Energy modeling in IDA ICE according to ASHRAE 90.1-2010, app. G

Content

About this document

This document is a user's guide for a relatively experienced IDA ICE operator for using the 90.1 add-in and for performing a correct energy modelling study for LEED or BREEAM. It outlines the steps in the modelling process but does not fully document ASHRAE 90.1 requirements, nor does it alleviate the user's need to be familiar with official ASHRAE 90.1 documentation.

It can also serve as supporting evidence to be sent to a reviewer in order to document the modelling process and IDA ICE software.

The Proposed Building Model (PBM)

To start a new A901 simulation study, the user must select New from the File menu, then IDA ICE, then Building, ASHRAE 90.1-2010 Proposed Building. The template contains the appropriate energy meters and uses the correct area definition, including both internal and external walls (for gross floor area, see system parameter FLOOR_AREA_METRIC).

The following requirements apply to the Proposed Building Model (PBM):
- The PBM should be consistent with the design documents. With a few exceptions, some of which are listed here, this model should represent the actual design (see Table G3.1 in the standard for all details).
- All energy use (end-use load components) within or associated with the building should be modelled. Energy meters inserted in the template include interior lighting, exterior lighting, space heating, space cooling, heat rejection, fans interior, fans parking garage, pumps, receptacle equipment, elevators and escalators, miscellaneous process equipment, and service water heating. The user must make sure the appropriate meter is used for each point of consumption.
- Thermal zoning. Some special rules apply to the way the PBM should be zoned (see Table G3.1.7-9, since the details are not examined here). Zone multipliers may be used when it makes physical sense and when appropriate space use can still be specified, i.e. spaces with different use may not be combined.
- All conditioned spaces must be simulated as being both heated and cooled even if no heating or cooling system will be installed in the actual building (except if HVAC systems 9 or 10 are used).
- Zones are not allowed to drift in temperature during unoccupied periods, i.e. heating and cooling equipment should be modelled to maintain setpoints, even if this is not the case in the actual design. The PBM may not have more than 300 Unmet Load Hours, even if the actual design does.
- Roof surface reflectivity shall be modelled with a reflectance of 0.3. This must be set manually in the PBM.
- Pipe losses shall not be modelled.

Once the PBM has been defined, operators should perform a yearly simulation using the Energy Run button on the Simulation tab. Users should ensure that the number of Unmet Load Hours does not exceed 300. Total Unmet Load Hours for the building is presented in the Report that is generated when the user clicks the Report button in the ASHRAE 90.1 tab (Note that the report is only generated if both the PBM and the BBM's has been simulated). Unmet Load Hours for each zone may be found under the Summary tab.

Input for generation of the Baseline Building Model (BBM)

Users should start by filling in the basic building information in the ASHRAE 90.1 tab. This information will be used when the BBM is generated.
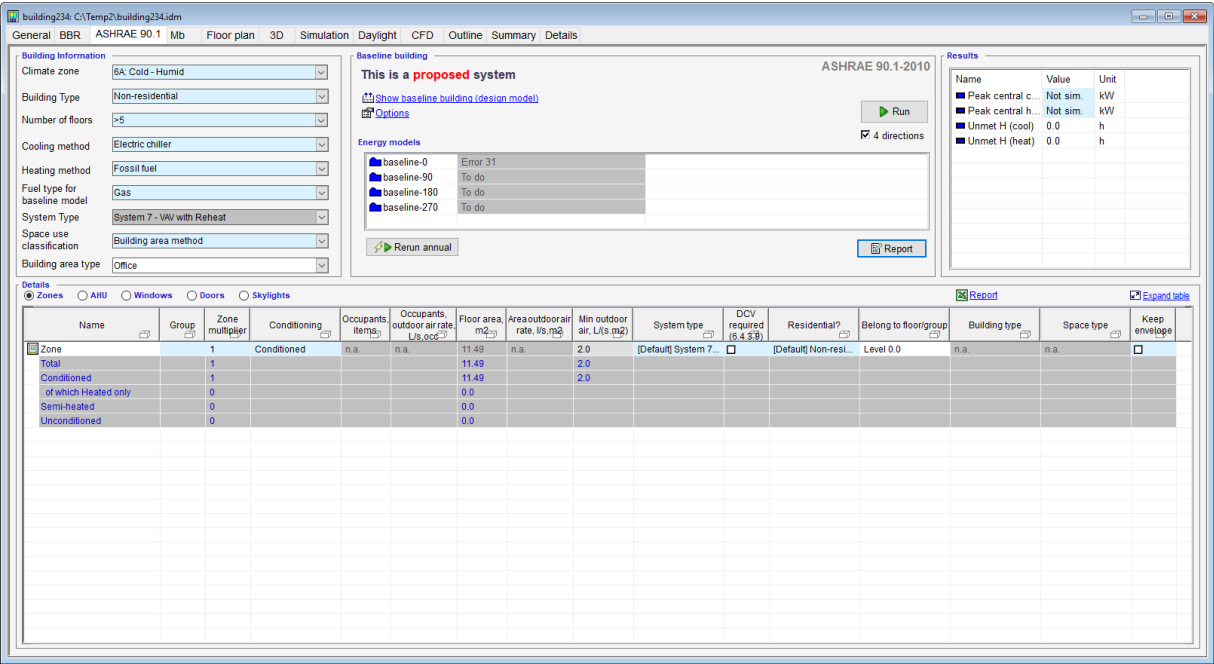
Building information

Climate zone	See Table B1, B2, B3, and B4 in ASHRAE 90.1-2010.
	The choice of climate zone will influence the performance of the building envelope, illustrating whether economizers will be inserted in the AHUs as well as indicating their high limit shutoff.
Building type	The building type will influence the performance of the building envelope and the HVAC system type. Each zone can individually be assigned to another building type (see the Details-Zones list).
Number of floors	The number of floors will influence the HVAC system type.
Cooling method	The "Purchased chilled water" option can be used as described in G3.1.1.2 and G3.1.1.3.
Heating method	The heating method will influence the HVAC system type. The "Purchased heat" option can be used as described in G3.1.1.1 and G3.1.1.3.
Fuel type	Boiler efficiency will depend on fuel type as described by Table 6.8.1F.
System type	The main system type for the building is set automatically depending on the aforementioned choices described in Table G3.1.1A. It can also be selected manually. Each zone can individually be assigned to another system type (see the Details-A901-ZONES list). Use this if any of the exceptions under G3.1.1 apply.
Space use classification	Select whether to use the Building Area Method (BAM) or the Space by Space Method (SSM) as described in Table G3.1.3, Space use classification in the standard. For the BAM, the building area type should be selected

(see next item on this list). Table 9.5.1 in the standard is included in the IDA ICE database.

For the SSM, the space type should be selected on the zone level (see the Details-Zones tab) and in this case, the building area type menu is disabled. Table 9.6.1 is included in the IDA ICE database.

More than one single building type category may be used in a building if it is a mixed-use facility. In this case select mixed-use building and a default building area type. On the zone level (Details-Zones tab), select the appropriate building type for each zone.

NOTE: Use View-Refresh to update fields after each selection.

Building area type	If the BAM or mixed-use building alternatives were selected in the space use classification pull-down menu, the building area type should be selected here. If SSM is selected, this menu will be disabled. In this case, the space type should be selected on the zone level (see the Details-Zones tab).

Baseline building-Options

Remove shadings	User should select which type of shading objects that should be removed as the Baseline building is generated. The default-values are based on Table G3.1.5 and Table G3.1.14 but the user might want to change the defaults.

Details-Zones

Conditioning	Operators should decide whether the zone is Conditioned, Semi-heated, Unconditioned or Heated only. This will influence the performance of the zone envelope and will determine whether the zone will be part of the "served area" (which, in turn, will dictate the number of boilers, chillers, types of chiller, and pumping system configuration as described by G3.1.3.2, G3.1.3.5, and G3.1.3.10). Zones that are "Heated only" will use System 9 and 10 depending on Heating method (see addendum dn to ASHRAE 90.1-2007 where System 9 and 10 are named System 10 and 11 respectively). Semi-heated and unconditioned zones will not be automatically sized and will not be connected to the BBM HVAC system (but rather, they will keep the same systems as in the PBM). Note that zones that are unconditioned in the BBM cannot be conditioned in the PBM. This might, for some configurations, lead to controlled errors. Unconditioned zones will keep the same lighting power density as in the PBM. See definitions in the standard ASHRAE 90.1-2010.
Occupants	Number of occupants in the zone. Used to calculate "Minimum outdoor air" if not constant air volume (CAV) is selected for the PBM. The parameter may manually be changed.
Occupant's outdoor air rate	Used to calculate "Minimum outdoor air" if not constant air volume (CAV) is selected for the PBM. The parameter may manually be changed. By default the parameter is set to 7 l/s,occupant (default-value from EN15251; category II).

Floor area	Zone gross floor area. Used to calculate "Minimum outdoor air" if not constant air volume (CAV) is selected for the PBM. The parameter may manually be changed.
Area outdoor air rate	Used to calculate "Minimum outdoor air" if not constant air volume (CAV) is selected for the PBM. The parameter may manually be changed. By default the parameter is set to 0.35 l/s,m2 (default-value from EN15251; category II, very low polluting building).
Minimum outdoor air	Users should insert the minimum outdoor air (l/s, m2) for each zone. The baseline building should have the same minimum outdoor air flow rate as the proposed building (some Exceptions might apply, see G3.1.2.6). The sum of the minimum outdoor air for all zones supplied by one AHU will be the minimum outdoor air (l/s) for that AHU´s economizer. If CAV is used in the PBM zone then the default-value is inherited from Supply air flow (l/s,m2) in the PBM. If not CAV is used it is calculated out of the number of occupant's, the occupant's outdoor air rate, the floor area and the area outdoor air rate in the preceding columns.
System type	The user should select a zone specific HVAC system type if any of the exceptions in G3.1.1 apply.
DCV required (6.4.3.9)	If DCV is required according to the paragraph 6.4.3.9 in the standard (Ventilation Controls for High-Occupancy Areas) the user should check this box so that DCV is included in the BBM zone. The zone air flow will then be modulated to maintain the set point of the zone CO_2-level (max set-point), the zone cooling set-point (if possible to cool with supply air) and the zone heating set-point (if possible to heat with supply air downstream the reheat coil).
Residential?	A general building type is selected from the building level (see "Building type" above). A different type may be selected for each zone. The default value is equal to the type selected from the building level. NOTE: Use View-Refresh to update fields after each selection.
Belong to floor/group	For System 5, 6, 7, 8, 9 and 10 each floor in the baseline building should be modelled with a separate HVAC system (see G3.1.1). Default in this cell is the zone floor level in IDA ICE. If two floors are close, the operator might opt to feed them from the same HVAC system; this can be done by manually assigning a floor level to the zones. Note: this will not influence the zone's actual location in the building. This parameter is only used to decide from which HVAC system the zone should be supplied.
Building type	Explained above (space use classification/building area type).
Space type	Explained above (space use classification/building area type).
Keep envelope	The user should decide whether the envelope properties in the baseline models should be kept as in the proposed model or transformed as required by the standard. The default value is "No," which means the baseline model will be assigned properties according to the standard (the envelope is <u>not</u> kept). Also, thermal bridges will be kept in this instance.

Details-AHU

Name	System type	Number of zones	Served area	Fan operation	pSup/pFan ratio	Heat recovery	Economizer	DOAS in PB?	BB airflow through device, L/s	dP, Fully ducted return/exhaust, Pa	dP, Return/exhaust control, Pa	dP, Exhaust treatment, Pa	dP, Particulate filtration credit, Pa	dp, Gas cleaners, Pa	dp, Biosafety cabinet, Pa	dp, Heat recovery, Pa	dp, Coil Runaround Loop, Pa	dp, Evaporative..., Pa	dp, Sound attenuation, OutExh, Pa	dp, Sound attenuation, Sup/..Pa	dp, Exhaust system servi...Pa	dp, Laboratory and vivari...Pa	Fan energy m
Level 0.0	7	1.0	11.49	Always on	0.5	AUTO	AUTO	True	22.98	125	0	0.0	125.0	0.0	0.0	0.0	0	0.0	38	38	0	0.0	[Default] Fans -
Total		1.0	11.49																				

Under the Details-AHU-list, the HVAC systems that will be generated in the baseline building are listed. They are named after the floor level that they will supply (system 5-10) or the zone they will supply (system 1-4).

Number of zones — The number of zones supplied by the system is listed automatically.

Fan operation — The fan operation schedule for the BBM HVAC systems should be specified. The schedule should be the same as in the proposed building.

pSup/pFan ratio — The system fan power (Pfan) is calculated for each HVAC system as described in G3.1.2.10 and Table G3.1.2.9. In this cell, the user must specify the size (ratio) of the supply fan compared to the total system fan power in the proposed case. When combined with the calculated system fan power, this information is used to set the size of the fans in the BBM.

Heat recovery — If the AUTO option is selected, a heat exchanger (with 50% recovery effectiveness) will be inserted as described by G3.1.2.11 and 6.5.6.1. If any of the exceptions under 6.5.6.1 apply, the heat exchanger can be left out by selecting the "No" option.

Economizer — If the AUTO option is selected, an economizer will be inserted if required according to Table G3.1.2.6A. The economizer will get the high limit shutoff according to Table G3.1.2.6B. If any of the exceptions under G3.1.2.7 apply, the economizer can be left out by selecting the "No" option.

Pressure drop adjustments — In the following columns, a number of pressure drop adjustments (PDA's) can be specified. These are used for calculating the system fan power (G3.1.2.10). See Table 6.5.3.1.1B Fan Power Limitation Pressure Drop Adjustment in the standard for appropriate input.
If the parameter "DOAS in PB?" is True the air flow rate specified in the column "BB airflow through device" is used for all devices when calculating the PDA. If the parameter "DOAS in PB?" is False the air flow rate specified in the column "BB airflow through device" is used for the devices located between the economizer and the outdoor i.e. heat recovery, runaround coil loop and sound attenuation outdoor/exhaust, when calculating the PDA. All other devices use, in this case, the design supply air flow which is sized automatically. The default value for "BB airflow through device" is the sum of minimum outdoor air for the zones supplied by the AHU but this value may be manually edited.
The PDA's for heat recovery, runaround coil loop and evaporative cooling are only included in the system fan power calculation if there is a heat recovery device in the BBM (may be tested automatically, see above).

Fans energy meter — The operator should decide to which energy meter the fan electricity should be measured.

Details-Windows

Under the Details-Windows list, the user may select the window framing type. Depending on the climate zone—whether the zone is conditioned (or not) and what type of building it is—different U-values will be assigned to the baseline windows as specified in the standard Tables 5.5-1-8. The frame of the window will be given the same U-value as the glazing. Solar heat gain coefficients (SHGC) are assigned as specified in the standard tables. Solar transmittance is assumed to be 80% of SGHC.

Details-Doors

Under the Details-Doors list, the user may select whether the external doors in the buildings are swinging or non-swinging. Depending on the climate zone—whether the zone is conditioned (or not) and what type of building it is—different U-values will be assigned to the baseline doors as specified in the standard Tables 5.5-1-8.

Details-Skylight

Under the Details-Skylight, the user may select whether the Skylight curb is glass or plastic. Depending on the climate zone—whether the zone is conditioned (or not) and what type of building it is—different U-values and SHGC's will be assigned to the baseline skylight as specified in the standard Tables 5.5-1-8.

NOTE: Currently (see date in doc header) the following limitations apply to the IDA ICE A901 add-in:

- The AHUs consequently use relief fans (and not return fans);
- No service hot water system is automatically generated for the Baseline Building Model. In most situations, service water data can be directly copied from proposed building simulation results, but there are exceptions to this rule (see Table G3.1).

Most of the work of constructing the BBM has been automated. Exceptions to this rule are listed below. To generate and then run the baseline model, press Run in the A90.1 tab. Below, the process of quality assuring the generated BBM is explained, and fine tuning the BBM sizing is examined.

Generation of the BBM

The following steps summarize the process of converting the Proposed Building Model to the Baseline Building Model.

Steps	What to do and think about in the add-in
1. Assign appropriate energy meters for end use loads.	Done automatically if the template is used.

2.	Check whether fenestration area is greater than 40% of gross above <u>and below</u> grade wall area. If true, then decrease fenestration area down to 40%. Fenestration area should be distributed in the same proportion as in the proposed building.	Done automatically. Walls in unconditioned zones are not included in the window-to-wall-area calculation. Windows in unconditioned zones are not tested for size reduction.
3.	Check whether skylight area is greater than 5% of gross roof area. If true, then decrease skylight area to 5%.	Done automatically.
4.	Set U-values of roofs, walls above grade, walls below grade, floors, and slab-on-grade floors according to Tables 5.5.1-8.	Done automatically. Note that all thermal bridges are removed. Slab-on-grade floors will have their U-value replaced by an F-factor (check "Loss factor for thermal bridges" in each zone). Walls below grade are assigned values according to Tables 5.5-1-8 even if not listed in Table G3.1.5.
5.	Set U-values and SHGC of vertical fenestration and skylights according to Tables 5.5.1-8.	Done automatically. Frames and skylight construction get the same U-values as glass but keep the same frame fraction as in the proposed building.
6.	Remove building self-shading (all building bodies), window recess depth and all shading projections (both integrated and external).	Done automatically as checked in the boxes under Options-Remove shadings on the ASHRAE 90.1-tab, Baseline building-field.
7.	Adjust lighting power density in accordance with section 9.5.1 or 9.6.1.	Done automatically as requested under "Space use classification" on the ASHRAE 90.1 tab.
8.	Remove automatic lighting control.	Done automatically.
9.	Choose HVAC-systems based on building type, number of floors, conditioned area, and heating source of the proposed building (see Table G3.1.1A). Follow exceptions according to G3.1.1. For system 1-4, each thermal block shall be modelled with its own HVAC system. For system 5-10, each floor shall be modelled with a separate HVAC system.	Without consideration of any possible exceptions, System 1, 2, 3, 4, 5, 6, 7, 8, 9 and System 10 are automatically generated.
10.	Use economizer in system 3-8 if required due to climate zone according to G3.1.2.7.	Done automatically. Exceptions are not tested.
11.	Set high limit shut-off temperature setpoints according to Table G3.1.2.6B.	Done automatically.
12.	Use exhaust air energy recovery in each AHU if required by G3.1.2.11.	Done automatically. Exceptions under 6.5.6.1 are not tested.
13.	Use the same outdoor air ventilation rates as in the proposed building. Set the correct minimum outdoor air in each AHU.	Minimum outdoor air must be manually inserted for each zone in the ASHRAE 90.1 tab (Details-Zones) and shall be equal to the proposed case. The minimum outdoor air for each economizer will be set automatically.
14.	Design the supply fan volume (supply air flow rate) for each AHU. Run a cooling load	Basic sizing process is done automatically.

simulation and use a supply-air-to-room-air-temperature-difference of 11°C. Use the largest of the required supply air flow rate (for cooling) and the required ventilation rate (or if a VAV system, the VAV minimum flow set point). Design the supply fan volume for system 9 and 10 using a design supply air temperature of +40.6°C in the heating case.	Note that the temperature rise over the fan and duct system is set to 0. If design supply air flow rate is equal or less than minimum outdoor air the VAV-system is changed to a CAV-system with a supply air flow rate equal to the minimum outdoor air flow rate. For system 1-4 also the heating case is considered using a design supply air temperature of +40.6°C.
15. Design the relief fan volume (relief air flow rate) for each AHU. It is the largest of the supply air fan quantity minus the minimum outdoor air and 90% of the supply air fan quantity.	Basic sizing process is done automatically. The "rated flow" of the relief fan is equal to the supply fan. The specific fan power is set based on system fan power (Pfan), design supply fan volume and the pSup/pFan ratio.
16. Run heating and cooling load simulations (for four directions or optionally one) and oversize cooling equipment by 15% and heating equipment by 25%. BBM Unmet Load Hours may not exceed 300; also Unmet Load Hours of proposed may not exceed baseline by more than 50 hours.	Basic sizing process is done automatically. See below for instructions on how to fine-tune the baseline model if the requirement on Unmet Load Hours is not met. The oversizing is made on the plant-side.
17. Calculate total system fan power for all fans in each AHU according to G3.1.2.10. Distribute the total fan power in the same proportion as in the proposed building.	Done automatically. The AHUs use relief fans (and not return fans).
18. Service hot water system. Same energy source as in Proposed. Performance according to Table 7.8. Entering water temperature shall be estimated based on the location. Recirculation pump electricity should be calculated explicitly.	Not presently supported in the BBM.
19. Model four directions. 0, 90, 180, and 270 degrees where 0 is equal to proposed orientation.	Done automatically.

Purchased heat and purchased chilled water

If Purchased heat is selected as heating method the systems are modified as described under G3.1.1.1 and G3.1.1.3. The hot water is produced with an efficiency of 100% and the furnace (systems 3 and 9) is replaced with a water-fed heating coil.

If Purchased chilled water is selected as cooling method the systems are modified as described under G3.1.1.2 and G3.1.1.3. The chilled water is produced with an efficiency of 100% and the DX-equipment (system 1, 2, 3 and 4) is replaced by a water-fed cooling coil. System 5 is replaced with system 7 and system 6 is replaced with system 8.
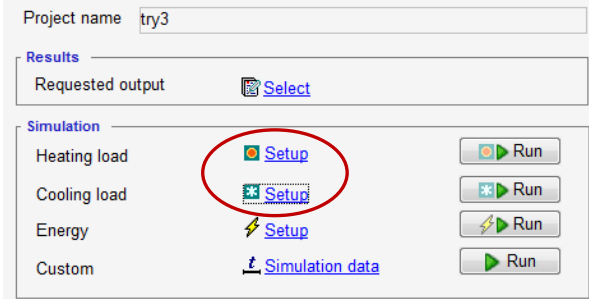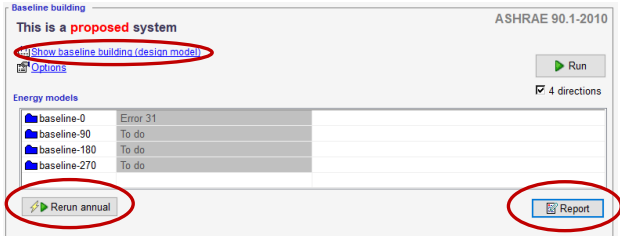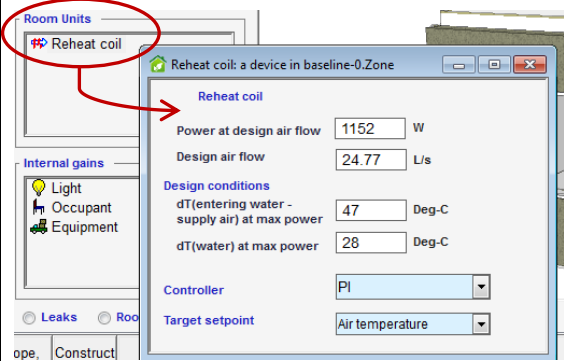
Reset of supply air temperature for system 5, 6, 7 and 8 during cycling

In order to avoid mechanical cooling during cycling (non-occupancy), when no outdoor air is allowed, the supply air temperature set-point is reset to the same value as the average of the heating set-points

of the zones supplied by that system. If any of the supplied zones has a cooling demand during cycling the set-point of the supply air temperature is reset based on that's zone's demand.

Editing the Baseline Building Model

There are three basic ways the user can resize the equipment of the automatically generated BBM:

1. Adjust the parameters, "Percentage of internal gains" in the dialogs for Cooling and Heating of the PBM (see figure 1 at right). Adjusting these, from the 100% and 0% defaults, respectively, will create less severe sizing situations and thereby smaller baseline equipment (and consequently more baseline Unmet Load Hours).	*Figure 1.*
2. Manually edit the design version of the baseline model. View this model by clicking on the link "Show baseline building (design model)" in the A901 tab of the PBM (see figure 2). This is a complete baseline case except for the plant (IDA ICE default plant). Change this model to alter the automatically generated baseline case (in case of errors in the generation process or to cater to features that are not currently supported). In order to continue with the sizing process and generation of the models for each direction, press Run in the A901 tab of the **Baseline design model**.	*Figure 2.*
3. In order to fine-tune sizes of individual pieces of equipment, the user may also edit the four automatically generated baseline energy models. Pressing Run from the A901 tab **of either** the PBM or the baseline design model will generate and then simulate the four baseline energy models. After the annual simulations have been completed, the table of baseline energy models will indicate "Done" for each model. Individual models can be opened, inspected, and edited by double clicking. Unmet Load Hours for each individual zone can be checked in the far right of the summary table of the Result tab. The total for the whole building can be inspected in the report generated when clicking the Report button (see figure 2). In order to optimize each of the four models, equipment sizes of the plant, air	*Figure 3. The size of the reheat coil in each zone (in each baseline direction) may be manually edited. System 7 example.*

handling units, and zone reheat coils (see figure) may be manually edited.

Press Rerun annual (see figure 2) to rerun all four yearly simulations with new equipment sizes. This can be done *either* from the PBM or from the Baseline design model (in case this has been manually edited).

If it is unnecessary to rerun all four models, individual models can be simulated by pressing the Energy Run button in the Simulation tab of the appropriate model.
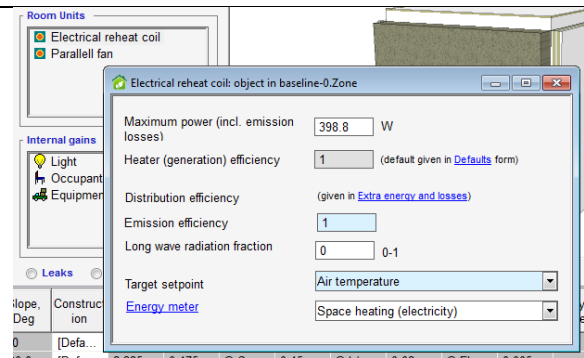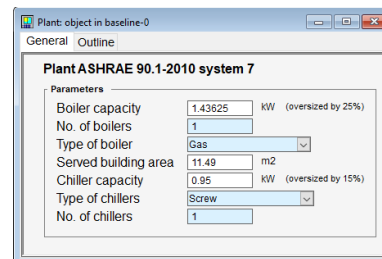

Figure 4. The size of the reheat coil in each zone (in each baseline direction) may be manually edited. System 8 example.

Figure 5. Plant parameters may be manually edited.
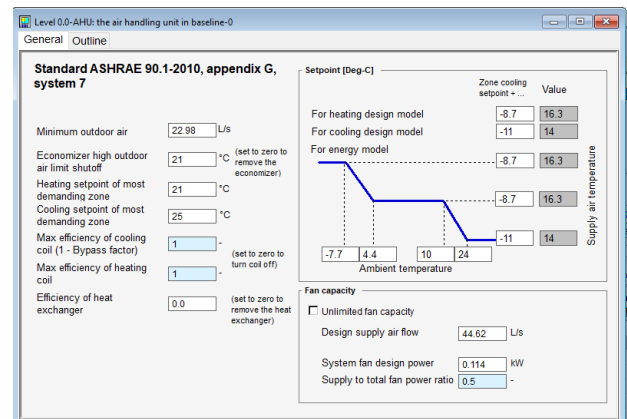
Figure 6. AHU parameters may be manually edited.

Shading of the rotated BBM

When the four directions of the baseline building model is generated, the building body is rotated around origo (look for the icon of the coordinate system in Floor plan). The user should verify in all the baseline-directions that the shading objects are located as expected. The building body may be moved so that origo is located at the center of the building. Note that for many projects the rotation is dictated by site considerations in which case the exception in Table G3.1 5a apply and only the 0-direction need to be simulated. In this case the user should uncheck the check-box "4 directions" on the ASHRAE 90.1-tab so that only the 0-direction is simulated.

Variable set-points

Variable set-points (e.g night set-back) may be used. The variable set-points are then used during both the sizing runs and the annual energy run. The cycling of systems during non-occupancy also utilize the variable set-points.
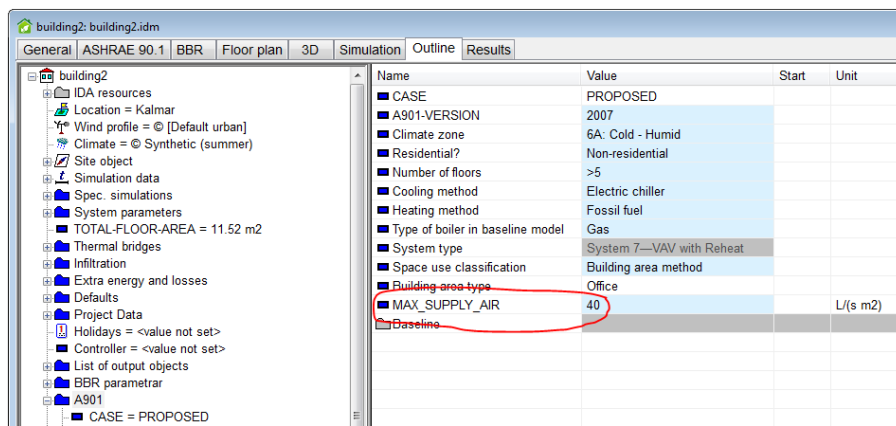
Tolerance for unmet load hour

The tolerance (temperature deviation from setpoint) for an unmet load hour may be changed under Outline-System parameters (see figure below). The default is 1°C.
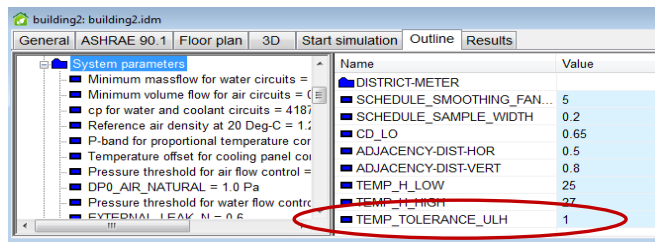
Max air flow rate during sizing runs

The max air flow rate for a cooling design run may be changed under Outline-A901 (see figure below). Default is 40 l/s,m2.

Design supply air flow rate for system 1, 2, 3 and 4

The design supply air flow is, for system 1, 2, 3 and 4, set to the highest of the minimum outdoor air as given by the user, the required supply air flow for the cooling case (using a design supply air temperature of 11°C lower than the space cooling set-point) and the required supply air flow for the heating case (using a design supply air temperature of +40.6°C).

Minimum air flow rate for system 5 and 7 VAV reheat boxes

For the 2010 version the minimum air flow rate for system 5 and 7 is calculated as the max of the following:

1) Minimum outdoor air as given by the user.
2) 30% of the maximum supply air.
3) Minimum supply air for heating at given temperature levels.

Cycling when a single system supplies zones with different set-points

If one system supplies several zones with different set-points the set-point for cycling of that system will be the strictest set-point of the zones supplied.

Sizing of system 9 and 10

Design airflow rates in system 9 and 10 are based on a the temperature difference between a supply air temperature of +40.6°C and the design space heating temperature set-point or the minimum outdoor air, whichever is greater. During the sizing run for heating this might, for some internal zones,

lead to excessive temperatures. To avoid indirect heat to adjacent zones and, as a consequence, undersized heating equipment the zone temperature of such a zone is decreased with ideal coolers.

How to handle thermal blocks (zones) with no floor area

One example of zones that the user might want to exclude from the total floor area calculation is plenums. Excluding floor area for a zone is done by forcing the floor area to a low value (see figure below; a yellow field means the link to the original parameter is broken and replaced by a manually fed value). If a zone has a floor area less than 0.1 m2, the baseline will be treated as:

1) All HVAC systems will be removed
2) All internal loads (occupant, lighting, equipment) will be kept the same as in PBM
3) Unmet Load Hours will not be considered

Name	Floor height, m	Room height, m	Area, m2	Heat setp.,°C	Cool setp.,°C	AHU	System	Supply air, L/sm2	Return air, L/sm2	Occup., no./m2	Lights, W/m2	Equipment, W/m2	Ext area
Zone	0.0	2.6	11.52	21	25	Air Ha...	CAV	2.0	2.0	0.08681	4.34	13.02	1.5
Zone1	0.0	2.6	0.01	21	25	Air Ha...	CAV	2.0	2.0	100.0	5000.0	15000.0	1.5

U-values according to table 5.5-1-8

IDA ICE uses a film heat resistance of 0.13 m2, K/W on the inside and 0.04 m2, K/W on the outside when the U-value for a construction is presented. In ASHRAE 90.1 (appendix A) other resistances are suggested as indicated in the table below. Also the poorest U-values in table 5.5-1-8 for glazing (including frames) and doors will require smaller resistances than IDA ICE uses. The U-values in the Baseline case models are therefore recalculated to agree with the table 5.5-1-8 values but with heat transfer coefficients used for presentation in IDA ICE.

Element¤	Rsi·(m2K/W)¤	Rse·(m2K/W)¤	Rs-tot·(m2K/W)¤
Roof¤	0.11¤	0.03¤	0.14¤
Wall¤	0.12¤	0.03¤	0.15¤
Floor¤	0.16¤	0.08·for·semi-exterior¤	0.24¤
Door¤	(0.09)¤	(0.03)¤	0.12¤
Glazing¤	(0.11)¤	(0.03)¤	0.14¤
Frame¤	(0.11)¤	(0.03)¤	0.14¤
Roof·glazing¤	(0.06)¤	(0.02)¤	0.08¤
Roof·window·frame¤	(0.06)¤	(0.02)¤	0.08¤

Note that the values discussed here are only for presentation. When running the simulation the heat transfer coefficients will vary depending on surface temperatures, ventilation rate (on the inside) and wind direction and speed (on the outside).

Semi-heated zones supplied by water-based systems

Semi-heated zones keep the PBM system if the parameter KEEP_SEMI_HEATED is set to TRUE (can be found under Outline-A901). If the BBM system is non water (system 2, 3, 4, 6, 9, 10) arbitrary PBM systems can be used. If the BBM system is water-based (1, 5, 7, 8) only ideal units can be used in the PBM (IDA ICE cannot generate two different plants at the standard level). The user must in this case use ideal units in the semi-heated zones and ideal coils in the AHU's supplying the semi-heated zones. The ideal AHU coils are named ASH90IHC (heating) and ASH90ICC (cooling) respectively. These coils do not require any plant but can be fed by any energy carrier (similar to ideal heaters and coolers in the zone). The user can manually replace the coils in an AHU with ideal coils.
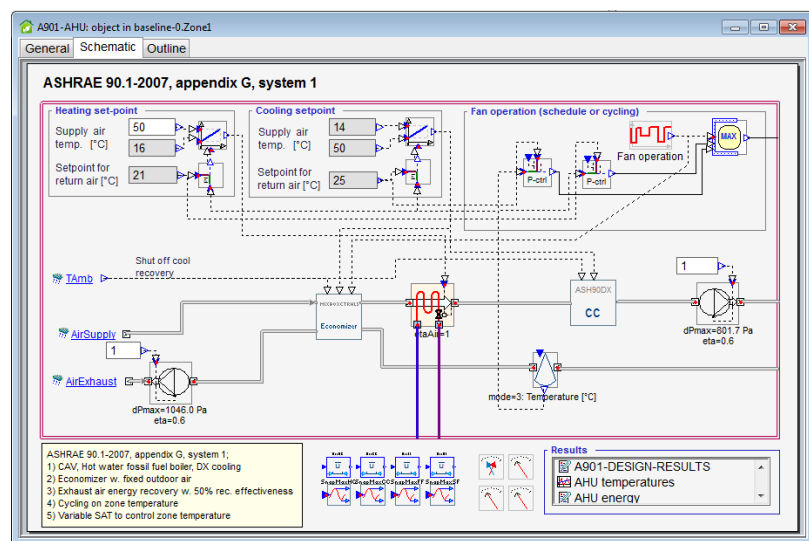
Reporting

A spreadsheet-report with information intended for the USGBC-report Minimum Energy Performance Calculator (MEPC) is generated when clicking the Report button. This sheet does not replace the MEPC. It serves as a complementary sheet that should help the user fill the baseline part of the MEPC as fast and as simply as possible. The user may copy cells from this sheet and paste value only in the MEPC. Note that the PBM and at least one BBM simulation must be performed in order to produce meaningful results.

HVAC System 1, 2, 3, 4, 5 and 6 at the advanced level

Inspecting the HVAC systems at the advanced level supplies more information on components, configuration, and controls.

|	
The System 1 AHU contains economizer with fixed outdoor air ratio, exhaust air energy recovery (not in the figure), fossil fuel boiler fed heating coil, DX-cooling, cycling on zone temperature, part-load performance on fans, and variable supply air temperature.	
The System 2 AHU contains economizer with fixed outdoor air ratio, exhaust air energy recovery (not in the figure), air-source electrical heat pump, DX-cooling, cycling on zone temperature, part-load performance on fans, and variable supply air temperature.	
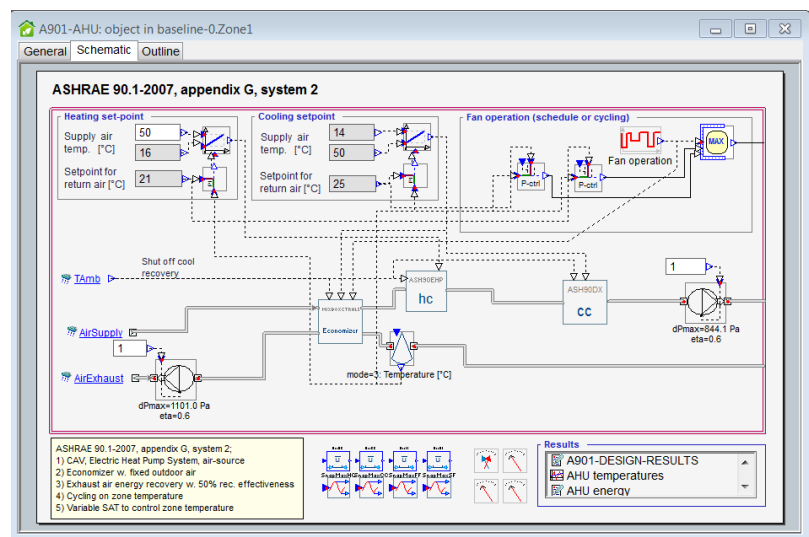
The System 3 AHU contains economizer with control including high limit shut-off, exhaust air energy recovery (not in the figure), fossil fuel furnace, DX-cooling, cycling on zone temperature, part-load performance on fans, and variable supply air temperature.
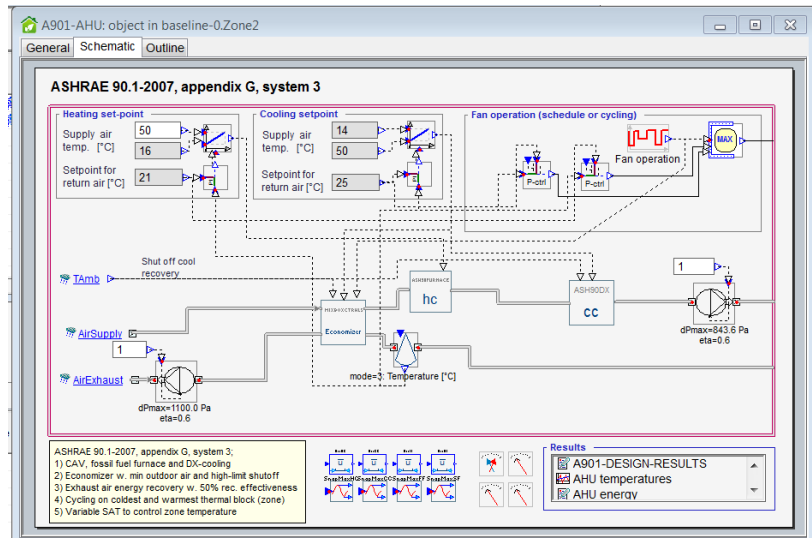
The System 4 AHU contains economizer with control including high limit shut-off, exhaust air energy recovery (not in the figure), air-source electrical heat pump, DX-cooling, cycling on zone temperature, part-load performance on fans, and variable supply air temperature.
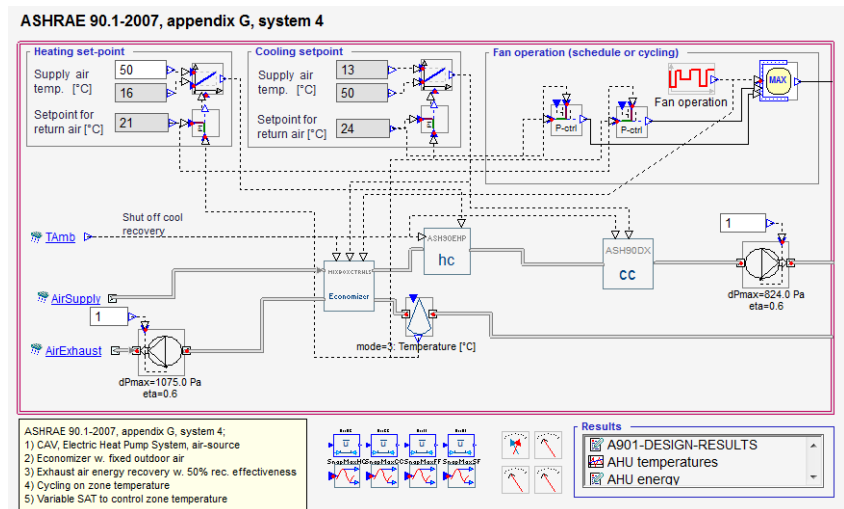
The System 5 AHU contains economizer with control including high limit shut-off, exhaust air energy recovery (not in the figure), fossil fuel boiler fed heating coil, DX-cooling, cycling on zone temperature, part-load performance on fans, and supply air temperature reset schedule as requested by Appendix G.
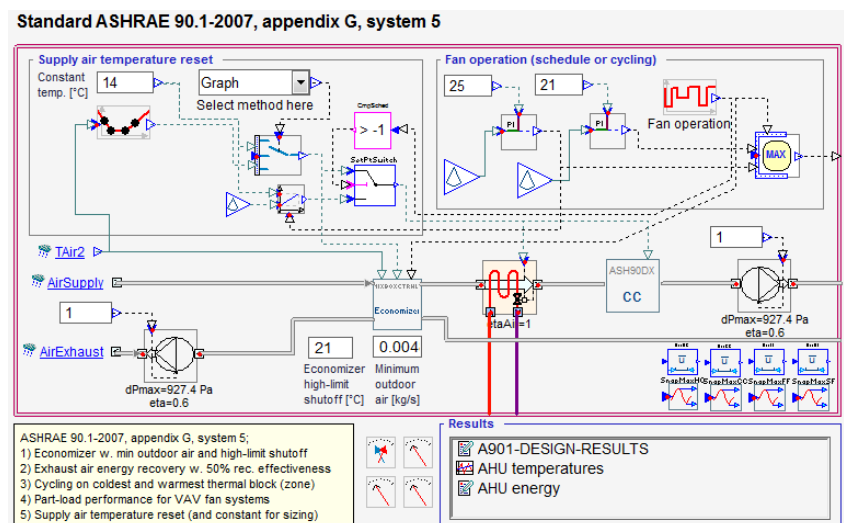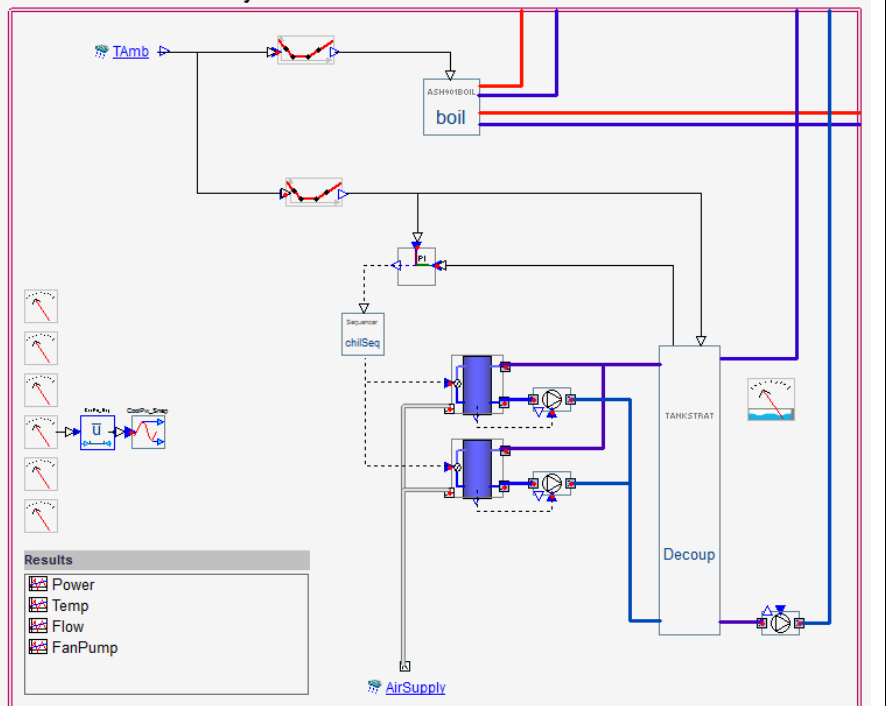
The System 6 AHU contains economizer with control including high limit shut-off, exhaust air energy recovery, electric type heating coil, DX-cooling, cycling on zone temperature (only for cooling, heating is supplied by PFP-boxes in the zones), part-load performance on fans, and supply air temperature reset schedule as requested by Appendix G.
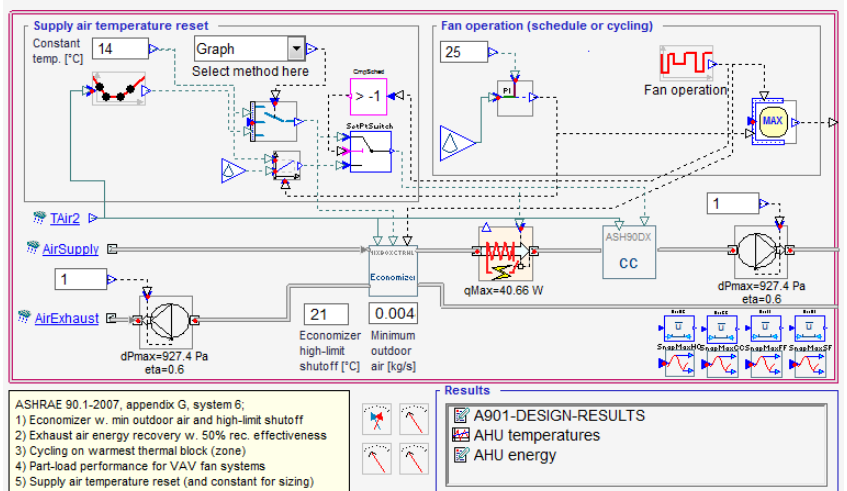
HVAC System 7 and 8 at the advanced level

The System 7 HVAC plant contains boilers and chillers (including cooling towers) and pumping systems all with part-load performance as requested by Appendix G.

In the System 8 case no boiler is included. Electrical coils are used in the AHUs and in reheat boxes.

The System 7 AHU contains economizer with high limit shut off, exhaust air energy recovery, cycling on coldest and warmest zone, part-load performance on fans, and supply air temperature reset schedule as requested by Appendix G.

In the System 8 case, the AHU is similar as in System 7 except for the heating coil, which is of the electrical type. Also cycling is applied only for cooling. Heating is supplied by PFP-boxes in the zones for system 8.
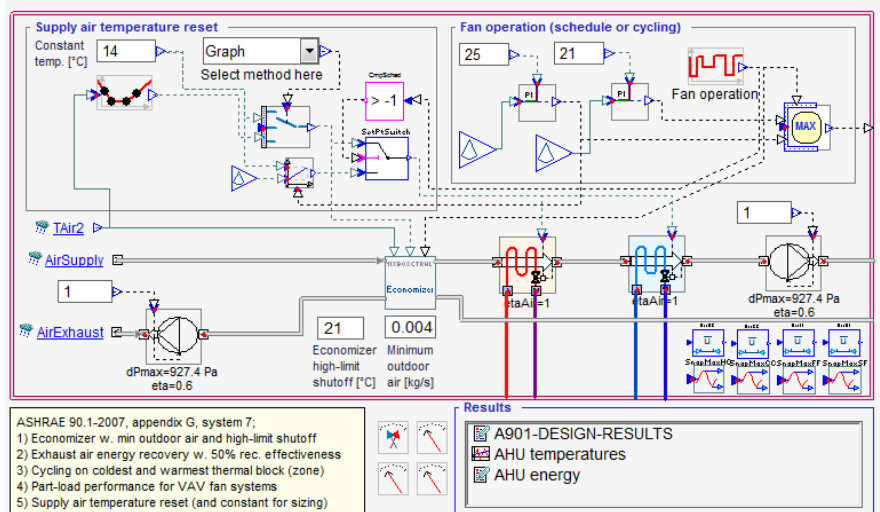

HVAC System 9 and 10 at the advanced level

The System 9 AHU contains a mixing box with fixed outdoor air ratio, exhaust air energy recovery, cycling on coldest zone, part-load performance on fans, and supply air temperature reset schedule to control zone temperature.
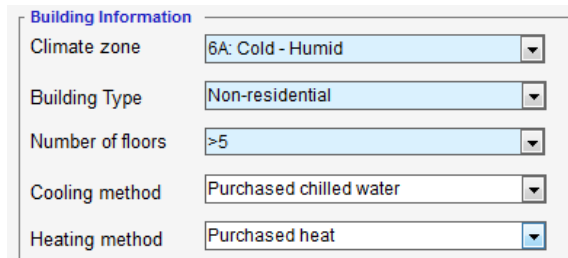
In the System 10 case, the AHU is similar as in System 9 except for the heating coil, which is of the electrical type.
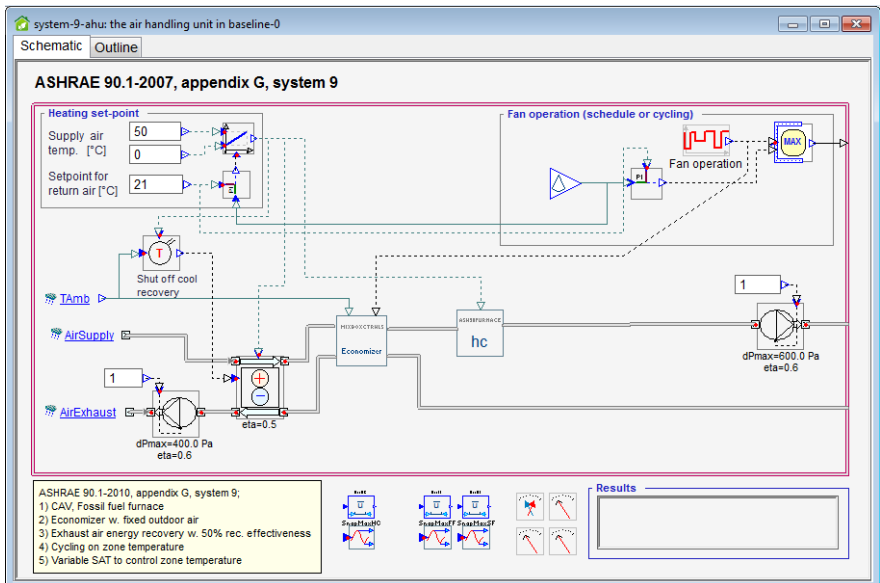
How to handle District Energy Systems (DES)

For district energy systems (DES) follow the paragraphs G3.1.1.1 to G3.1.1.3. The energy source is modelled as purchased heat (if district heating) and purchased chilled water (if district cooling) in both the Proposed and Baseline buildings.

In the IDA ICE add-in, the user should choose "Purchased heat" and "Purchased chilled water" (see figure below). In this case, the report will display the energy delivered to the building under the end uses District Heating and District Cooling respectively. The correct specific pump power will be used.

Another option is to use the document "Treatment of District or Campus Thermal Energy in LEED V2 and LEED 2009 – Design & Construction" (hereafter called the DES-guide). Under this option, the project may benefit from a higher level of efficiency in the district thermal system compared to the efficiency of local boilers and chillers. The DES-guide suggests two options where Option 1 (Building stand-alone scenario) is similar to the approach in the addenda mentioned above. Option 1 has a limited number of points that can be earned. In Option 2 (Aggregate Building/DES Scenario), the Proposed building must be modelled together with a virtual boiler and/or chiller representing the "upstream" DES.

For projects in Europe using LEED version 3 the document, "Treatment of Scandinavian District Energy Systems in LEED" from the Sweden Green Building Council supplies an interesting option. This document describes a method to calculate "performance factors" for "upstream" DES to be used in option 2 described in the DES-guide. This approach is however not, by default, approved for LEED version 4 projects.

For **service water heating** (SWH), the DES should, according to the DES-guide, be hold cost neutral. The energy source should be modelled as purchased energy. The project team may, however, use an exceptional calculation method to document DES-related savings from service water heating.

In the baseline generated by the IDA ICE add-in, no SWH is modelled. The user may add SWH in "Extra energy and losses," in which case the BB will be treated in the same way as the PB.

There is a pilot alternative compliance path (EApc95) using alternative energy performance metrics that may be used in the context of district heating and cooling. Search the USGBC web-site for more information.

How to convert an IDA ICE-model to a Proposed Building Model

In most cases, the user will start with the ASHRAE 90.1 template. In some cases, however, the user may wish to convert an already made IDA ICE-model into a PBM. If this is the case, the user must then take the following steps:
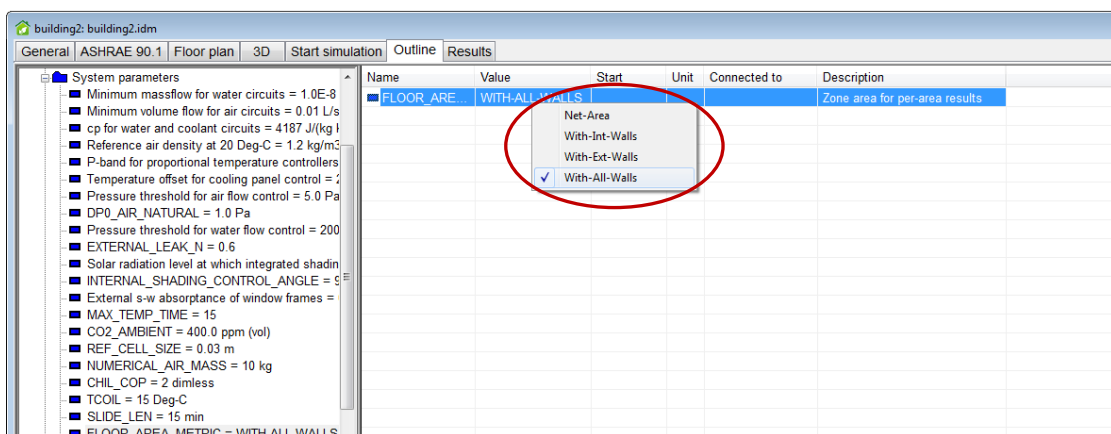
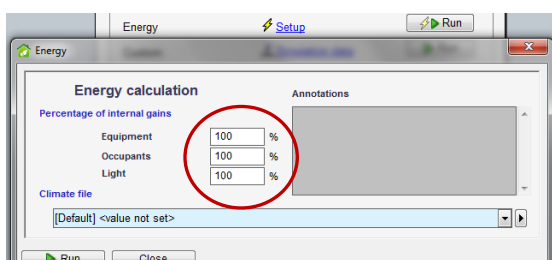1. Assign the parameter "CASE" with the value "Proposed."
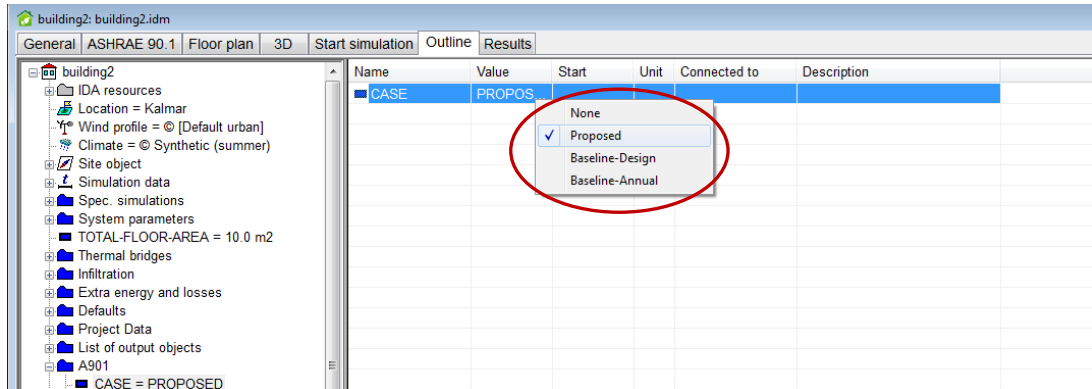
2. Assign the parameter A901-VERSION with the correct version of ASHRAE 90.1.
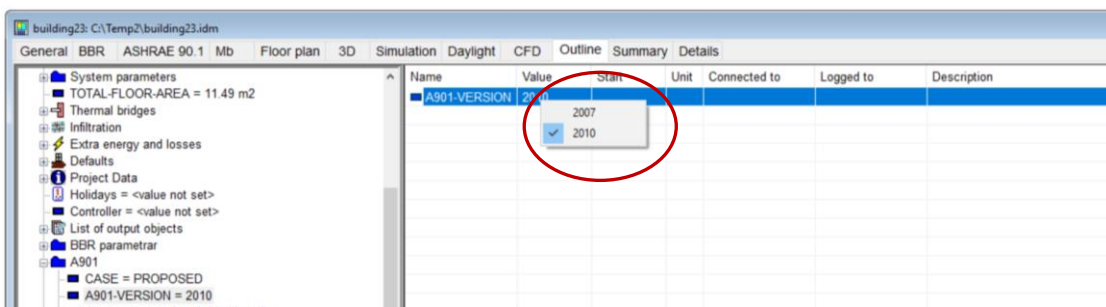
3. Assign the parameter "FLOOR_AREA_METRIC" with the value "With-All-Walls."

4. Change "Percentage of internal gains" to 100% under "Energy Setup."

5. The name of the energy meters must be identical to the names in the template building. The easiest way to do this is to drag-and-drop energy meters from a template building. Each energy user must be measured to a new energy meter. The old energy meters can be deleted as soon as they are disconnected.
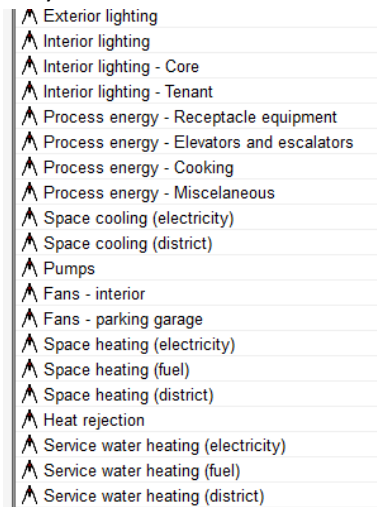
6. The user should make sure all end use loads are measured to the correct energy meters. The user should then open "Building defaults" and assign the correct meters for each energy carrier and energy type in the table, "Energy meters."
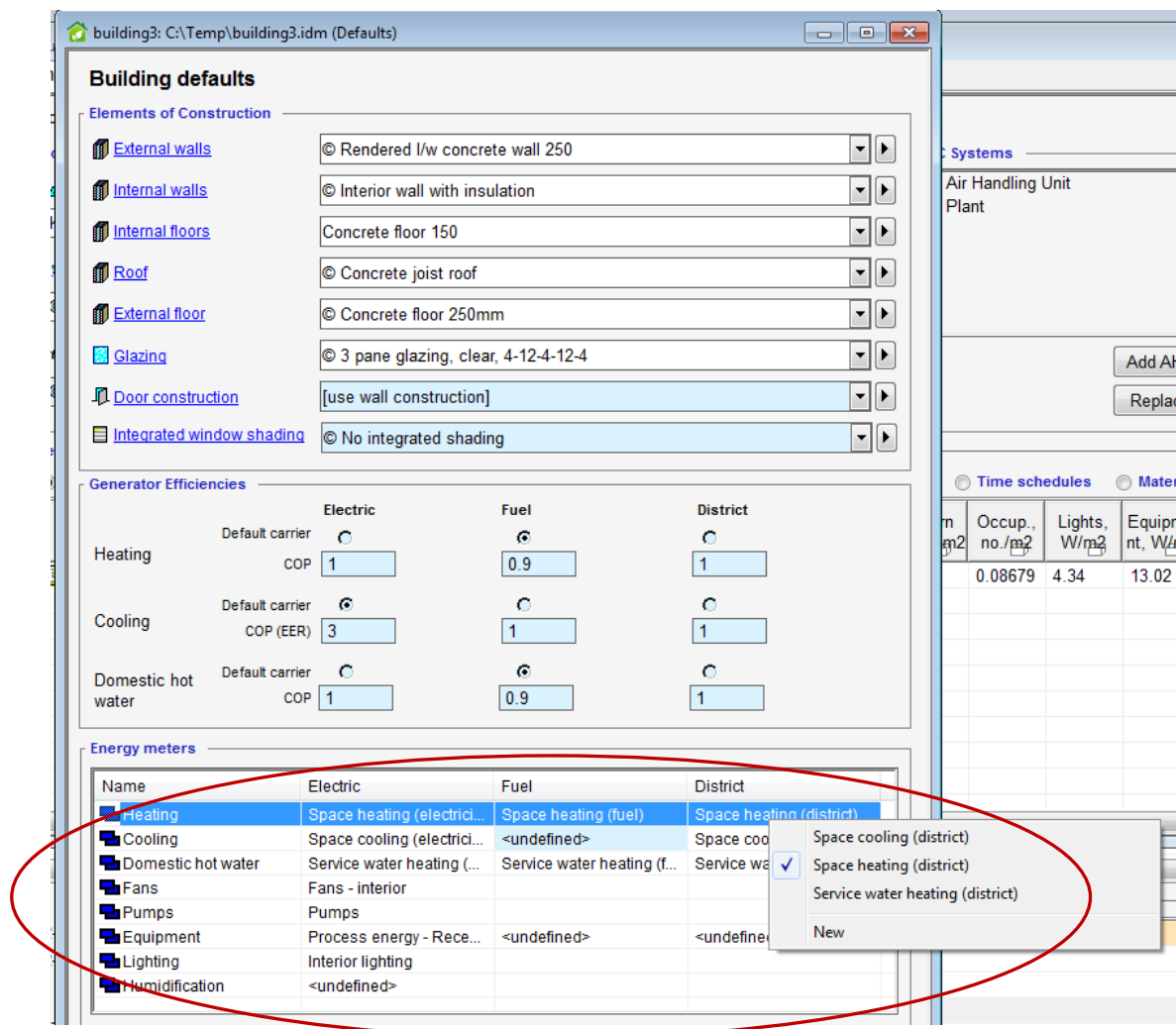
7. The user should save the model, close it, and open it again.

8. The user should select a "Building area type" or change to "Space use classification" (which also requires selection on the zone level). See below.