2 Design Team

To access this screen, click the Building Data button and select the Design Team tab.

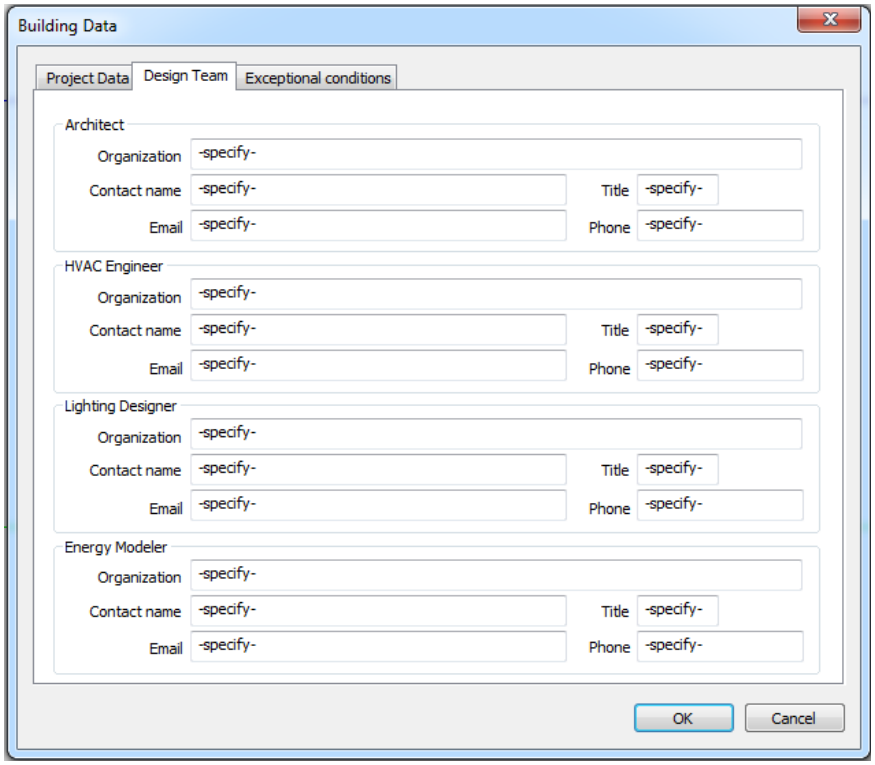


Figure 12 – Design Team Tab

Input summary for the Design Team tab:

- Architect Info section
  - Organization: Architect Organization (input is optional).
  - Contact Name: Architect primary contact name (input is optional).
  - Title: Architect primary contact title (input is optional).
  - Email: Architect primary contact email (input is optional).
  - Phone: Architect primary contact phone (input is optional).
- HVAC Engineer Info section
  - Organization: HVAC Engineer Organization (input is optional).
  - Contact Name: HVAC Engineer primary contact name (input is optional).
  - Title: HVAC Engineer primary contact title (input is optional).
  - Email: HVAC Engineer primary contact email (input is optional).
  - Phone: HVAC Engineer primary contact phone (input is optional).
- Lighting Designer Info section
  - Organization: Lighting Designer Organization (input is optional).
  - Contact Name: Lighting Designer primary contact name (input is optional).
  - Title: Lighting Designer primary contact title (input is optional).
  - Email: Lighting Designer primary contact email (input is optional).

- Phone: Lighting Designer primary contact phone (input is optional).
- Energy Modeler Info section
  - Organization: Energy Modeler Organization (input is optional).
  - Contact Name: Energy Modeler primary contact name (input is optional).
  - Title: Energy Modeler primary contact title (input is optional).
  - Email: Energy Modeler primary contact email (input is optional).
  - Phone: Energy Modeler primary contact phone (input is optional).

4.4.3 Exceptional conditions

To access this screen, click the Building Data button and select the Exceptional conditions tab.

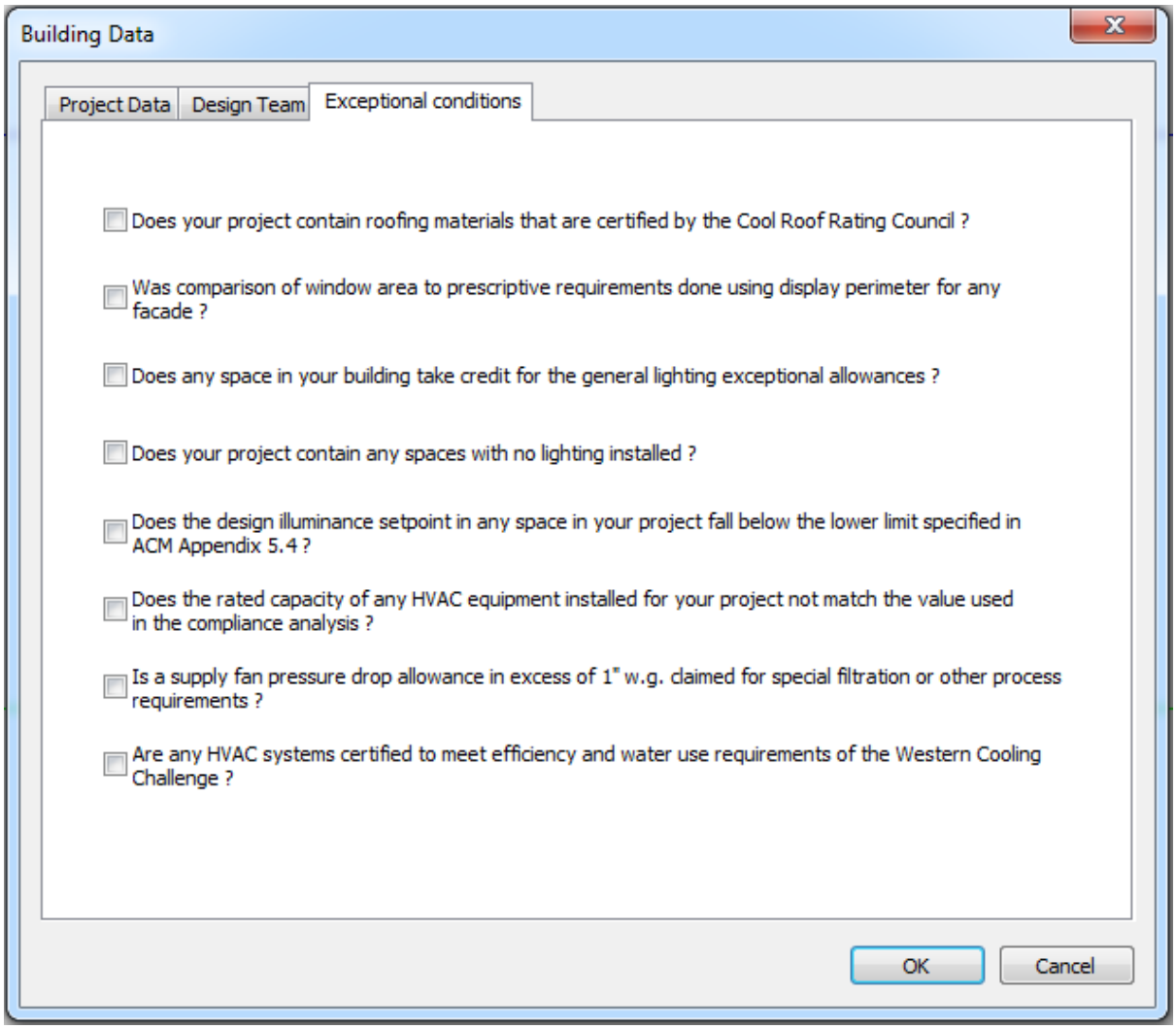


Figure 13 – Exceptional Conditions tab

Input summary for the Exceptional Conditions tab:

- If any of the exceptional conditions apply to your project, mark that item using the tick box provided. The compliance forms will include guidance for the code reviewer to check the exceptional conditions for compliance.

4.5 Set site location

To set your site location, the user should click the "Set site location" button (Figure 14)

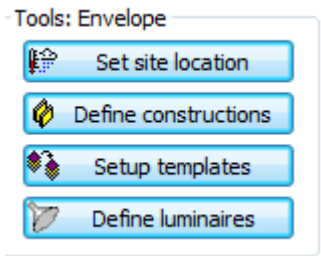


Figure 14 – Set Site Location Button

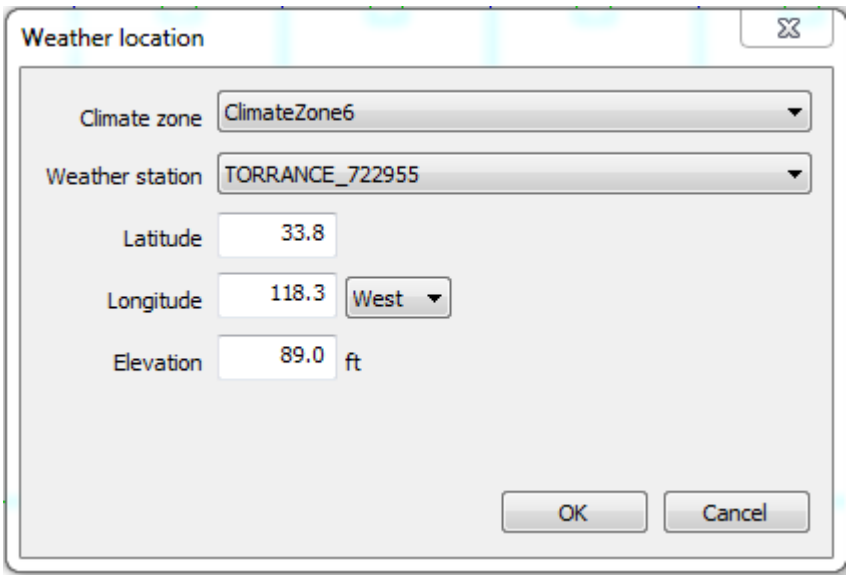


Figure 15 – Weather Location Dialog

Location and Weather File date defaulted based on this value.

- Climate Zone: Climate zone
- Weather Station: California weather station
- Latitude: Building latitude
- Longitude: Building longitude
- Elevation: Building elevation

4.6 Constructions

Please refer to the Constructions Database User Guide available in the IESVE Support User Guide section of the IESVE website.

Further directions specific to Title 24 modelling are listed in this section.

4.6.1 Defining a Construction

Opaque and glazed constructions can be defined using the "Define constructions" button (Figure 16).

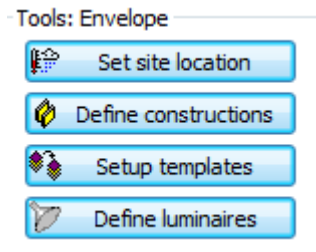


Figure 16 – Define constructions button

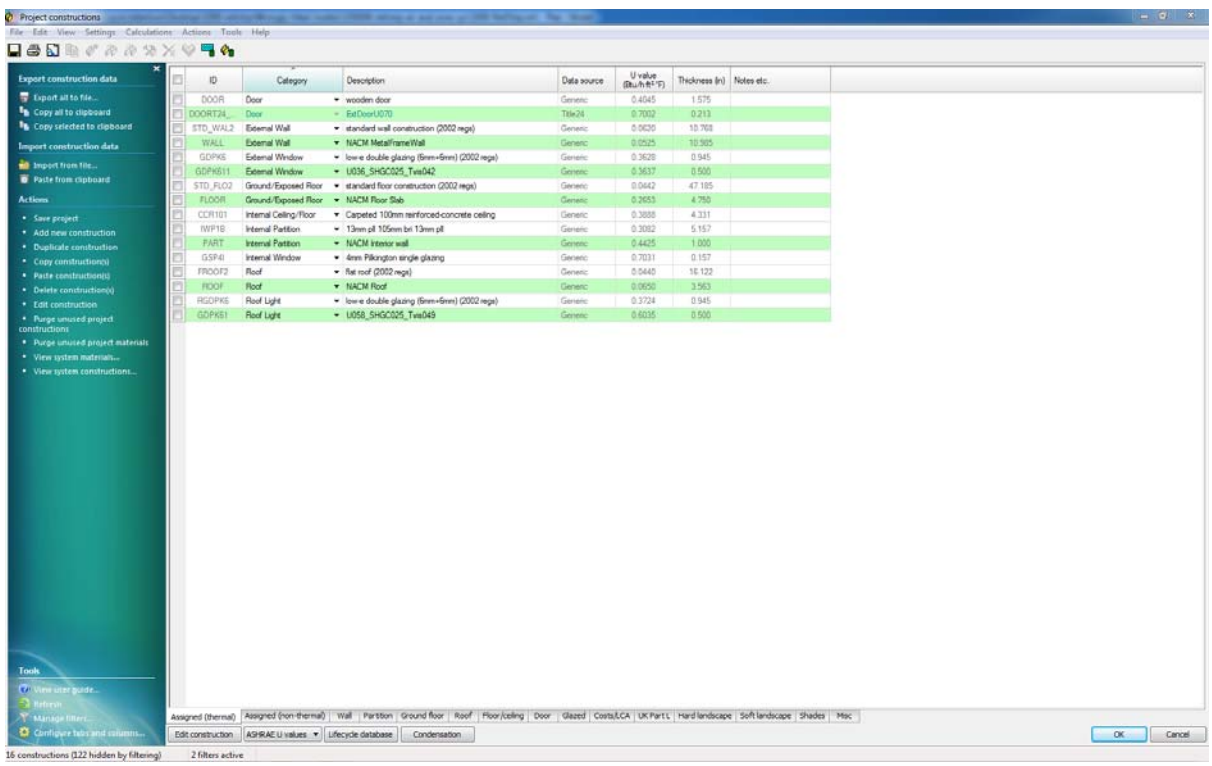


Figure 17 – Constructions Database default view

4.6.1.1 Materials

All materials that can be used for a Title 24 compliance simulation have been created for the user. These can be found in Constructions Database > View Menu > Project Materials (Figure 18). Please refer to the

Constructions Database User Guide available in the IESVE Support User Guide section of the IESVE website.

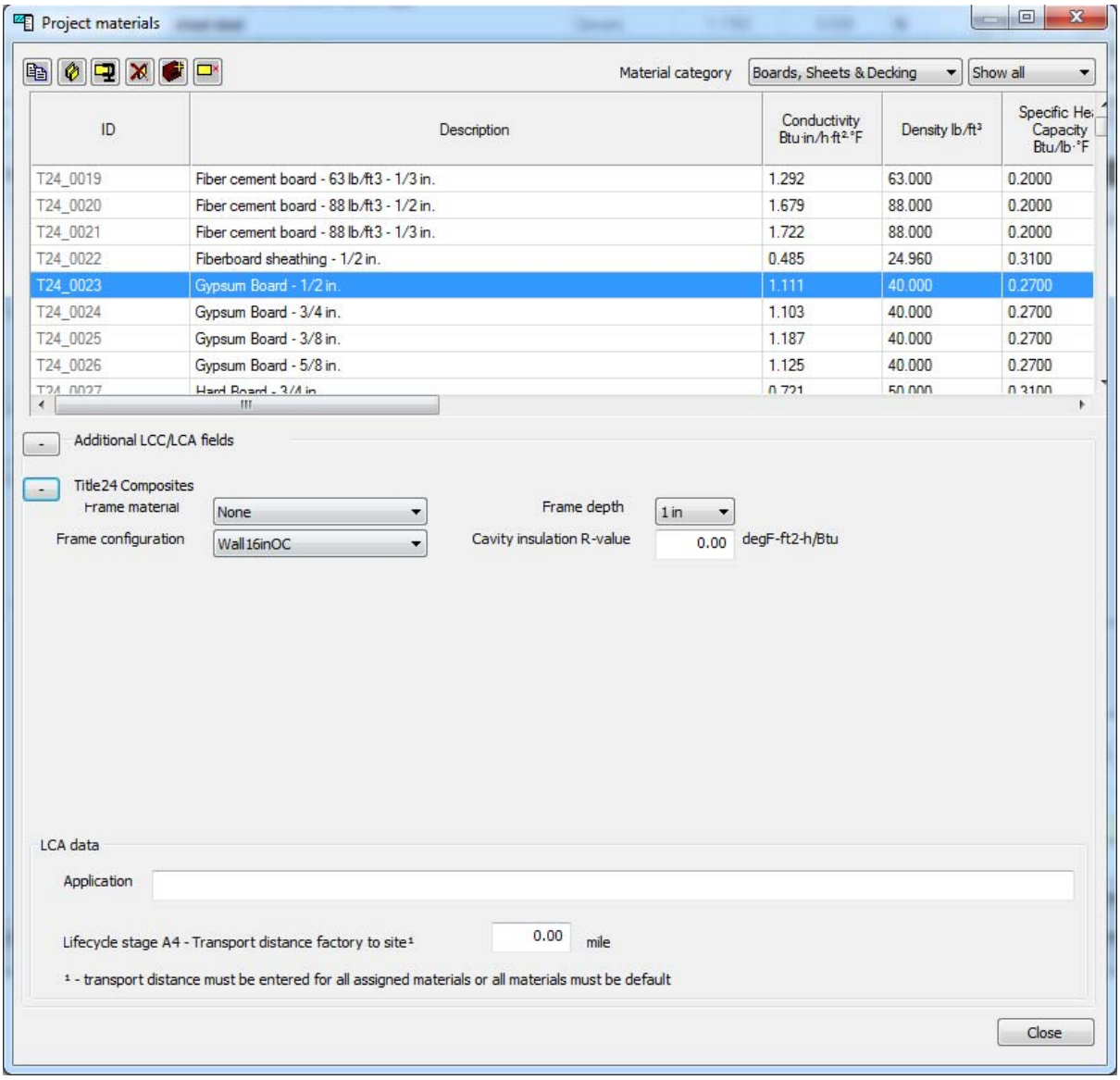


Figure 18 – Project Materials Title 24

Only the specific set of air cavity thicknesses for each construction category outlined in Table 2 can be used for Title 24 Compliance simulation.

Table 2 – Air Cavity Thickness

Construction Type (Thickness)	*Ceiling*	*Floor*	*Roof*	*Wall*
1/2 in.	X	X	X	X
3/4 in.	X	X	X	X
1 1/2 in.	X	X	X	X
3 1/2 in.	X	X	X	X
4 in. or more	X		X	X

Each air cavity in VE constructions will be rounded to the nearest thickness of this set at the point of simulation, with the exception of a special case "Air - Metal Wall Framing - 16 or 24 in. OC", which is defined by the Wall construction > Air – Metal Frame checkbox (Figure 19).

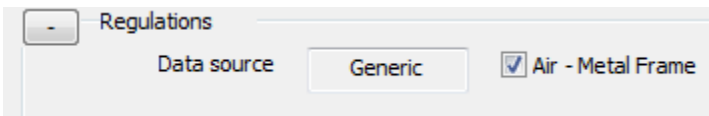


Figure 19 – Metal Framed Air Cavity tick box

Known issue: Currently VE has a limit of a <u>single</u> Title24 air thickness per construction category.

4.6.1.2 Composite materials

To assign a composite material to a construction, the user must first select a material that is outside of the composite material. The composite material will be assigned to this material. The user will then click the "Project materials" button.

Known issue (bug): To access the Title24 Composite material parameters, it is necessary to first open the group **Additional LCC/LCA**:

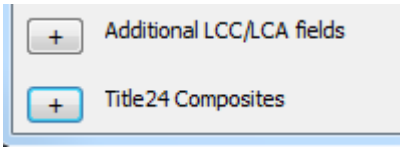


Figure 20 – Additional LCC/LCA

Then using the Title 24 Composite material dropdowns (Figure 21), the composite material can be assigned to the highlighted material.

Figure 21 – Title 24 Composite Materials

Input summary for Title 24 Composites (Figure 21):

- Frame Material: The framing is constructed with the selected material
- Frame Configuration: The framing is constructed with the selected configuration
- Frame Depth: The framing is constructed with the selected depth.
- Cavity Insulation R-Val: Nominal R-value of composite layer cavity insulation.

4.6.1.3 Construction roughness

The VE defines roughness only for materials and as a number. To enter the roughness number of the construction, the first (outside) material of the construction should be selected and the appropriate roughness number entered in the Roughness column in Project materials (Figure 18) using the conversion outlined in Table 3.

Table 3 – Construction Roughness

Roughness	*Thickness (mm)*
Very Rough	5
Rough	4
Medium Rough (default)	3
Medium Smooth	2
Smooth	1
Very Smooth	0

4.6.1.4 Visible Absorptance/Visible Reflectance

A constructions visible absorptance can be entered as using the visible light reflectance fields (Figure 24).

$$Visible\ Light\ Reflectance = 1 - Visible\ Light\ Absorptance$$

Equation 1 – Visible Light Absorptance

The visible reflectance input fields can be accessed via the tabular edit. The user must add these to the default view. This can be done by the following steps:

- Click “Define Constructions” button (Figure 16)
- Click “Tools” at the top of the Project Constructions dialog (Figure 17)
- Click “Configure tabs and columns…” (Figure 22)
- Both Internal and External visible light reflectance can then be added to the “Currently used columns” (Figure 23)

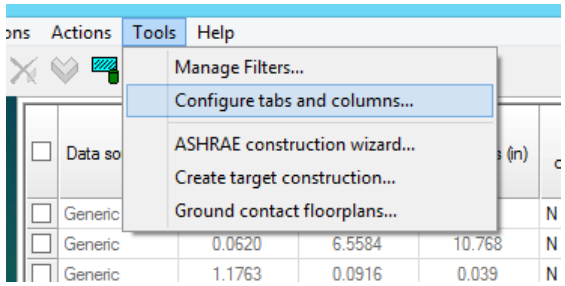


Figure 22 – Configure tabs and columns

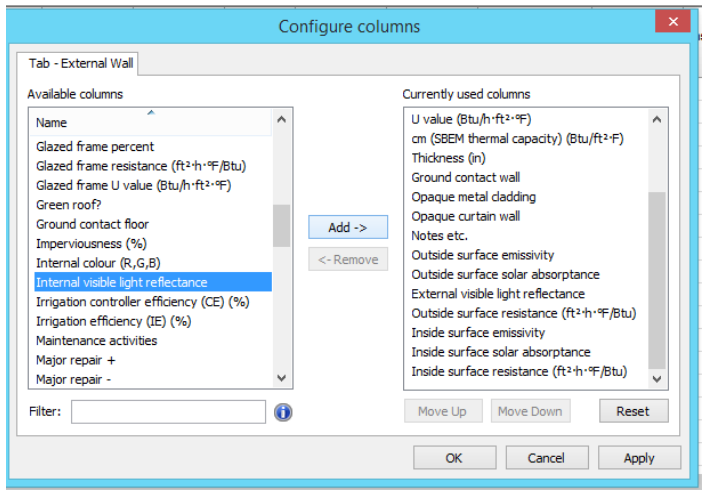


Figure 23 – Adding a column to “Currently used columns”

Internal visible light reflectance	External visible light reflectance
0	0
0	0
0	0
0	0
0	0
0.11	0.12
0.11	0.12
0	0

Figure 24 – Visible Light Reflectance

4.6.1.5 Underground Walls

An underground wall is defined via the Adjacency toolbar button and applying any temperature from profile. Please refer to the Apache View User Guide available in the IESVE Support User Guide section of the IESVE website for further guidance.

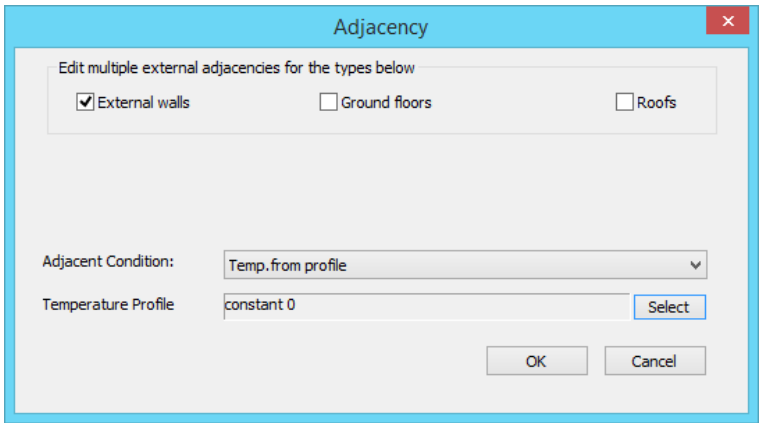


Figure 25 – Underground wall Adjacency

4.6.1.6 Underground Floor

An underground floor can be defined utilizing the F-factor analysis method. This can be done by:

- Ticking the "Ground-contact floor" tick box (Figure 26)
- Then click "Adjust" (Figure 26)
- Change Analysis method to F-Factor (Figure 27)
- Press OK

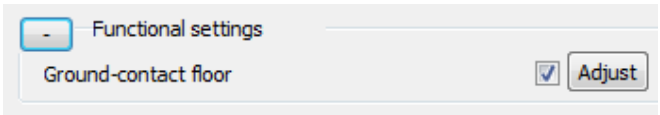


Figure 26 – Ground-contact floor

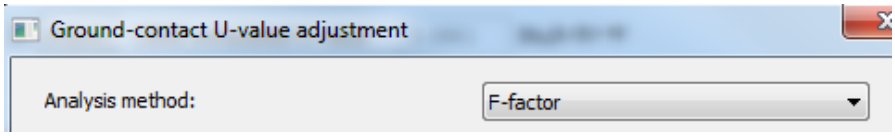


Figure 27 – F-Factor Analysis Method

The F-factor used in the simulation will be determined by the three slab parameters (Figure 28)

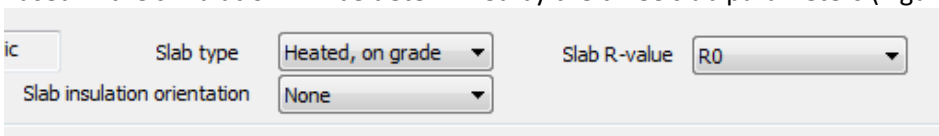


Figure 28 – Underground floor parameters

Input summary for Underground Floor Slab:

- Slab Type: The Underground slab type (Heated or Unheated, On Grade or Below Grade)
- Slab insulation orientation: The location and extent of slab-on-grade floor insulation
- Slab R-Value: Nominal R-value of the underground floor slab

4.6.1.7 Roof

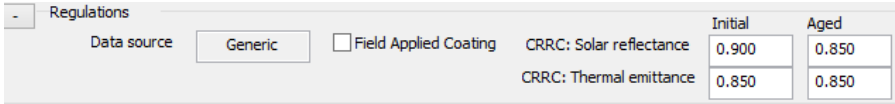


Figure 29 – Roof Regulations

Input summary for Roof Surface Properties:

- Field Applied Coating (checkbox): This indicates if a roofing surface is from a coating applied on site or not.
- CRRC: Solar Reflectance (Initial): The Initial Reflectance value from Cool Roof Rating Council (CRRC) testing of the roofing.
- CRRC: Solar Reflectance (Aged): The Aged Reflectance value from Cool Roof Rating Council testing of the roofing.
- CRRC: Thermal Emittance (Initial): The Initial Emittance value from Cool Roof Rating Council testing of the roofing.
- CRRC: Thermal Emittance (Aged): The Aged Emittance value from Cool Roof Rating Council testing of the roofing.

4.6.1.8 Door

A doors construction can be set as “Swinging” or “Non-swinging”. The default setting is “Swinging” but can be changed using the “Non-swinging” tick box.

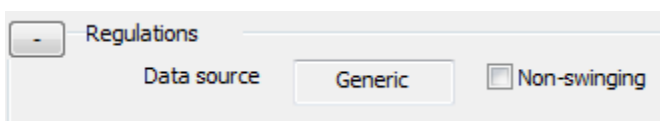


Figure 30 – Door Regulations

Known issue: the Door construction UI is incomplete, with more parameters to come soon.

4.6.1.9 Exterior Shading Object

An external shading object can be entered in a Glazed construction.

Both Local shades, which define the projections, and External shades must be defined to set a shade.

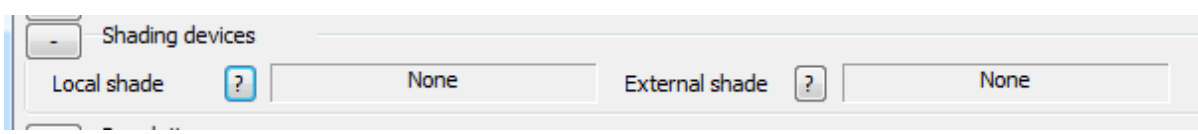


Figure 31 – Shading Devices

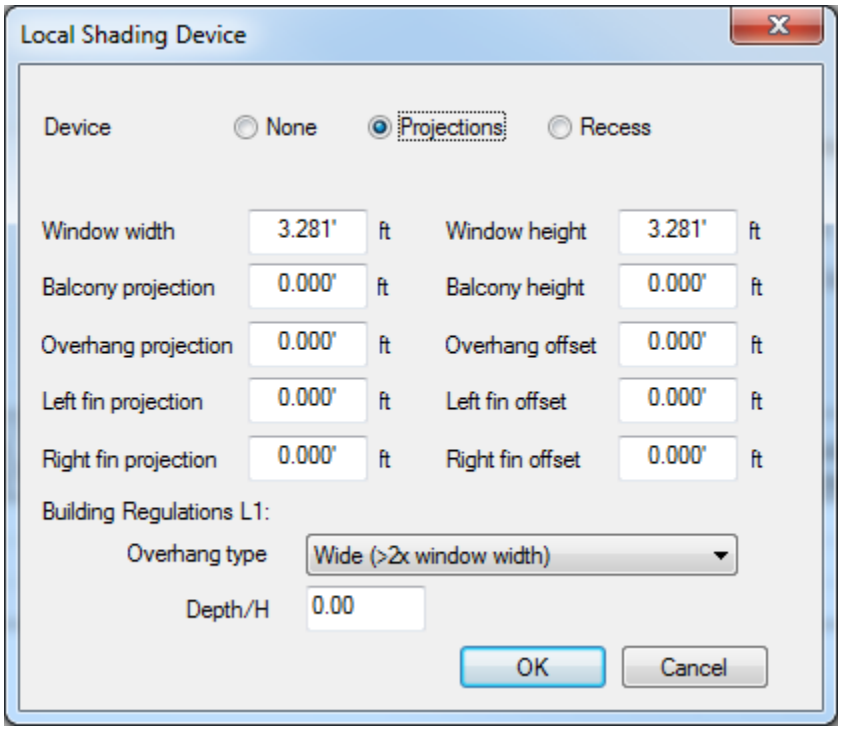


Figure 32 – Local Shading > Projections

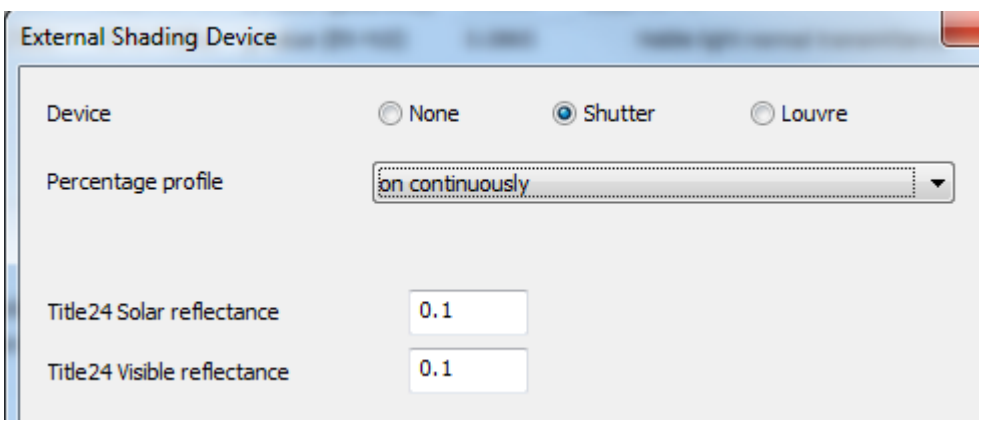


Figure 33 – External Shading > Shutter

4.6.2 Assigning a Construction

A construction can be assigned using the Assign Constructions icon . Please refer to the Apache View User Guide available in the IESVE Support User Guide section of the IESVE website.

4.7 Schedules/Profiles

All schedules that can be assigned in Title 24 Compliance have been created for the user. These schedules can be interrogated in ApPro. Please refer to the ApPro User Guide available in the IESVE Support User Guide section of the IESVE website.

4.8 Setup templates

Templates for space data can be created using the "Setup templates" button (Figure 34).

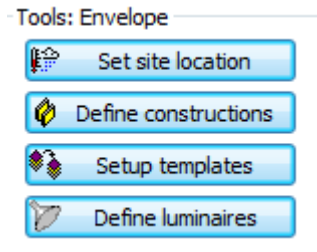


Figure 34 – Setup Templates button

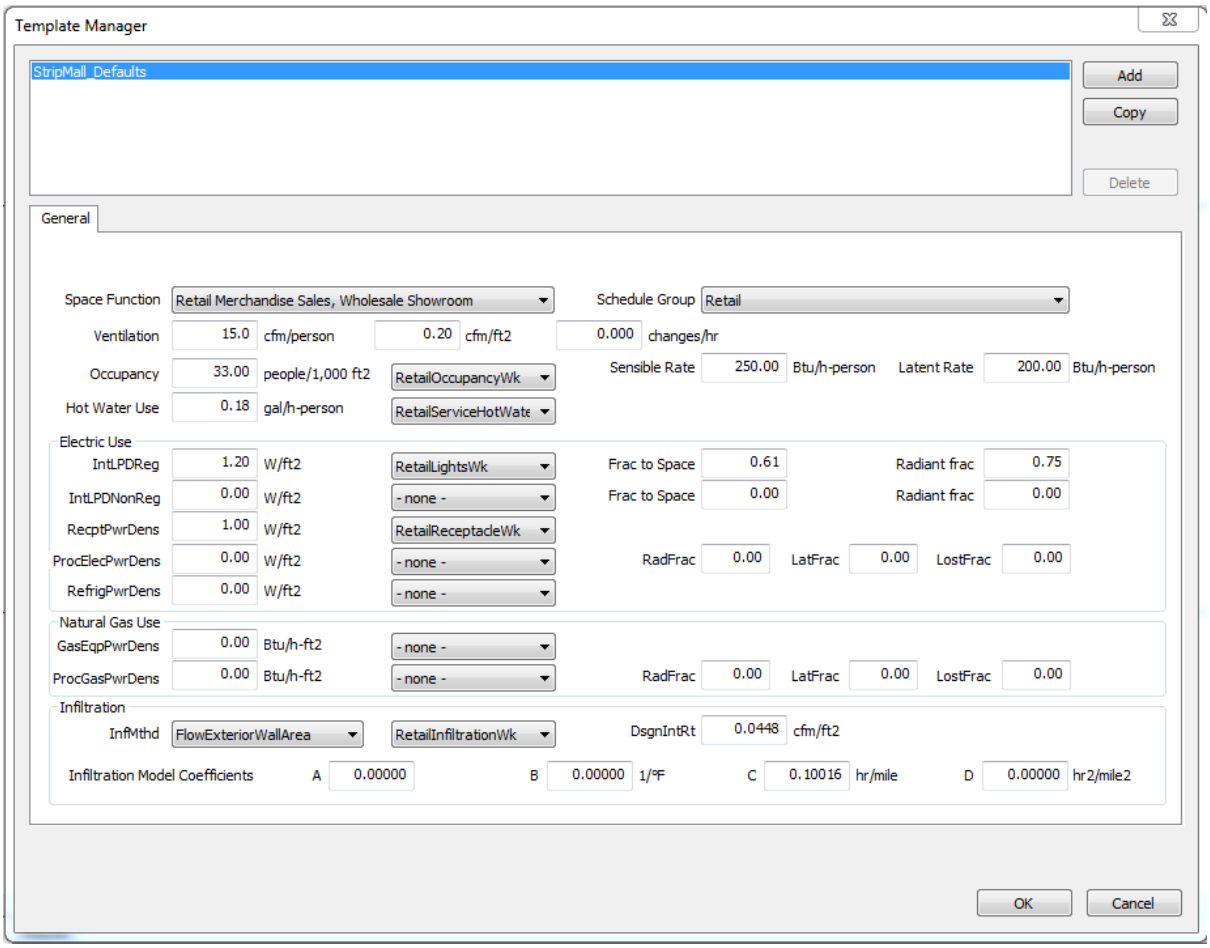


Figure 35 – Template Manager

Input summary for the Template Manager screen:

- Space Function: The area category occupancy type from Nonresidential Appendix 5.4A
- Schedule Group: A type specifying occupancy categories used to determine schedules
- Ventilation: The amount of outside air provided to a space during occupied hours divided by the floor area of that space

- Occupancy: The area density of people associated with a space expressed in people per 1000 square feet
    - Schedules (Occupancy): Reference to a schedule that describes the fraction of occupancy on an hourly basis
    - Sensible Rate: The rate of sensible heat released per person, which is a function of activity
    - Latent Rate: The rate of latent heat released per person, which is a function of activity
- Hot Water Use: The amount of hot water for each person in a space during occupied hours
    - Schedules (HotWater use): Reference to a schedule that describes the fraction of hot water use on an hourly basis
- Electric Use section:
    - IntLPDReg: Total regulated connected lighting power density for all interior lighting systems in a Space. This includes the loads for lamps and ballasts
        - Schedules (drop-down box): Reference to a schedule that describes interior lighting use
        - Fraction to Space: Fraction of regulated interior lighting heat gain going to space air
        - Radiant Fraction: Fraction of regulated interior lighting radiant heat gain going to space surfaces
    - IntPDNonReg: Total non-regulated connected lighting power density for all interior lighting systems in a Space. This includes the loads for lamps and ballasts
        - Schedules drop-down box: Reference to a schedule that describes the fraction of lighting use on an hourly basis
        - Fraction to Space: Fraction of non-regulated interior lighting heat gain going to space air
        - Radiant Fraction: Fraction of non-regulated interior lighting radiant heat gain going to space surfaces
    - RecptPwrDens: The usage of electrical devices plugged into receptacles in a space based on the occupancy type
        - Schedules (drop-down box): Reference to a schedule that describes the fraction of receptacle use on an hourly basis
    - ProcElecPwrDens: Process electrical power density resulting from an activity or treatment not related to the space conditioning, lighting, service water heating, or ventilating of a building as it relates to human occupancy. Process load may include sensible and/or latent components. For data centers this includes transformers, UPS, PDU, server fans, power supplies, etc
        - Schedules (drop-down box): Reference to a schedule that describes fraction of process electric use on an hourly basis
        - RadFrac: The fraction of radiant heat gain to a space based on appliance energy use
        - LatFrac: The fraction of latent heat gain to a space based on appliance energy use

        - LostFrac: The fraction of heat lost to the exterior is based on appliance energy use
    - RefrigPwrDens: The energy consumption of commercial refrigeration equipment in a space expressed in watts per square foot of space floor area. Commercial refrigeration EPD is used for walk in freezers, walk in coolers, and refrigerated casework. Other equipment such as Plug in coolers, vending machines and plug in refrigerators should be accounted for in receptacle loads
        - Schedules (drop-down box): Reference to a schedule that describes fraction of refrigeration use on an hourly basis
- Natural Gas Use section:
    - GasEqpPwrDens: Commercial gas power density is the average power density for all commercial gas equipment, assuming constant year-round operation
        - Schedules (drop-down box): Reference to a schedule that describes the fraction of gas equipment use on an hourly basis
    - ProcGasPwrDens: Process load is the gas energy consumption in the conditioned space of a building resulting from an activity or treatment not related to the space conditioning, lighting, service water heating, or ventilating of a building as it relates to human occupancy. Process load may include convective (sensible) and/or latent components
        - RadFrac: The fraction of radiant heat gain to a space based on appliance energy use
        - LatFrac: The fraction of latent heat gain to a space based on appliance energy use
        - LostFrac: The fraction of heat lost to the exterior based on appliance energy use
- Infiltration section:
    - InfMthd: The method used to calculate infiltration rate, specified by the ACM to be leakage through the building walls per unit area (cfm/ft2)
    - Methods available to calculate infiltration include effective leakage area, which is generally applicable for small residential scale buildings. The required component leakage method requires the user to specify the average leakage through the building wall per unit area (cfm/ft2). Component leakage rates can also be applied to the total building envelope area. Specification of a maximum rate, usually as air changes per hour, is also used. For all methods, the rate is modified by a schedule
    - Infiltration Model Coefficients: The constant and linear coefficients to affect the infiltration
    - DesgnInfRt: Design infiltration airflow

4.8.1 Assign template to selection set

A template can be assigned to an individual or selection of spaces using the Assign Room Thermal Template icon . Please refer to the Apache View User Guide available in the IESVE Support User Guide section of the IESVE website.

4.8.2 Room Data

To access this screen, click a thermal zone in the model viewer window and then the “Room Data” button.

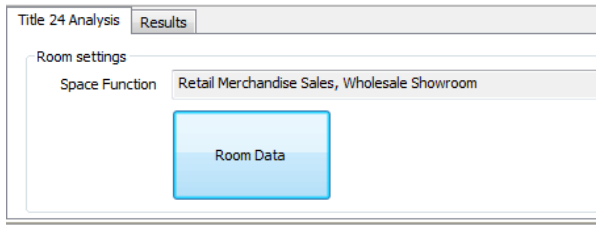


Figure 36 – Room Data button

4.8.2.1 General

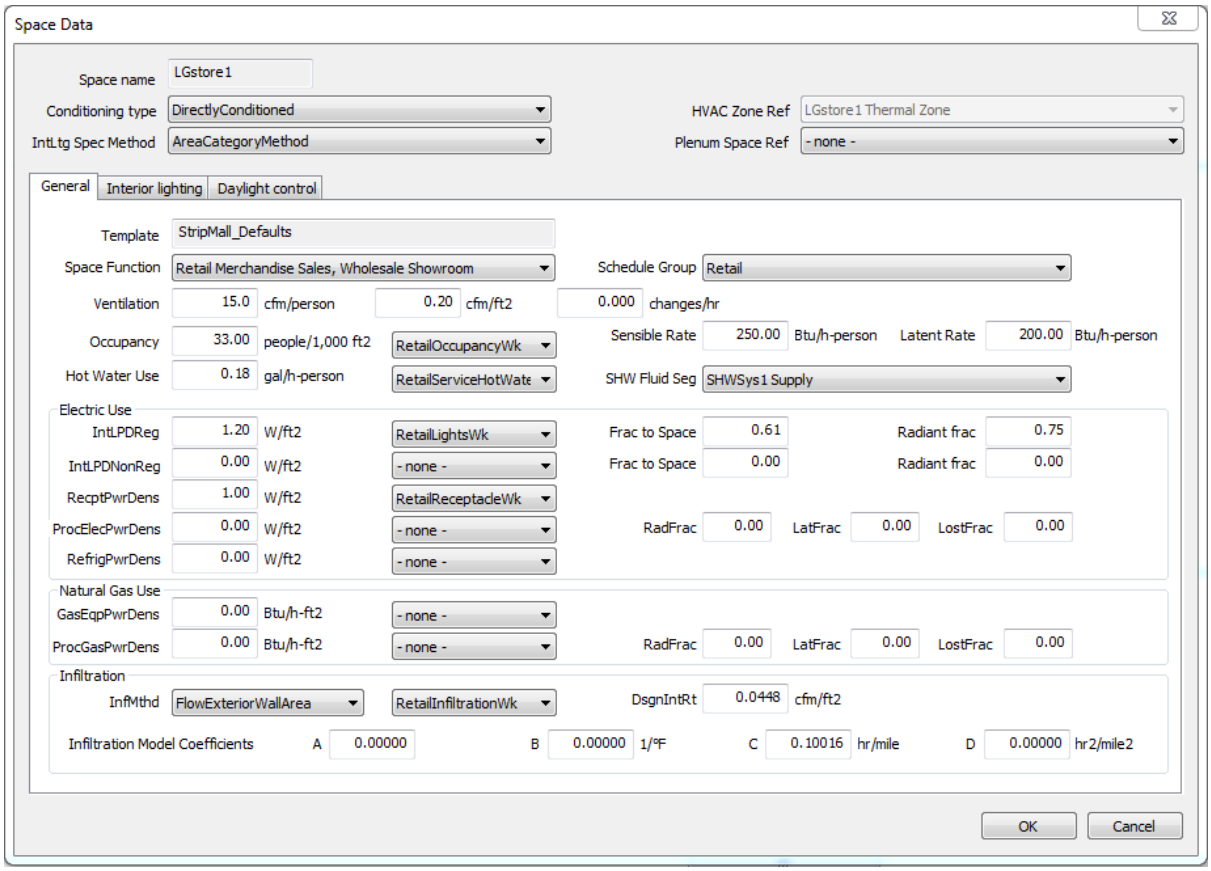


Figure 37 – Room Data General Tab

Input summary for Room Data dialog:

- Space Name: The name of the active space
- Conditioning Type: One of a list of categories that characterize the type of conditioning for the space
- IntLtg Spec Method: The method for selecting baseline lighting and other loads for a space
- HVAC Zone Ref: This is a reference to the HVAC zone that serves a given space (Section 4.10)

- Plenum Space Ref: This is a reference to the plenum space that serves a given space

The room data > general tab shows the same data as in a template (Section 4.8) with the following additional input information.

- Template: The template that has been assigned to the space
- SHW Fluid Seg: The services hot water segment that supplies the space with hot water

4.8.2.2 Interior lighting

To use this tab, users must have previously defined their luminaires in the "Define luminaires" dialog (Section 4.9).

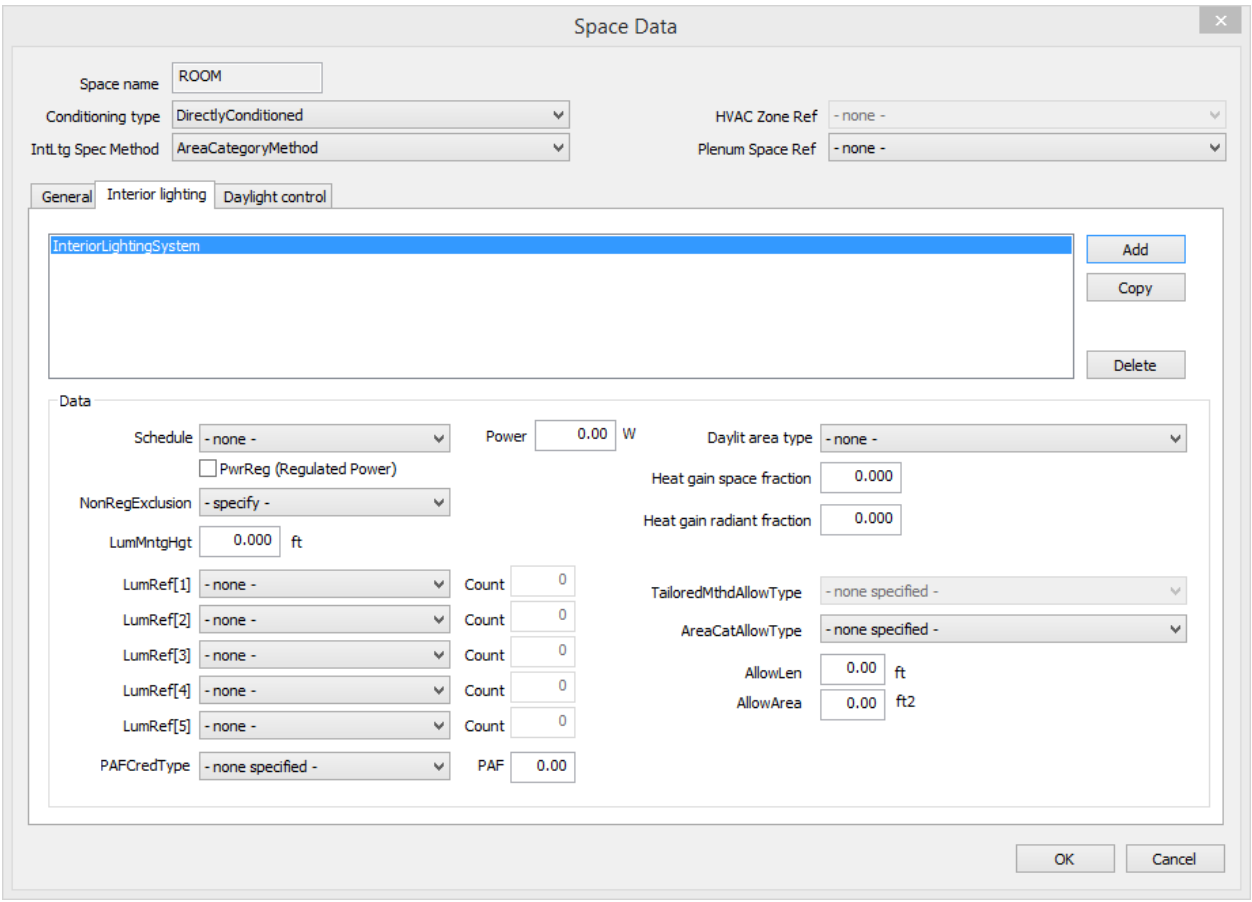


Figure 38 – Interior Lighting

Input summary for Interior Lighting data:

- Schedule: Reference to a unique Schedule Name of interior type for association with an interior lighting system
- Power: Luminaire power (taking Count into account)
- PwrReg (Regulated Power): Whether this lighting system's power is Regulated vs. Non-Regulated. Defaults to True (regulated)
- Daylit Area Type: The origin of the daylight

- LumMntgHgt: The Luminaire Height of an IntLtgSys, only necessary for Tailored Method Baseline General and Additional Lighting Power Allowances. Assumed by default to be the same as the space floor to ceiling height
- LumRef[1]: Whether or not first luminaire is assigned.
- LumRef[2]: Whether or not second luminaire is assigned.
- LumCnt[1]: Luminaire count.
- LumCnt[2]: Luminaire count.
- Heat Gain Space Fraction: Fraction of interior lighting heat gain going to space air
- Heat Gain Radiant Fraction: Fraction of interior lighting radiant heat gain going to space surfaces
- PAFCredType: Selection of PAF Credit Type allows the software to apply the power adjustment factors (PAF) which represents the percent reduction in lighting power that will approximate the effect of the control. Models account for such controls by multiplying the controlled watts by (1-PAF)
- PAF: Power adjustment factors (PAFs) represent the percent reduction in lighting power that will approximate the effect of the control. Models account for such controls by multiplying the controlled watts by (1-PAF)
- TailoredMthdAllowType: Custom Lighting Power Allowance Type for Interior Lighting Specified via Tailored Method
- AreaCatAllowType: Custom Lighting Power Allowance Type for Interior Lighting Specified via Area Category Method
- AllowLen: The Width (ft) of Chalk/Display Board to which the Area Category or Tailored Allowance (W/ft) is applied
- AllowArea: The Area (ft2) of to which the Area Category or Tailored Allowance (W/ft2) is applied

4.8.2.3 Daylight control

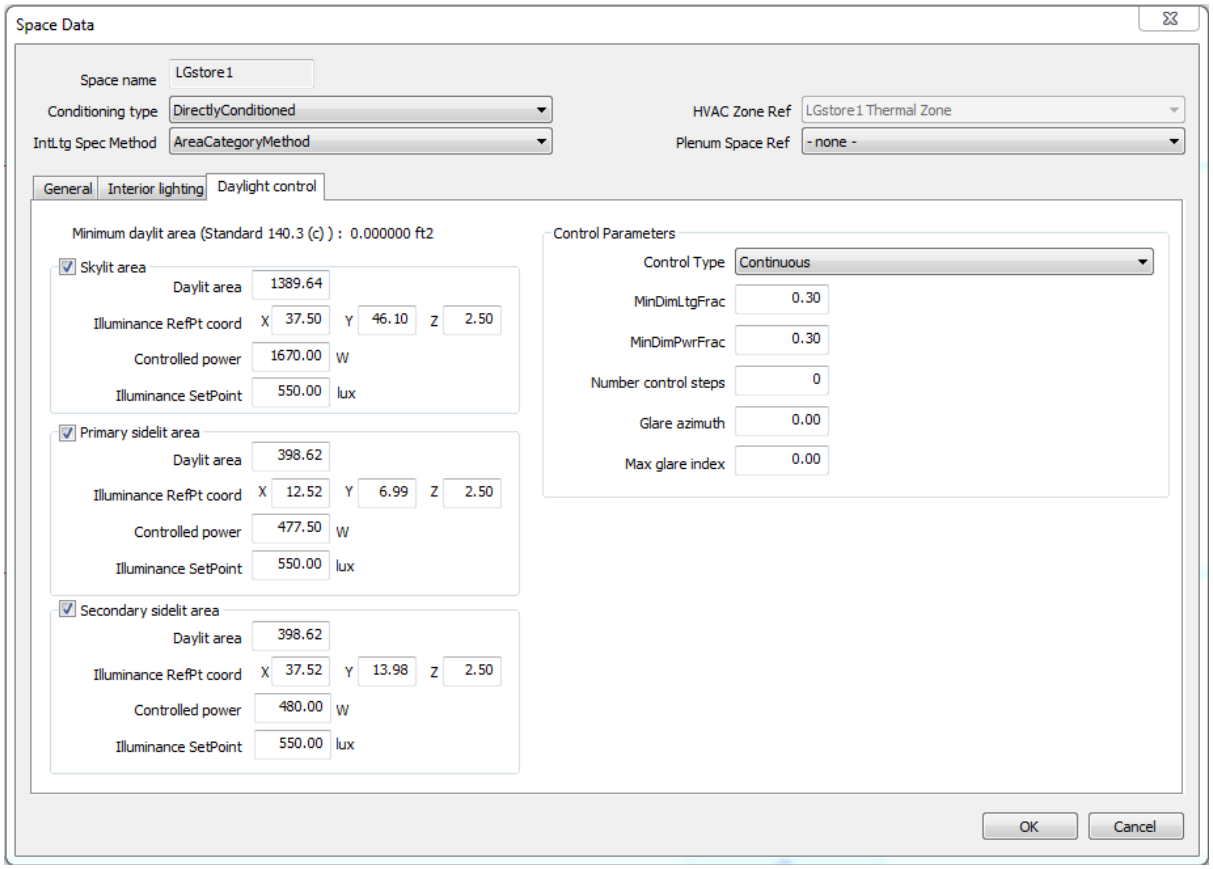


Figure 39 – Daylight control

Input summary for the Space Data screen (Daylighting tab):

- Minimum Daylit Area per 2013 T-24 Standards Sec.140.3(c): Area Required to be daylit (Skylit + Primary Sidelit) by Section 140.3c of Title 24 Standards.
- Skylit Daylit Area: The skylit area is the portion of the floor area that gets daylighting from a skylight
- PriSide Daylit Area: The primary sidelit daylit area is the portion of the floor area that gets the highest illumination from a window. Primary sidelit daylit area is defined as a band near the window with a depth equal to the distance from the floor to the top of the window and width equal to window width plus 0.5 times window head height wide on each side of the window opening
- SecSide Daylit Area: The secondary sidelit daylit area is the portion of the floor area that gets less high, but still useful daylighting from a window. Secondary sidelit daylit area is defined as a band beyond the primary daylighted area that extends a distance double the distance from the floor to the top of the window and width equal to window width plus 0.5 times window head height wide on each side of the window opening
- Illuminance RefPt coord: The position of the daylight reference points within the daylit space, identified by the Cartesian X, Y, and Z position of the reference point (feet), with respect to the overall project coordinate system

- Controlled Power: The total lighting power (Watts) controlled by dayighting controls associated with the Daylighting Control Position
- Illuminance SetPoint: The design illuminance for the daylit area associated with the Daylighting Control Position. Lighting controls are simulated so that the illuminance at the reference position is always maintained at or above the illuminance setpoint
- Daylighting Control Parameters: The following inputs describe the daylighting control algorithm for all of the controls located within a particular space.
    - MinDimPwrFrac: The minimum power fraction when controlled lighting is fully dimmed. Minimum power fraction = (Minimum power) / (Full rated power)
    - Glare Azimuth: This field specifies the view direction for calculating glare. It is the angle, measured clockwise in the horizontal plane, between the zone y-axis and the occupant view direction
    - Max Glare index: If a daylit zone has windows with shading devices (except exterior screens), the shades will be deployed if the daylight glare at the First Reference Point exceeds the value of this field

4.9 Define luminaires

To define a luminaire, click the “Define luminaires” button (Figure 40).

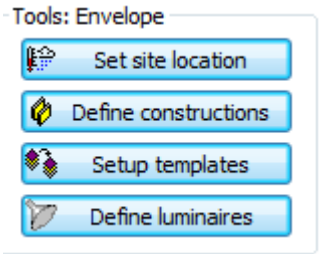


Figure 40 – Define Luminaires button

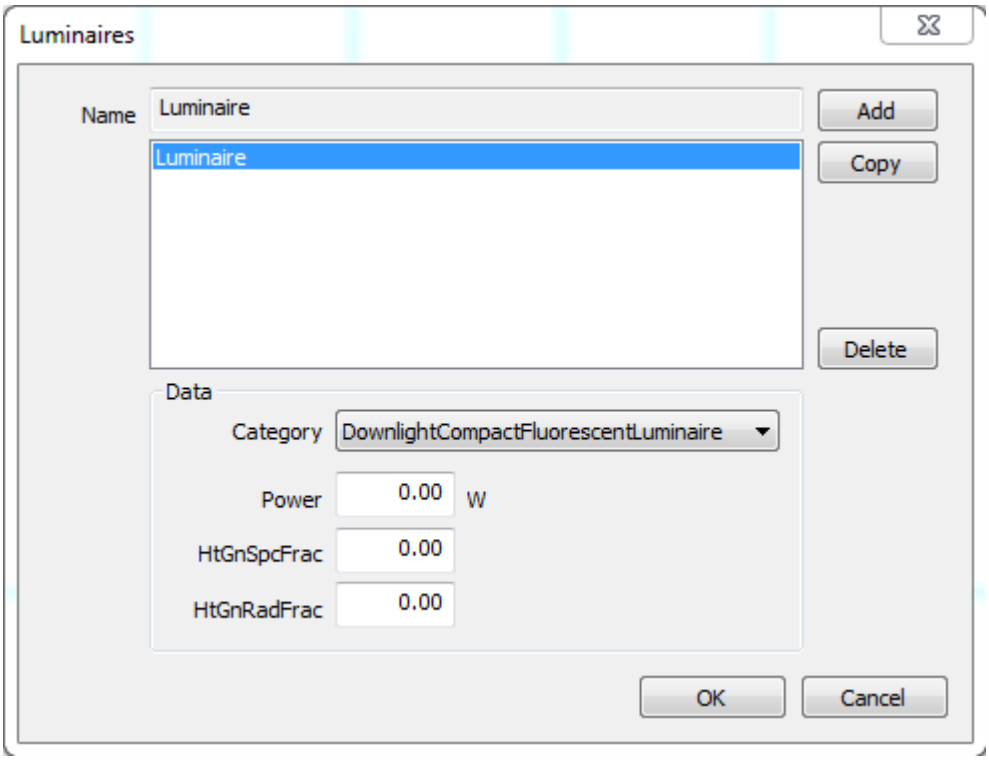


Figure 41 – Luminaires dialog

Input summary for Luminaires:

- Name: The name of the selected luminaire
- Category: The type of luminaire used to determine heat gain distribution. Options are:
  - Downlight Compact Flourescent Luminaire
  - Downlight Incandescent Luminaire
  - NonInCeiling Flourescent Luminaire
  - RecessedFlourescentLuminairewithLens
  - RecessedFlourescentLuminairewithoutLens
- Power: The Connected power for a luminaire including lamp and ballast
- HtGnSpcFrac: Fraction of luminaire heat gain going to space air
- HtGnRadFrac: Fraction of luminaire radiant heat gain going to space surfaces

4.10 Define HVAC Zones

A HVAC zone can be defined using the “Define HVAC zones” button (Figure 42).

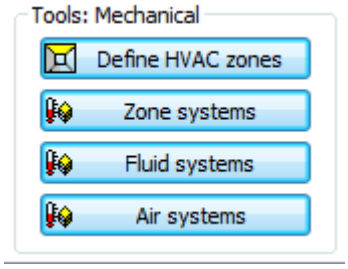


Figure 42 – Define HVAC zones button

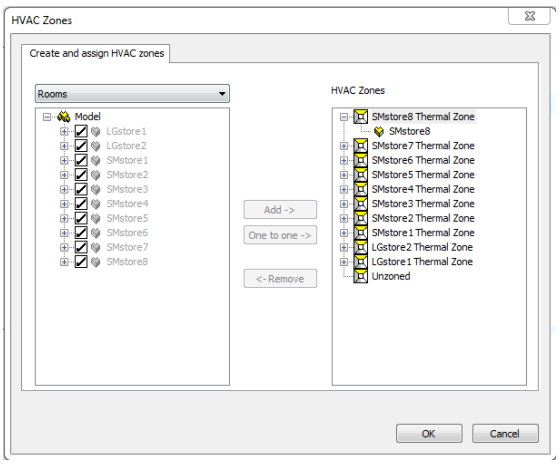


Figure 43 – HVAC Zones

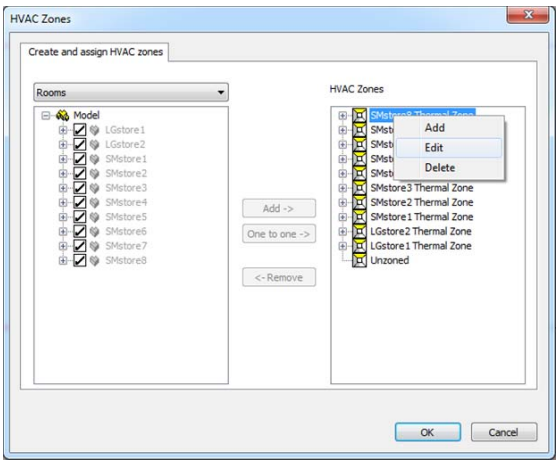


Figure 44 – HVAC Zones right click

Upon clicking the “Define HVAC zones” button, the HVAC Zones creation dialog will open (Figure 43). A HVAC zone can be created by clicking right clicking on an already defined HVAC zone (Figure 44) and clicking “Add”; or by clicking on a room in the left hand window and clicking “One to one ->” in the center of the screen (highlighted in Figure 43). By right clicking on a HVAC Zone and selecting “Edit”, the HVAC Zone Input dialog shall be accessed (Figure 45).

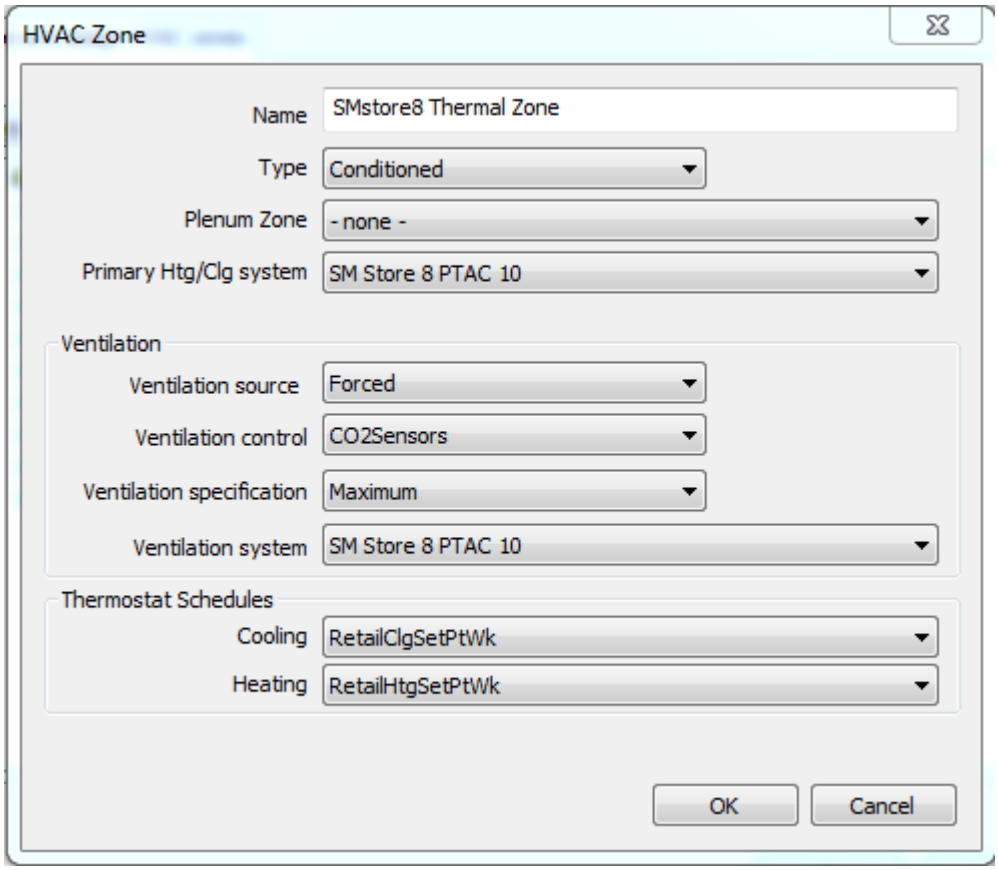


Figure 45 – HVAC Zones Input Dialog

Input summary for the HVAC Zone Input Dialog:

- Name: Name of selected HVAC Zone
- Type: One of a list of categories that characterize the type of conditioning for the space
- Plenum Zone: Name of the plenum zone if the thermal zone has a plenum space
- Primary Htg/Clg System: The name of the air or zone system that is the principal source of heating and/or cooling for the thermal zone. Only one unique AirSystem can be assigned to this field
- Ventilation section:
    - Ventilation Source: The source of ventilation for a thermal zone. Options are NotRequired, Forced, and Natural
    - Ventilation Control: The method used to vary the minimum ventilation flow. Ventilation airflow may be fixed at a specified rate or it may be reduced by the use of CO2 sensors or shut off based on an occupancy sensor
    - Ventilation Specification: Options are: NoVentilation, Maximum, Sum, FlowPerPerson, FlowPerArea, AirChangesPerHour, and FlowPerZone
    - Ventilation System: The name of the air or zone system that provides ventilation air to the thermal zone. This is by default the same system as the primary air conditioning system
- Thermostat Schedules section:

- Cooling: HVAC zone cooling temperature schedule. The schedules specified in Appendix 5.4A and detailed in Appendix 5.4B is used as default
- Heating: HVAC zone heating temperature schedule. The schedules specified in Appendix 5.4A and detailed in Appendix 5.4B is used as default

4.11 Mechanical Systems

Systems are divided into three sections:

- Zone systems
- Fluid systems
- Air systems

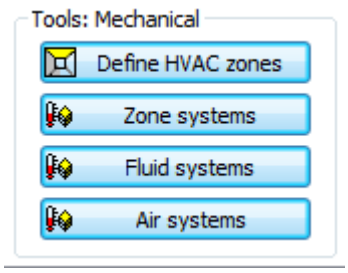


Figure 46 – Systems button

4.11.1Fluid System

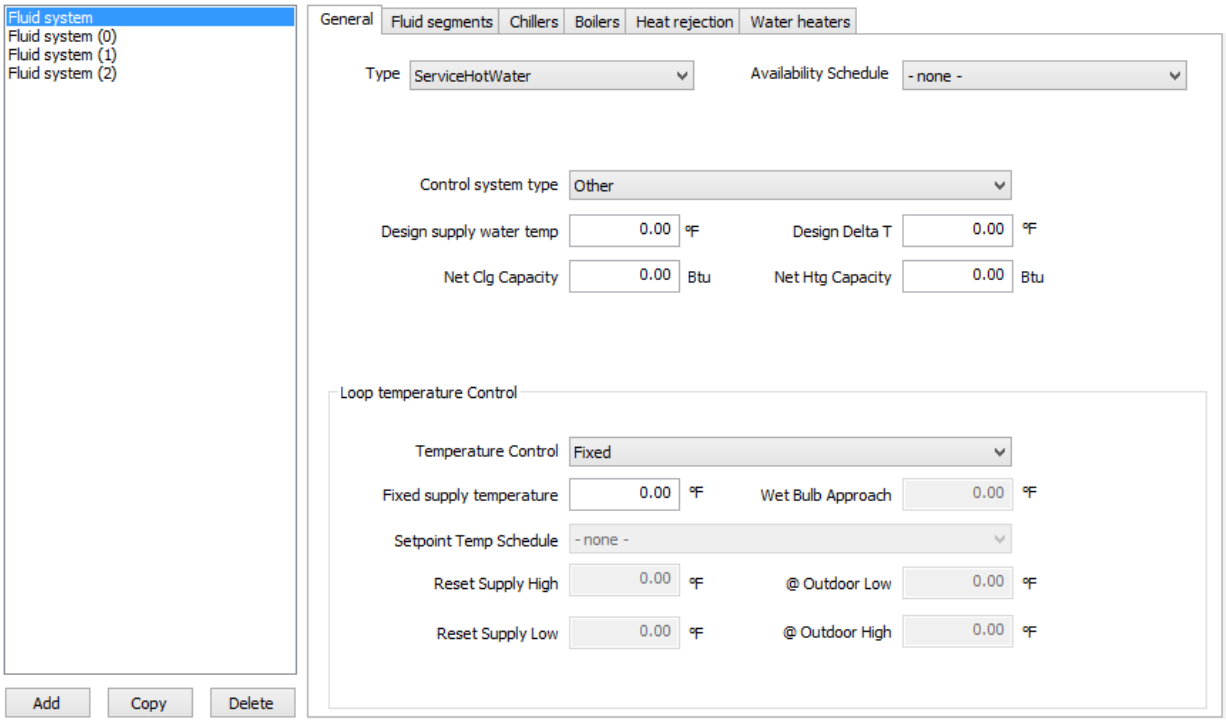


Figure 47 – Fluid System General tab

Input Summary:

- Name: The name of the fluid system.
- Type: The type of fluid system.
    - The type is used to validate the connections between various FluidSys objects.
- Availability Schedule: The name of the schedule that determines when the hot water system is available to provide heating. The system is not necessarily providing heating at all times it is available, but if it is not available, no heating will be provided
- Control System Type: The type of control system used for the fluid system - DDC or other. This is used to specify part load curves for variable speed pumps.
- Design supply water temp: The design supply water temperature of the loop
- Design Delta T: The design supply water temperature delta T.
- Net Clg Capacity/ Net Htg Capacity: The net capacity in Btu of the heating and cooling system
- Loop Temperature Control section
    - Temperature Control: The method used to control the water supply temperature. The options are Fixed, Scheduled, OutsideAirReset and WetBulbReset.
        - Fixed means that a constant temperature setpoint is used
        - Scheduled means that the temperature is adjusted based on a user specified schedule
        - OutsideAirReset means that the water supply temperature is adjusted based on the outdoor air temperature
        - WetBulbReset reset means that the water supply temperature is adjusted based on the cooling load
    - Fixed Supply Temp: The supply water temperature setpoint for 'Fixed' temperature control

4.11.1.1 Chillers

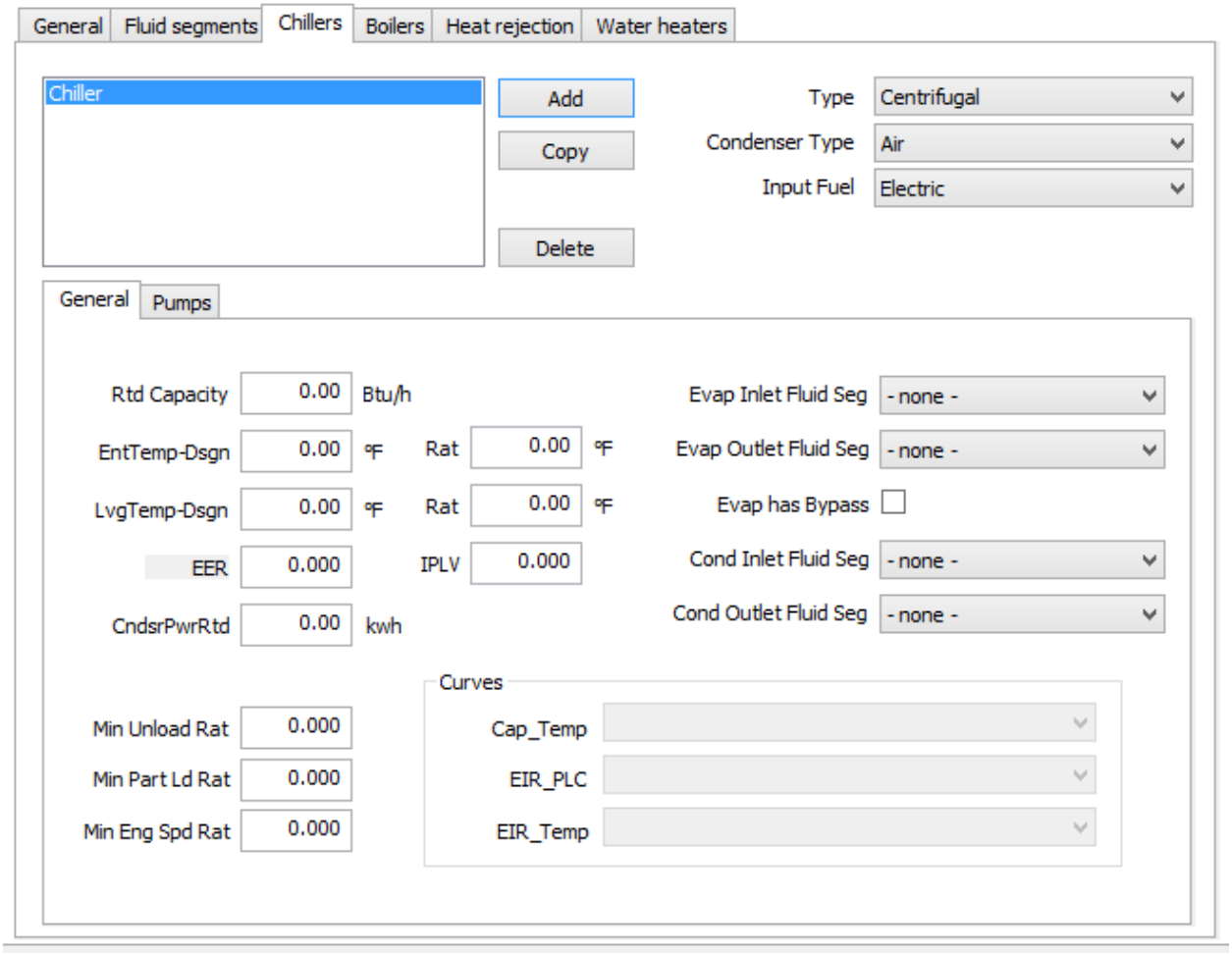


Figure 48 – Chiller Input Dialog

Input summary:

- Type: The type of chiller being used based on the compressor type or absorption process. The type of chiller selected from a list: Centrifugal, Reciprocating, Scroll, Screw, Heat Recovery, Heat Pump, Single Effect Absorption, Double Effect Absorption, Triple Effect Absorption. Note that the heat rejection process is not included in the Type descriptor. See Condenser Type
- Condenser Type: Method used to reject heat from the chiller
    - Air-cooled chillers use air to cool the condenser coils
    - Water-cooled chillers use cold water to cool the condenser and additionally need either a cooling tower or a local source of cold water
    - Evaporatively cooled chillers are similar to air-cooled chillers, except they use a water mist to cool the condenser coil, which makes them more efficient
- Input Fuel: The form of the primary energy input to the chiller
    - All chillers have a primary energy input along with electricity use for auxiliaries
    - This input describes the form of the primary energy. Options are Electricity, Steam, Hot Water, Natural Gas, or Oil

- Rtd. Capacity: The cooling capacity of the chiller at rating conditions
    - The full load output of the chiller operating at rating temperatures and flows
- EntTemp -Dsgn: The chilled water return temperature at design conditions
    - This temperature is used to size the chilled water components of the system
- (EntTemp) -Rat: Rated chilled water entering temperature
- LvgTemp -Dsgn: The chilled water supply temperature at design conditions
    - This temperature is used to size the chilled water components of the system
- (LvgTemp) -Rat: Rated chilled water leaving temperature
- Status: Defines if equipment is new, existing or modified
- Evap Inlet Fluid Seg: Name of the fluid segment connected to the evaporator inlet. This is the chiller evaporator inlet connection, to chilled water return.
- Evap Outlet Fluid Seg: Name of the fluid segment connected to the evaporator outlet. The chiller condenser outlet connection, to condenser water return.
- Evap Has Bypass: Whether or not the chiller has Bypass.
- Cond Inlet Fluid Seg: Name of the fluid segment connected to the condenser inlet. This is the chiller condenser inlet connection, to condenser water supply
- Cond Outlet Fluid Seg: Name of the fluid segment connected to the condenser outlet. This is the chiller condenser outlet connection, to condenser water return
- Min Unload Rat: Minimum unloading ratio
- Min Part Ld Rat: Minimum part load ratio
- Cap_fTempCrvRef: The name of the performance curve which describes the chiller cooling capacity as a function of operating temperatures
    - For water cooled chillers the temperatures are the leaving chilled water and entering condenser water temperature.
    - For air cooled chillers the temperatures are the leaving chilled water temperature and the outdoor air drybulb

4.11.1.2 Fluid Segment

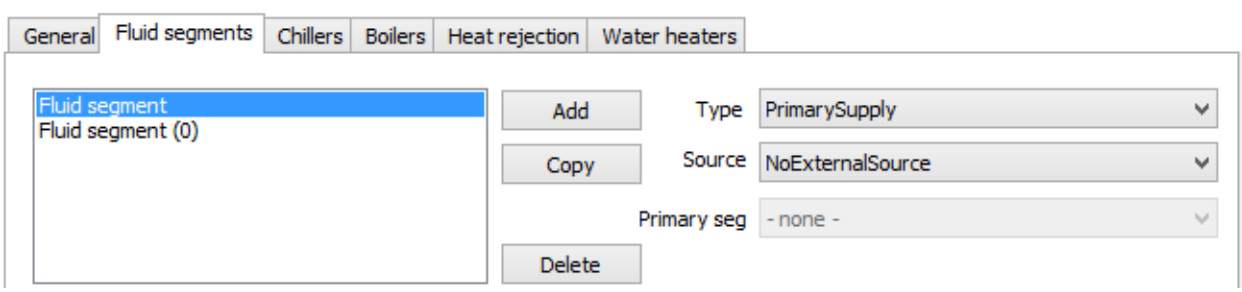


Figure 49 – Fluid Segment Input Dialog

Input Summary:

- Type: The type of fluid segment. It is used to validate the connections between various FluidSys objects. Options include PrimarySupply, PrimaryReturn, SecondarySupply, SecondaryReturn, MakeupFluid and Connector

- Source: The source of the Fluid Segment. Available options are No external source and MunicipalWater
- Primary Seg: Refers to the segment that supplies fluid to a secondary segment. Applicable to fluid loops subordinate to the primary loop (secondary, tertiary, etc.), this property is used to define the inlet and outlet of secondary segment

4.11.1.3 Pump Data

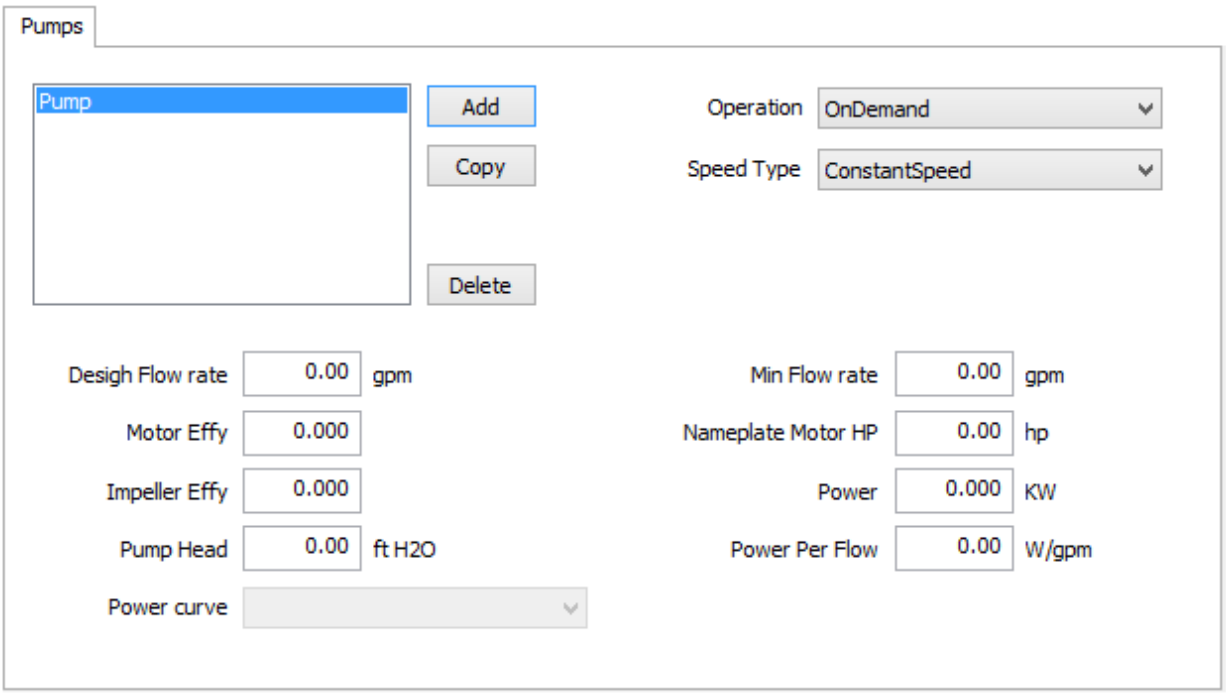


Figure 50 – Pump Data Input Dialog

Input summary:

- Operation: The type of system the pump will be operating in
- Speed Type: Selection allows for constant or variable speed pump
- Design Flow Rate: The capacity of the pump
- Minimum Flow Rate: The lowest flow rate available for the pump
- Motor Effy: Indicates how well the motor converts electrical power into mechanical power and is defined as output power divided by input power expressed as a ratio
- Impeller Effy: Full load efficiency of the pump impeller
- Pump Head: The pressure head of the pump at design flow conditions
- Nameplate Motor HP: The nameplate horsepower of the pump motor
- Power: The design power of the pump. This inputs gets calculated by the software based on user inputs for other pump parameters
- Power Per Flow (Ref): The power of the pump per unit flow at design flow capacity
- Power curve: The name of the power as a function of PLR curve. This is normally a biquadratic curve

4.11.1.4 Boiler Data

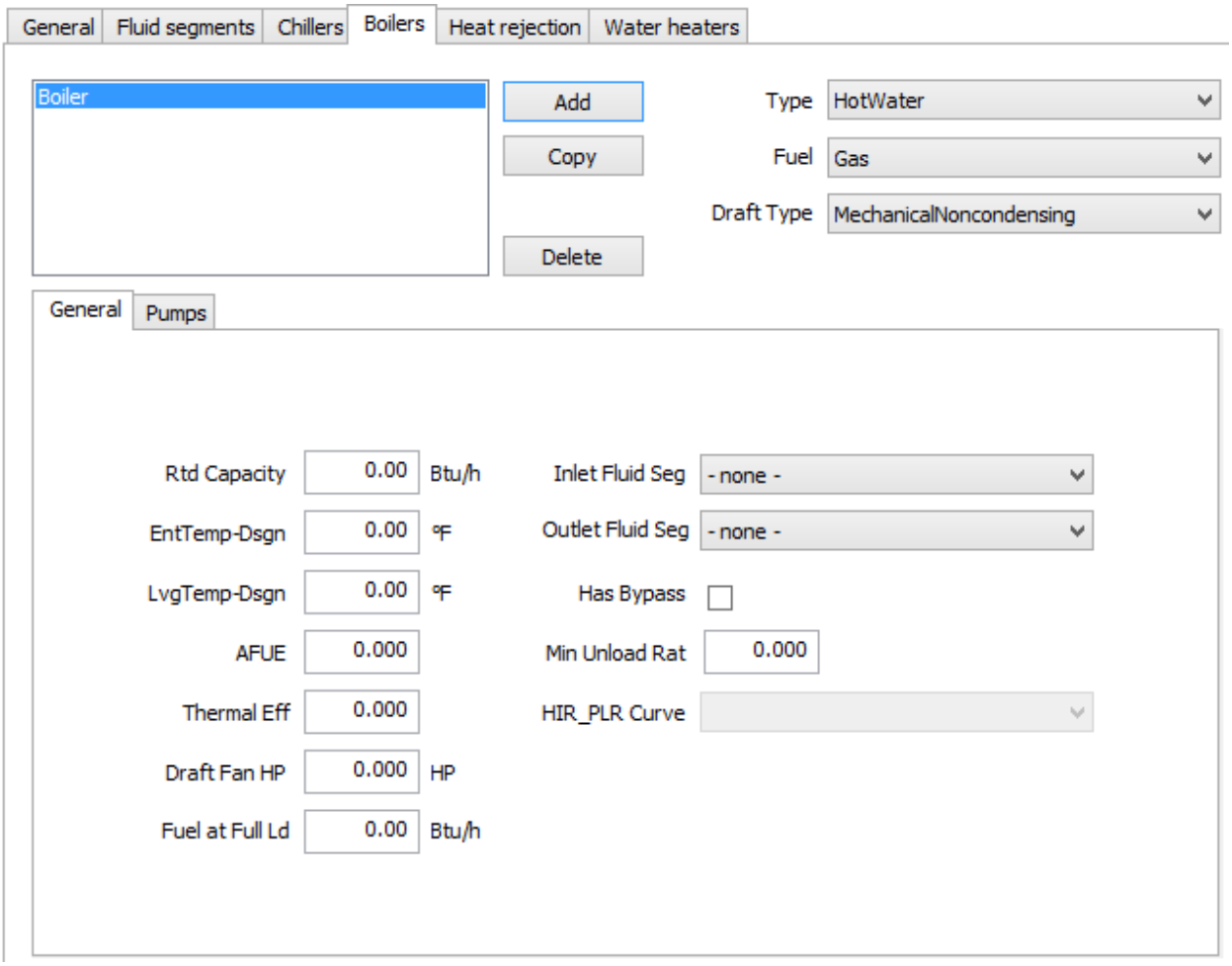


Figure 51 – Boiler Data Input Dialog

Input summary:

- Type: Type of boiler in terms of steam or hot water. Boiler type in terms of fuel used or draft type are defined in other descriptors and rules
- Fuel: The primary fuel used by the boiler to generate heat. Options are gas, oil or electric
- Draft Type: Draft type for fuel fired boilers. Options include Mechanical and Natural
- Rtd. Capacity: Heat output of the boiler at full load and rated conditions
- EntTemp-Dsgn: The temperature of the hot water returned to the boiler at design conditions. This may not be the return water temperature during normal operation
- LvgTemp-Dsgn: The temperature of the hot water supplied by the boiler at design conditions. This may not be the supply water temperature during normal operation
- AFUE: The Annual Fuel Utilization Efficiency of the boiler. Applies only to smaller gas, propane, or oil fired boilers with output heating capacities of less than 300,000 Btu/hr. For larger fuel-fired boilers, use thermal efficiency, and for electric boilers use EIR

- Thermal Eff: The Thermal Efficiency of the boiler. Applies only to larger gas, propane or oil fired boilers with output heating capacities of 300,000 Btu/hr or more. For smaller fuel-fired boilers use AFUE. For electric boilers use EIR
- Draft Fan HP: The nameplate horsepower of the draft fan motor for boilers with mechanical draft
- Fuel at Full Ld: The fuel consumption at design conditions
- Inlet Fluid Seg: The boiler inlet connection, to hot water return, or HWR
- Outlet Fluid Seg: The boiler outlet connection, to hot water supply, or HWS
- HasBypass (checkbox): Whether or not the Boiler has Bypass
- Min Unload Rat: The minimum load on the boiler at which the boiler can operate without cycling, expressed as a fraction of the full load capacity. At loads less than this, the boiler cycles at the minimum capacity as needed to meet the load
- HIR_PLR Curve: The name of the performance curve which modifies the boiler efficiency (heat input ratio) for the time step as a function of the part load ratio

4.11.1.5 Heat Rejection

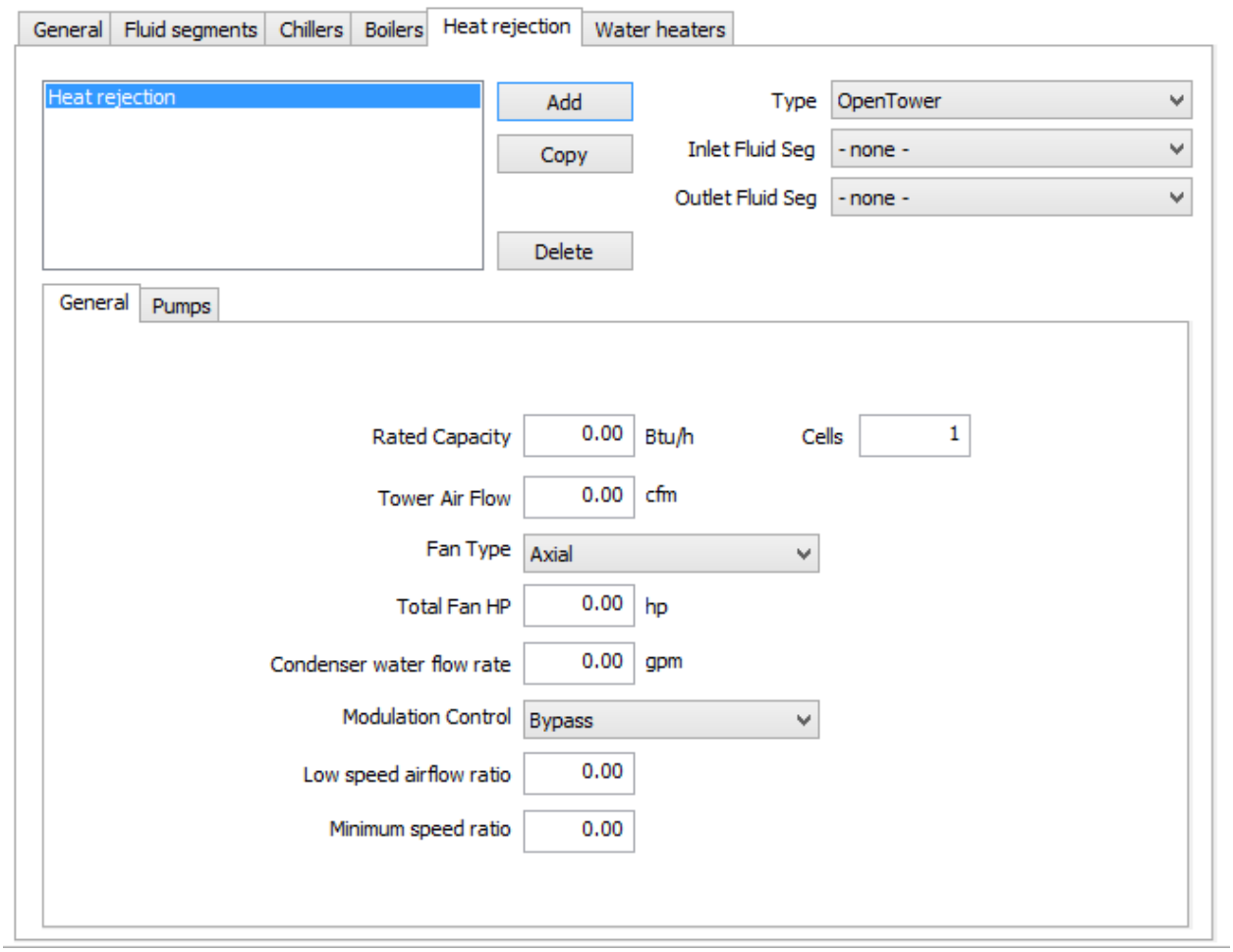


Figure 52 – Heat Rejection Input Dialog

Input summary:

- Type: The type of heat rejection device
  - Heat rejection devices include cooling towers and ground source types. The available options are OpenTower, ClosedTower, GroundSourceHeatExchanger, Lake and Well
- Inlet Fluid Seg: The heat rejection inlet connection, to condenser water return, or CWR
- Outlet Fluid Seg: The heat rejection outlet connection, to condenser water supply, or CWS
- Rated Capacity: The rated cooling capacity at CTI test conditions
  - The cooling capacity at rated conditions of 95°F condenser water return, 85°F condenser water supply, and 78°F wet-bulb with a 3 gpm/nominal ton water flow, where a nominal ton is 15,000 Btu/hr
- Number of Cells: The number of cells in the cooling tower. Each cell has its own fan and water flow allowing for responding to lower load conditions.
  - Each cell will be modeled as equal size. Cells are subdivisions of cooling towers into individual cells, each with their own fan and water flow, allowing the cooling system to respond more efficiently to lower load conditions
- Tower Air Flow: The rate of air moving through the tower
- Fan Type: The type of fan used in a cooling tower
  - an type options are axial or centrifugal.
- Total fan HP: The sum of the nameplate rated horsepower (hp) of all fan motors on the cooling tower
- Condenser water flow rate: The rate of water flowing through the condenser
- Modulation Control: The method used by the heat rejection device to modulate capacity
- Low Speed Air Flow Ratio: Ratio of the low-speed airflow to full speed airflow. The percentage full load airflow that the tower has at low speed or with the pony motor operating. This is equivalent to the percentage full load capacity when operating at low speed
- Minimum Speed Ratio: Minimum fan speed for a variable speed tower. The minimum fan speed setting of a VSD controlling a cooling tower fan expressed as a ratio of full load speed

4.11.2Air System

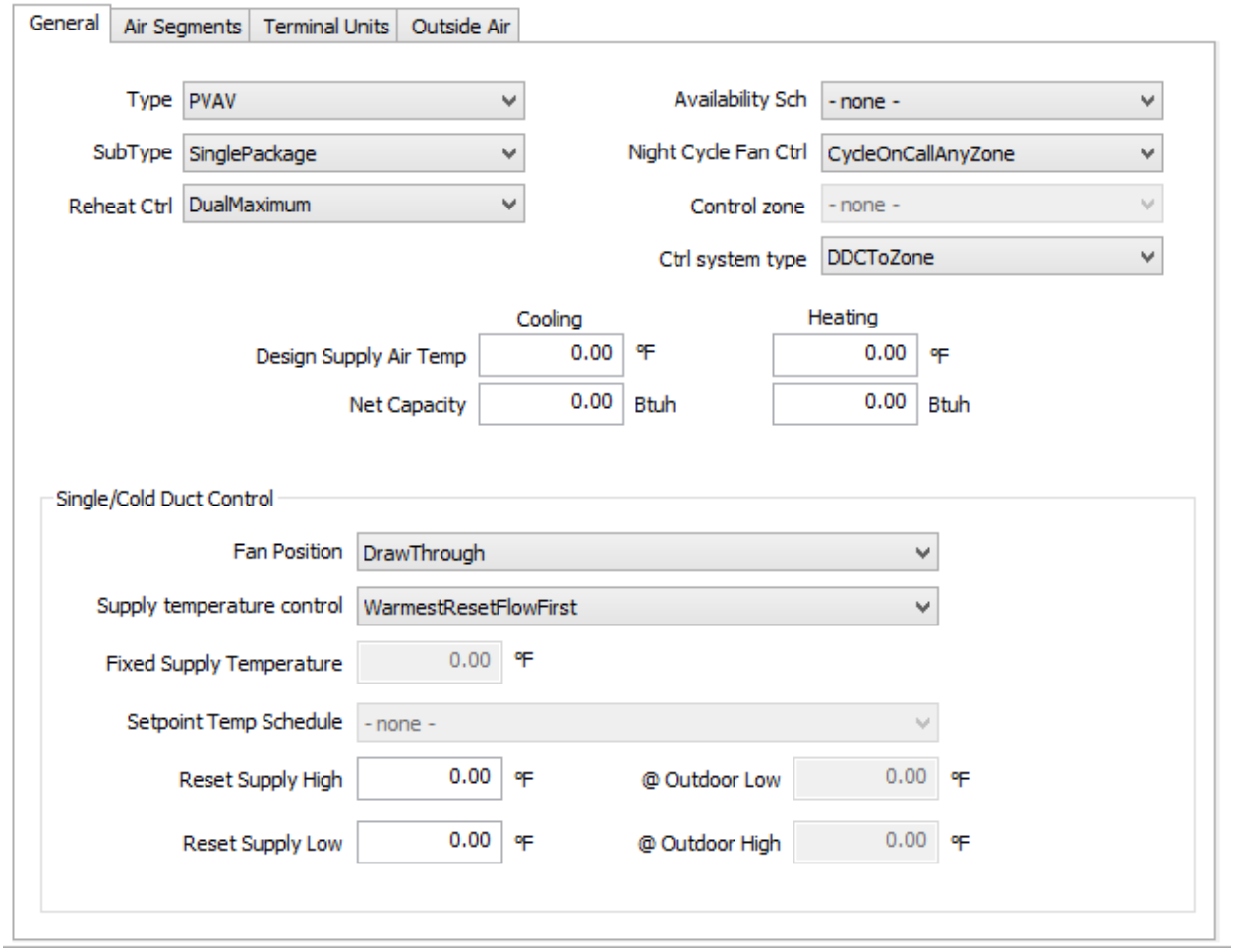


Figure 53 – Air System General Tab

Input summary:

- Type: A unique descriptor that identifies high level attributes of a HVAC system. Options available are PVAV, VAV, SZAC, SZHP, SZVAVAC, SZVAVHP and HV
- Sub Type: Property used to define rating conditions and efficiency requirements of system components. Options available are Single Package and Split System
- Reheat Ctrl: The air/temperature control strategy for VAV reheat box in heating mode.
    - Single Maximum: The airflow is set to a minimum constant value in both the deadband and heating mode. The minimum airflow septoint is typically 30 to 50 percent of maximum. This control mode typically has a higher minimum airflow than the minimum used in the dual maximum below, resulting in more frequent reheat.
    - Dual Maximum: raises the SAT as the first stage of heating, and increases the airflow to the zone as the second stage of heating, as follows:
        - The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no larger than 95°F while the airflow is maintained at the deadband flow rate.

        - The second stage of heating consists of modulating the airflow rate from the deadband flow rate up to the heating maximum flow rate (50 percent of design flow rate).
- Availability Sch: Name of the Availability schedule for the Air System
- Night Cycle Fan Ctrl: The HVAC system control method when heating, cooling and fan systems are scheduled to be Off. For this control, the space is controlled to the setback or setup temperature only; this control is not equivalent to night purge control. Options for Night Cycle Fan Control include CycleOnCallAnyZone, CycleOnCallPrimaryZone, CycleZoneFansOnly and StaysOff
- Control Zone: A reference to the Thermal zone name where controls for the Air System are located
- Ctrl System Type: The type of control system used for an HVAC system. Applicable to multizone HVAC systems and their related equipment only. This input affects the proposed design system specification for zone level controls, supply air temperature reset controls, ventilation controls and fan and pump static pressure part-load curves
- Design Supply Air Temp (Cooling): The design cooling supply air temperature of single duct system or the cold duct of a dual duct system. This is also the control setpoint for Fixed air temperature control.
- Design Supply Air Temp (Heating): The design heating supply air temperature of single duct system or the hot duct of a dual duct system. This is also the control setpoint for 'Fixed' air temperature control.
- Net Capacity (Cooling): Net Capacity of the Cooling System
- Net Capacity (Heating): Net capacity of the Heating System.
- Fan Position: The position of the supply fan relative to the cooling coil.
- Supply Temperature Control: The method of controlling the supply air temperature of a single duct system, or the cold duct of dual duct system.
- Fixed Supply Temp: The temperature of the air being supplied to the space.
- Setpoint Temp. Sch: The scheduled supply air temperature setpoint of a single duct air system, or the scheduled setpoint temperature of the cold duct in a dual duct system.
- Reset Supply High: The maximum (high) reset supply air temperature for a single duct system, or for the cold duct of a dual duct system.
    - If supply air temperature is reset based on outside air temperature, specifies the supply air high setpoint to at the outside drybulb low. If supply air temperature is reset based on 'Warmest' zone, specifies the maximum supply air temperature for reset.
- @ Outdoor Temp (High): The minimum (low) outdoor air temperature at the high reset supply air temperature during cooling. Applicable when cooling supply air temperature is reset based on outside air temperature, specifies the outside drybulb low.
- Reset Supply Low: The minimum (low) reset supply air temperature during cooling. If cooling supply air temperature is reset based on outside air temperature, specifies the supply air low setpoint to at the outside drybulb high. If cooling supply air temperature is reset based on warmest zone, specifies the minimum supply air temperature for reset
- @ Outdoor Temp (Low): The maximum (high) outdoor air temperature at the low reset supply air temperature during cooling. If cooling supply air temperature is reset based on outside air temperature, specifies the supply air low setpoint to at the outside drybulb high

4.11.2.1 Air Segment

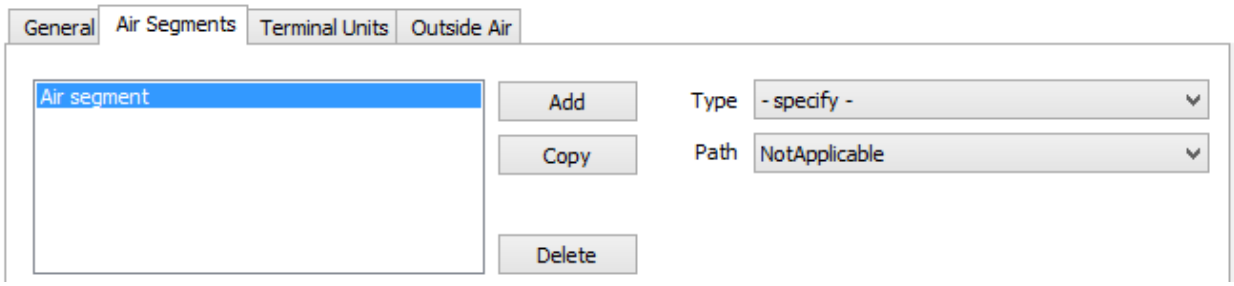


Figure 54 – Air Segment Input Dialog

Input summary:

- Type: The type of Air Segment. Options are Supply, Return and Relief
- Path: The path of the Air Segment. Options are NotApplicable, Direct, Ducted and PlenumZones

4.11.2.2 Cooling Coil (Chilled Water)

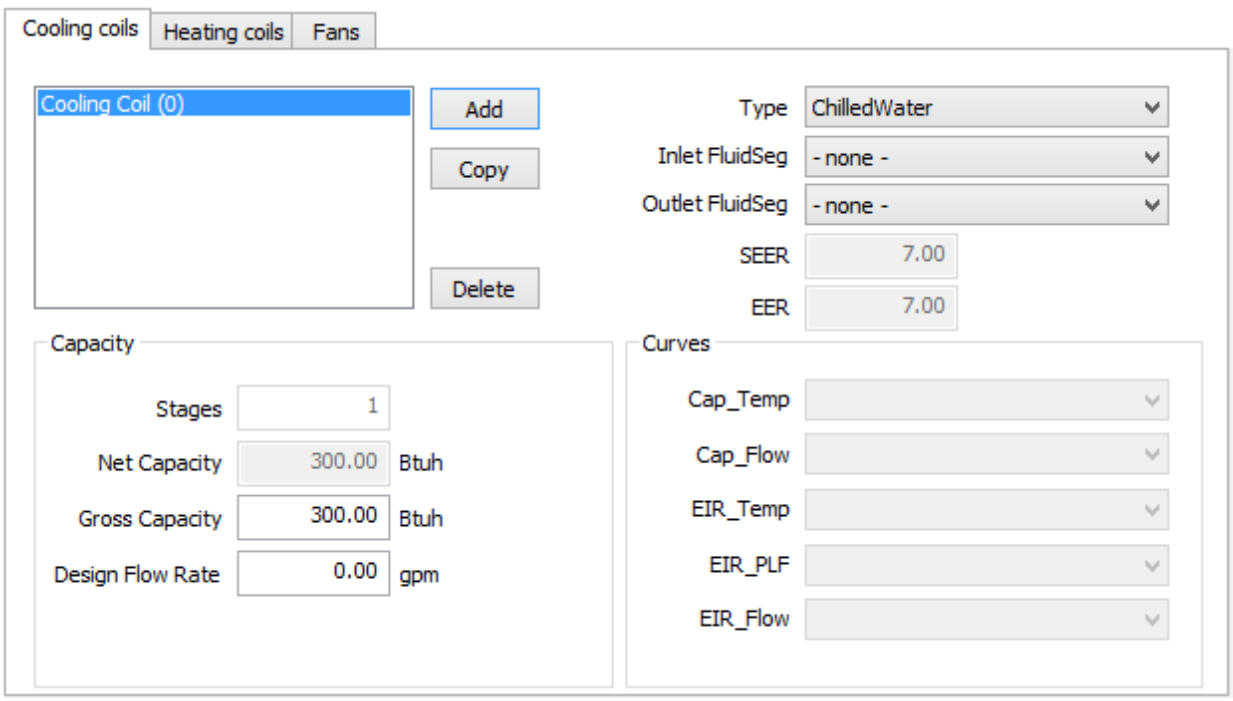


Figure 55 – Cooling Coil (Chilled Water) Input Dialog

Input summary:

- Type: The type of cooling coil. Options available are Chilled Water and Direct Expansion.
- Inlet FluidSeg: Defines the inlet/supply-side fluid segment of hydronic coils.
- Outlet FluidSeg: Defines the outlet/return-side fluid segment of hydronic coils

- SEER (Input): The Seasonal Energy Efficiency Ratio (SEER) is a term used to describe the seasonal performance of a DX cooling system. It is determined in accordance with AHRI standards.
- EER (Input): The cooling efficiency of a direct expansion (DX) cooling system at AHRI rated conditions.
- Capacity section
    - Gross Capacity (Total): The gross total (both sensible and latent) cooling capacity of a cooling coil or packaged DX system at AHRI rating conditions.
        - The gross capacity is the total cooling capacity without adjustments for fan heat.
    - Design Flow Rate: The rate of water moving through the coil.

4.11.2.3 Cooling Coil (Direct Expansion)

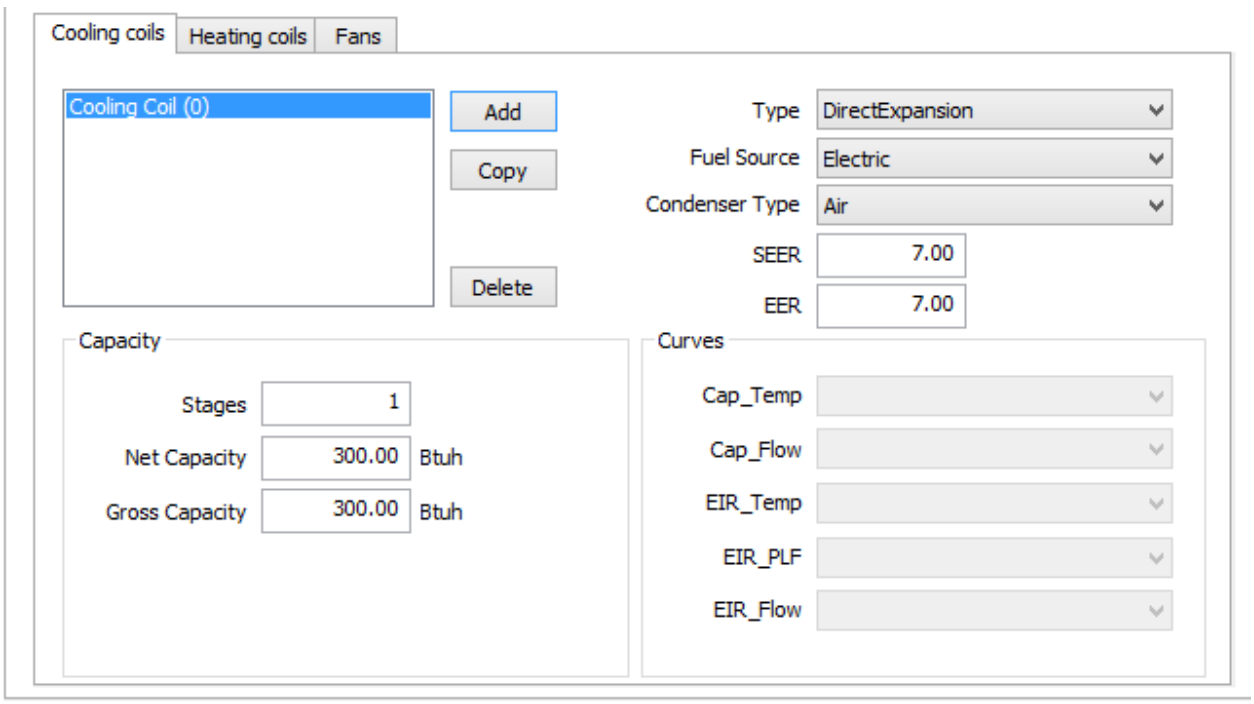


Figure 56 – Cooling Coil (Direct Expansion) Input Dialog

Input summary:

- Type: The type of cooling coil. Options available are Chilled Water and Direct Expansion.
- Fuel Source: Electric is the only source of fuel for direct expansion
- Condenser Type: The type of condenser for a direct expansion (DX) cooling system. Options available are Air, Evaporatively Cooled, Water Source, Groundwater Source and Ground Source
- SEER (Input): The Seasonal Energy Efficiency Ratio (SEER) is a term used to describe the seasonal performance of a DX cooling system. It is determined in accordance with AHRI standards
- EER (Input): The cooling efficiency of a direct expansion (DX) cooling system at AHRI rated conditions

- Stages: The number of mechanical cooling stages for a DX cooling coil. This applies to DX systems with more than one stage of DX cooling. This system is typically a packaged unit with multiple compressors and a two-speed or variable-speed fan.
- Net Capacity: The net total (both sensible and latent) cooling capacity (both sensible and latent) of a cooling coil in unitary system at AHRI conditions.
    - The net capacity is the total cooling capacity of the coil after adjusting for fan heat at rated conditions.
- Gross Capacity: The gross total (both sensible and latent) cooling capacity of a cooling coil or packaged DX system at AHRI rating conditions.
    - The gross capacity is the total cooling capacity without adjustments for fan heat.

4.11.2.4 Heating Coil (Hot Water, Steam)

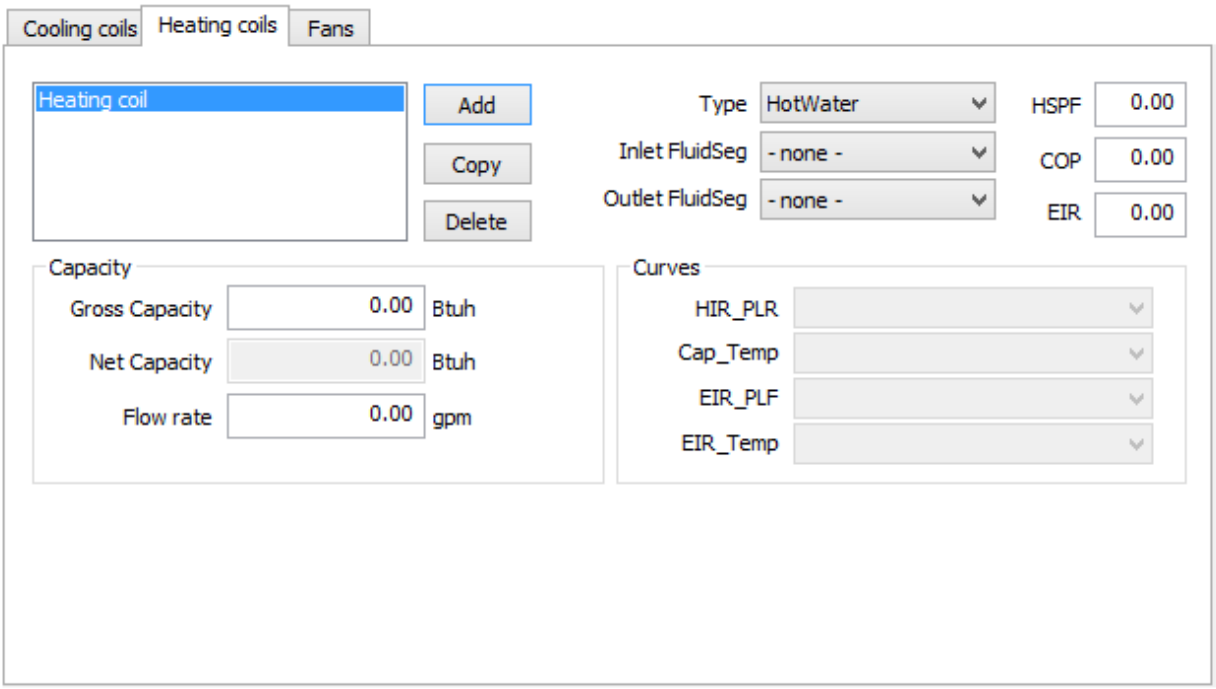


Figure 57 – Heating Coil (Hot Water, Steam) Input Dialog

Input summary:

- Type: The type of heating coil. Options are Resistance, Furnace, Heat Pump, Hot Water and Steam
- Inlet FluidSeg: Defines the inlet/supply-side fluid segment of hydronic/steam coils
- Outlet FluidSeg: Defines the outlet/return-side fluid segment of hydronic/steam coils
- HSPF (Input): The Heating Season Performance Factor (HSPF) is an indicator of expected, average seasonal heat pump efficiency. It is determined in accordance with AHRI Standards.
- COP (Input): The heating efficiency of a heat pump at AHRI rated conditions
- EIR (Input): The heating efficiency of a heat pump heating coil, described for simulation purposes. Energy Input Ratio (EIR) is the inverse of the COP
- Capacity section

- Gross Capacity: The gross heating capacity of the coil at AHRI conditions without adjustments for fan heat
- Flow Rate: The design water volume flow rate (gpm) through the coil

4.11.2.5 Heating Coil (Resistance, Furnace, Heat Pump)

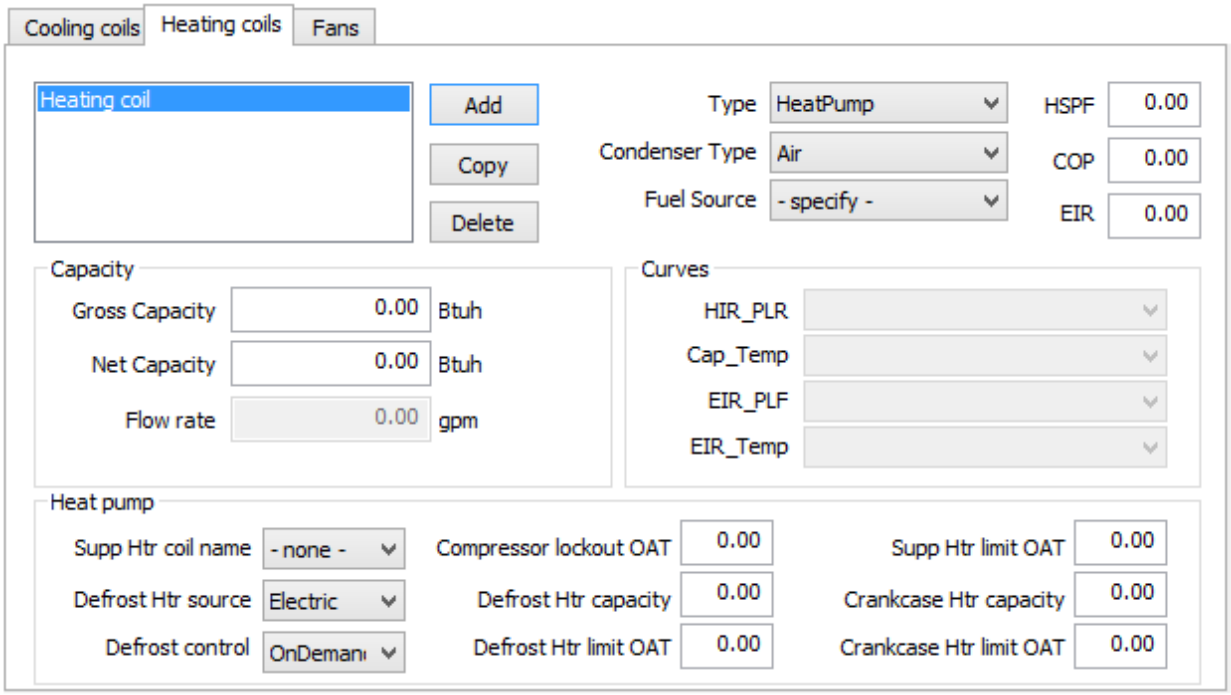


Figure 58 – Heating Coil (Resistance, Furnace, Heat Pump) Input Dialog

Input summary:

- Type: The type of heating coil. Options are Resistance, Furnace, Heat Pump, Hot Water and Steam
- Condenser Type: The type of condenser for heat pump heating systems. Options include Air, WaterSource, Groundwater Source and GroundSource
- Fuel Source: The fuel driving the heating coil
- HSPF (Input): The Heating Season Performance Factor (HSPF) is an indicator of expected, average seasonal heat pump efficiency. It is determined in accordance with AHRI Standards
- COP (Input): The heating efficiency of a heat pump at AHRI rated conditions
- EIR (Input): The heating efficiency of a heat pump heating coil, described for simulation purposes. Energy Input Ratio (EIR) is the inverse of the COP
- Gross Capacity: The gross heating capacity of the coil at AHRI conditions without adjustments for fan heat
- Supp Htr Coil Name: Select the Heating Coil
- Compressor Lockout OAT: The outside dry-bulb temperature below which the heat pump supplemental heating is allowed to operate
- Supp Htr Limit OAT: The outside dry-bulb temperature below which the heating coil is allowed to operate

- Defrost Htr Source: The fuel used for defrosting the evaporator
- Defrost Htr Capacity: The designed power of the defrost
- Defrost Control: Select if defrost operates at a specific time or when required
- Defrost Htr Limit OAT: The outside dry-bulb temperature below, which the defrost is allowed to operate
- Crankcase Htr Capacity: The designed power of the crankcase heater
- Crankcase Htr Limit OAT: The outside dry-bulb temperature below which the crankcase heater is allowed to operate
- AFUE (Input): The Annual Fuel Utilization Efficiency (AFUE) is an indicator of expected, seasonal furnace efficiency. It is determined in accordance with DOE Test Standards
- Thermal Eff (Input): The heating efficiency of a furnace at AHRI rated conditions
- Ignition Type: The method used to start combustion in fuel-fired furnaces
- Pilot Fuel Input: The fuel input for a pilot light on a furnace

4.11.2.6 Fans

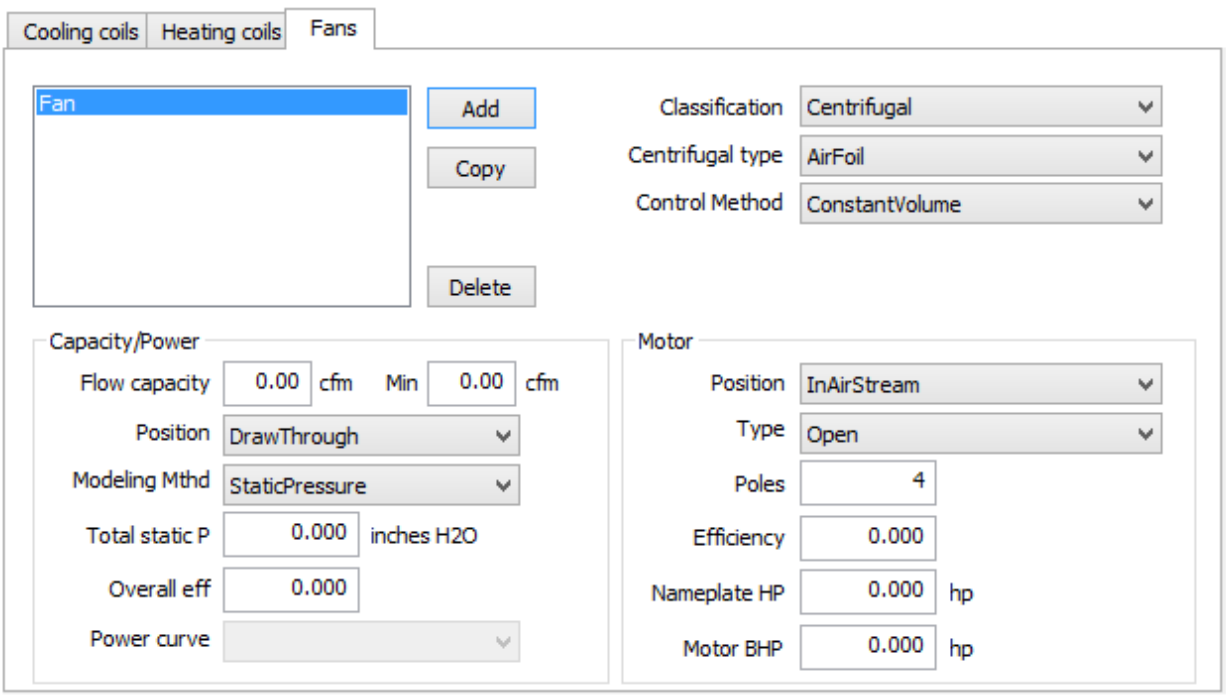


Figure 59 – Fan Data Input Dialog

Input summary:

- Classification: Fan classification based on centrifugal or axial types
- Centrifugal Type: The type of blade type used in a centrifugal fan. Options are AirFoil, BackwardInclined, ForwardCurved
- Control Method: The method used to control fan flow. Options are Constant Volume, VariableSpeedDrive, Dampers and InletVanes
- Capacity/Power section

- Flow Capacity: The design air flow rate of the fan at design conditions
    - This building descriptor sets the 100 percent point for the fan part-load curve. This input should be at least as great as the sum of the design airflow specified for each of the thermal zones that are served by the fan system. For multiple deck systems, a separate entry should be made for each deck
- Min: The lowest flow rate rated for a fan
- Position: The position of the supply fan relative to the cooling coil
- Modeling Method: The method used to describe the design power consumption of a fan. Software commonly models fans in three ways. The simple method is for the user to enter the electric power per unit of flow (W/cfm). This method is commonly used for unitary equipment and other small fan systems. A more detailed method is to model the fan as a system whereby the static pressure, fan efficiency, part-load curve, and motor efficiency are specified at design conditions. A third method is to specify brake horsepower at design conditions instead of fan efficiency and static pressure. This is a variation of the second method whereby brake horsepower is specified in lieu of static pressure and fan efficiency. The latter two methods are commonly used for VAV and other larger fan systems
- Total Static P: The total static pressure drop across the fan at design conditions. The total static pressure (TSP) drop includes the pressure drop across components both internal and external to an air handler. It is important for both fan electric energy usage and fan heat gain calculations
- Overall eff: The efficiency of the fan at design conditions
    - Overall fan efficiency includes belt/drive and fan efficiency, but does not include the efficiency of the fan motor
- Power Curve: A part-load power curve which represents the percentage full-load power draw of the supply fan as a function of the percentage full-load air flow

- Motor Information section
    - Position: The position of the supply fan motor relative to the cooling air stream
    - Type: Defines if the motor is open or closed
    - Pole Count: The number of pole electromagnetic windings in the motor's stator and used to assign MotorEfficiency. Poles are always paired, so PoleCount is always a multiple of 2
    - Efficiency: The efficiency of the motor serving a fan
    - Nameplate HP: The nameplate HP of the fan motor
    - Motor Brake HP: The design motor shaft brake horsepower of the fan
        - The motor brake horse power is the power at the motor shaft, including fan and drive efficiencies

4.11.2.7 Terminal Unit

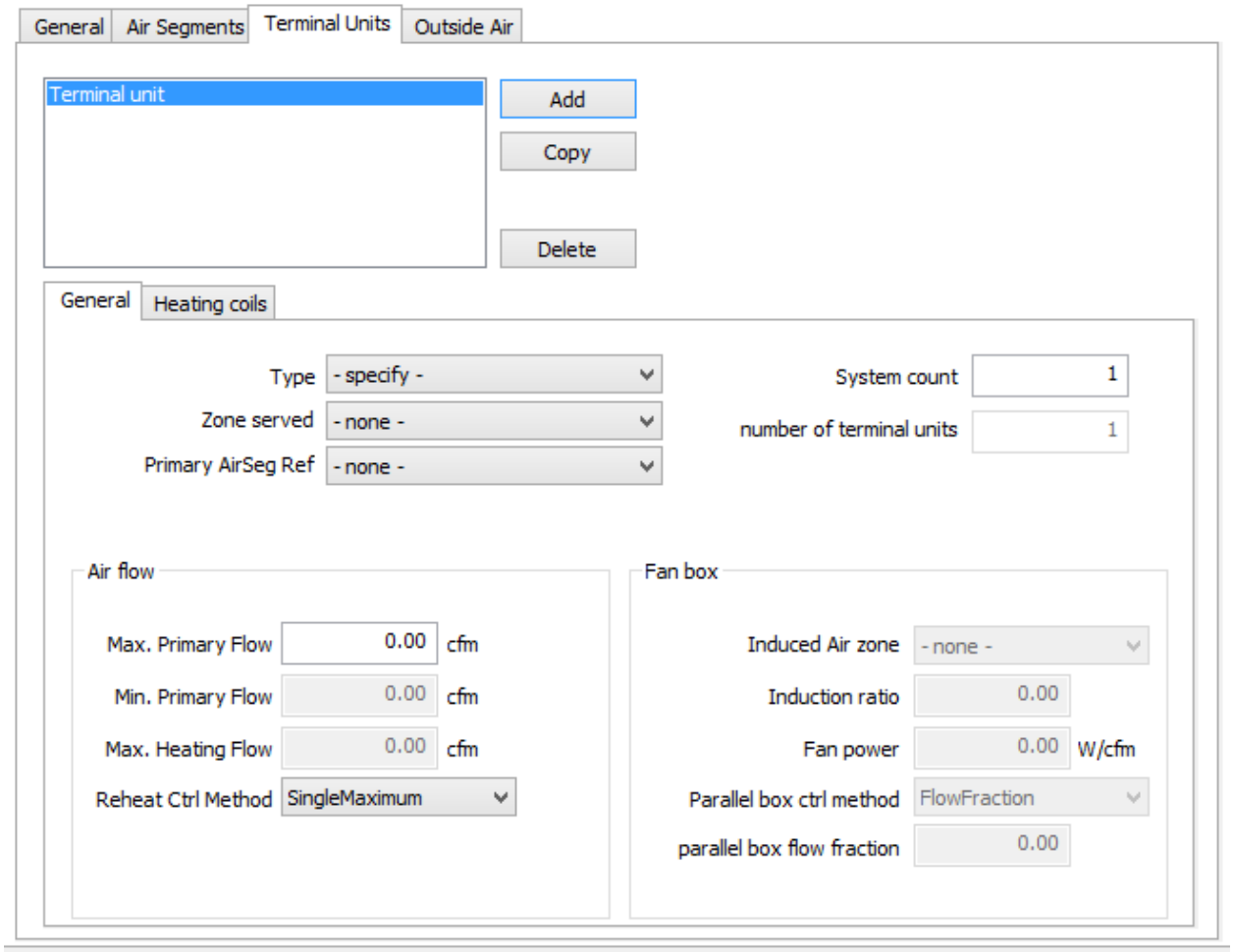


Figure 60 – Terminal Unit Data Input Dialog

Input summary:

- Type: The type of terminal used to deliver and if applicable, regulate air delivery to a thermal zone
- Zone Served: The name of the HVAC zone that the terminal unit provides air to
- Primary AirSeg Ref: Definition of the supply air segment that provides primary air to the terminal unit
- System count: The number of duplicate systems represented by the current system. The number of duplicate systems can only be >1 when all attributes of the system are the same. If Count is specified to be >1, all parameters (capacities, power, etc.) should be specified for the single piece of equipment. The ruleset applies multipliers for the final simulation.
- number of Terminal Units: The number of duplicate terminal units represented by the current terminal unit
- Air Flow section
    - Max. Primary Flow: The zone air delivery rate at design conditions. For uncontrolled terminal units, describes the design air flow rate provided to zones when the system is

on. For VAV systems, specifies the maximum air flow delivered to the zone by the terminal unit.

- Min. Primary Flow: The minimum air flow rate of variable volume terminal units
- Max. Heating Flow: The maximum primary air flow to the terminal in heating mode
- Reheat Ctrl Method: The air/temperature control strategy for VAV reheat box in heating mode. Options available are Single Maximum and Dual Maximum.
    - Single Maximum: The airflow is set to a minimum constant value in both the deadband and heating mode. The minimum airflow setpoint is typically 30 to 50 percent of maximum. This control mode typically has a higher minimum airflow than the minimum used in the dual maximum below, resulting in more frequent reheat.
    - Dual Maximum: Raises the SAT as the first stage of heating, and increases the airflow to the zone as the second stage of heating, as follows:
        - The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no larger than 95°F while the airflow is maintained at the deadband flow rate.
        - The second stage of heating consists of modulating the airflow rate from the deadband flow rate up to the heating maximum flow rate (50 percent of design flow rate)

4.11.2.8 Outside Air Control

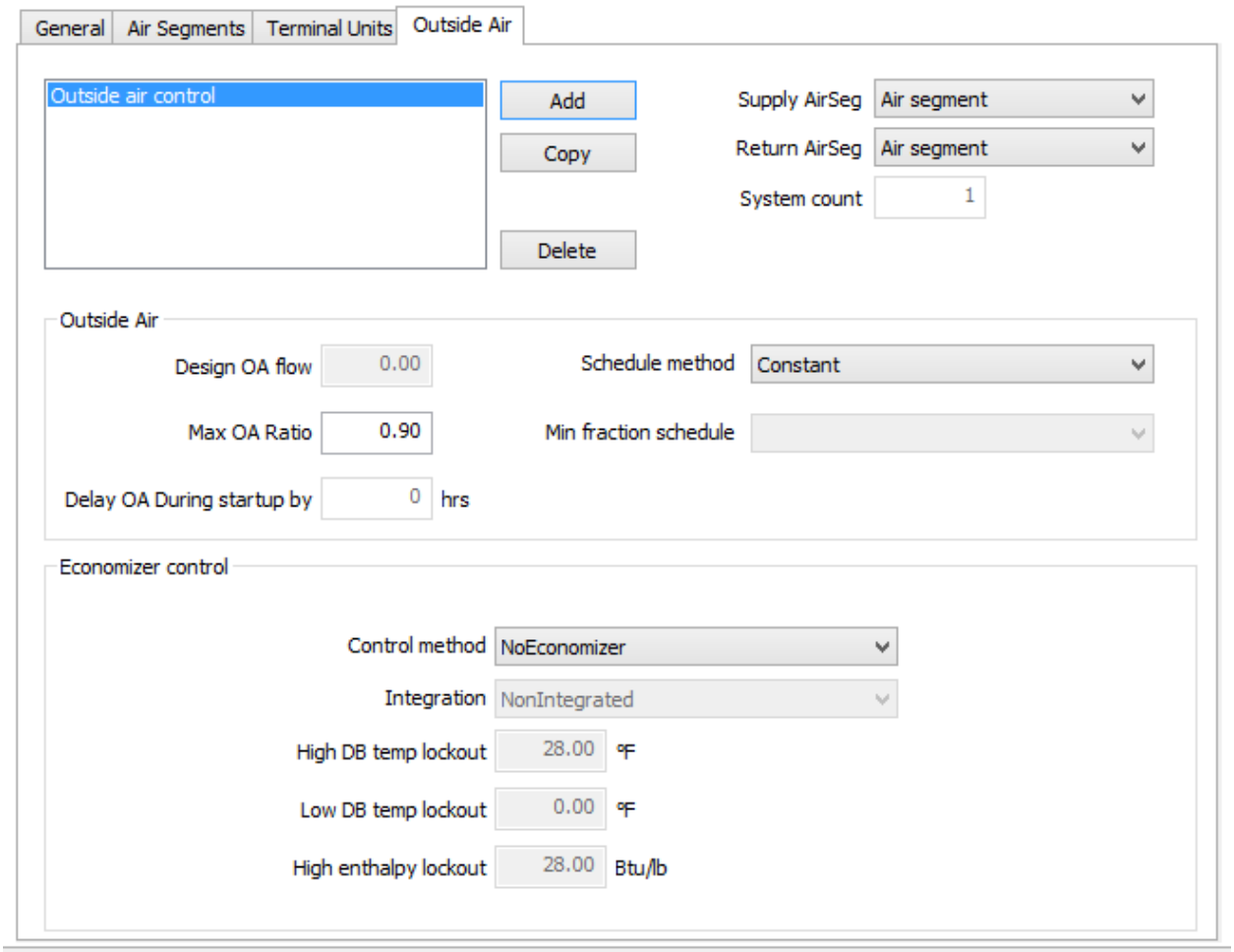


Figure 61 – Outside Air Control Input Dialog

Input summary:

- Supply AirSeg: Defines the supply air segment of the Air System
- Return AirSeg: Defines the return/relief air segment of the Air System
- System count: The number of duplicate systems represented by the current system. The number of duplicate systems can only be >1 when all attributes of the system are the same. If Count is specified to be >1, all parameters (capacities, power, etc.) should be specified for the single piece of equipment. The ruleset applies multipliers for the final simulation
- Outside Air section
    - Design OA Flow (For individual systems, not total if # of systems>1): The rate of outside air that needs to be delivered by the system at design conditions
    - Max OA Flow (For individual systems, not total if # of systems>1): The maximum ratio of outside air that a system can provided, defined as a percentage of the design supply air. Applies to systems with modulating outside air dampers. Economizers for smaller systems (<54,000 Btu/h) are assumed to have a restricted intake capacity

- Delay OA During Startup By: If the OAScheduleMethod is 'FollowHVACAvailability', this positive integer value indicates the number of hours that the system outside air flow is zero during system start up
- Schedule Method: The method used to describe the minimum amount of ventilation (outdoor) air that is provided by the system
- Min Fraction schedule: A schedule that defines the minimum outdoor air flow rate as a fraction of total system airflow

- Economizer Controls section
  - Control method: The method used to control the air-side economizer. An air-side economizer increases outside air ventilation during periods when mechanical cooling loads can be reduced by increasing outside airflow. The control types include:
    - No economizer: Fixed outside are fraction at the system's design outside air flow when the system fan runs
    - Fixed dry-bulb: The system shifts to 100 percent outside air and shuts off the cooling when the temperature of the outside air is equal to or lower than the supply air temperature
    - Differential dry-bulb: The system shifts to 100 percent outside air when the temperature of the outside air is lower than the return air temperature but continues to operate the cooling system until outside air temperature reaches the supply air temperature
    - Differential enthalpy: The system shifts to 100 percent outside air when the enthalpy of the outside air is lower than the return air enthalpy but continues to operate the cooling system until the outside air enthalpy reaches the supply air enthalpy
    - Differential enthalpy and dry-bulb: Utilizes combination of both the DifferentialDryBulb and DifferentialEnthalpy economizer control strategies
  - Integration: Specifies whether or not the economizer is integrated with mechanical cooling. Options include:
    - NonIntegrated: The system runs the economizer as the first stage of cooling. When the economizer is unable to meet the load, the economizer returns the outside air damper to the minimum position and the compressor turns on as the second stage of cooling
    - Integrated: The system can operate with the economizer fully open to outside air and mechanical cooling active (compressor running) simultaneously, even on the lowest cooling stage
  - High DB Temp Lockout: The outside air drybulb temperature above which the economizer will return to its minimum position
  - Low DB Temp Lockout: The outside air drybulb temperature below which the economizer will return to its minimum position
  - High Enthalpy Lockout: The outside air drybulb temperature above which the economizer will return to its minimum position

5 Special Features and Modeling Assumptions

5.1 Modeling Assumptions

The IES VE uses the concept of three parallel sets of input for a single building modeled for compliance.

1. The user model is the set of inputs entered by the user that reflect the actual specification of the as-designed building.
2. The proposed model is generated by the software and applies modeling constraints to user inputs, when needed, for use in compliance. Values of prescribed inputs such as schedules or equipment power density are overridden with inputs to follow the rules in the ACM Reference Manual.
3. The standard design model is the baseline for comparison.

The modeling rules and input restrictions are defined in detail in the ACM Reference Manual, available on the California Energy Commission website.

6 Field Verification

The following list of features must be verified in the field.

- NRFC rating for Fenestration
- Thermal performance of Window Films. For details refer NA7 of 2013 Nonresidential Appendices
- Thermal performance of Dynamic Glazing. For details refer NA7 of 2013 Nonresidential Appendices
- Lighting Controls installed to earn a Power Adjustment Factor (PAF) in accordance with Section 140.6(a) 2. For details refer NA7 of 2013 Nonresidential Appendices
- Lighting for a Videoconferencing Studio in accordance with Exception to Section 140.6(a)3T. For details refer NA7 of 2013 Nonresidential Appendices
- Kitchen Exhaust Systems with Type I Hood Systems. For details refer NA7 of 2013 Nonresidential Appendices
- Fault Detection and Diagnostic Systems - this is a mandatory feature for systems with capacity of 54,000 Btu/h and above
- DHW Distribution Diagnostic Testing- Duct System Leakage Diagnostic Testing - Duct leakage testing for systems serving less than 5,000 ft2 of space that have ducts in unconditioned space. Refer to NA2 for field test details. To claim the prescriptive required leakage level (6%) or lower, the tests in Reference Appendix NA2 must be completed. Otherwise, a higher default level is assumed in the compliance model
- Low Leakage Air- handling Unit verification

7 Checklist for Compliance Submittal

The IES VE will produce the Certificate of Compliance for the Nonresidential Performance Compliance Method, NRCC-PRF-01-E, which meets the requirements of a compliance submittal.

Note: Please check Compliance Statement to make sure that the version you are using has been certified by the California Energy Commission to show compliance with California's 2013 Building Energy Efficiency Standards.

8 Sample Compliance Documentation

See below for copy of NRCC-PRF-01-E

Two examples are provided:

1. 100006-RetlStrp-BaselinePTAC – is a sample project of a strip mall using PTAC units
2. 030006-OffMed-Baseline – is a sample project of a medium office using PVAV system with DX cooling and a central boiler system

9 Compliance Statement

IES VE 2013, Title 24 Feature Pack may not be used to show compliance with California's 2013 Building Energy Efficiency Standards using CBECC-Com 2013-v1.0F.

10 Related Publications

The following documents provide the basis for compliance with the 2013 Standards:

- 2013 Building Energy Efficiency Standards (http://www.energy.ca.gov/2012publications/CEC-400-2012-004/CEC-400-2012-004-CMF.pdf)
- 2013 Nonresidential Alternate Calculation Method Reference Manual (http://www.energy.ca.gov/2013publications/CEC-400-2013-004/CEC-400-2013-004-CMF.pdf)
- 2013 Nonresidential Compliance Manual (http://www.energy.ca.gov/2013publications/CEC-400-2013-002/CEC-400-2013-002-CMF.pdf)
- 2012 Appliance Efficiency Regulations (http://www.energy.ca.gov/2012publications/CEC-400-2012-019/CEC-400-2012-019-CMF.pdf)
- Reference Nonresidential Appendices (http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF.pdf)
- Reference Joint Appendices (http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF.pdf)

11 - 100006-RetlStrp-BaselinePTAC

12 - 030006-OffMed-Baseline