eQuest HOW TO GUIDE

FOR

SCA ENERGY MODELS

ASHRAE 90.1-2010 & 2020 NYCECC eQuest Templates

by:
Socotec, Inc.
50 Washington Street
Norwalk, CT 06854
Adrian Tuluca, RA
Senior Principal
Phone: 203-299-1411
Fax: 203-299-1656
E-mail: adrian.tuluca@socotec.us

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1 Purpose

The purpose of this guide is to describe the specific modeling requirements for New York City School Construction Authority (SCA) projects to assist in repeatable modeling processes. Only systems included in the SCA design requirements are included in this guide. Project specific systems should be modeled using generally accepted methods consistent with the software version used. This guide is intended for users with at least 3 years of experience modeling buildings in eQuest 3.63 or later versions.

This guide should be used in conjunction with the "eQuest Input Summary for SCA Energy Models", henceforth known as "Input Summary Report", which contains the actual values to be used in individual projects. All values may be updated as the Energy Code, Systems & Local Law requirements change.

1.1 Files

The following templates are provided:

PS/ECC Schools with natural gas heating (for all primary school and early childhood center models):

- PS_School_Design.zip
- PS_School_GSG Baseline.zip
- PS_School_NYCECC_2020 Baseline.zip

PS/ECC Schools with electric heating:

- PS_Elec_School_Design.zip
- PS_Elec_School_GSG Baseline.zip
- PS_Elec_School_NYCECC_2020 Baseline.zip

IS/HS schools with natural gas heating (for all intermediate and high school models):

- IS_HS_School_Design.zip
- IS_HS_School_GSG1 Baseline.zip (Schools < 150,000 ft^2)
- IS_HS_School_GSG2 Baseline.zip (Schools > 150,000 ft^2)
- IS_HS_School_NYCECC_2020 Baseline.zip

IS/HS schools with electric heating:

- IS_HS_Elec_School_Design.zip
- IS_HS_Elec_School_GSG1 Baseline.zip (Schools < 150,000 ft^2)
- IS_HS_Elec_School_GSG2 Baseline.zip (Schools > 150,000 ft^2)
- IS_HS_Elec_School_NYCECC_2020 Baseline.zip

Weather files

- NY_New_York_J_F_Kennedy_TMY3.bin
- NY_New_York_Laguardia_TMY3.bin
- NY_NewYork_Cent-Park_TMY3.bin

1.2 Definitions

Proposed Design - The model of the building based on the design documents

NYCECC 2020 Baseline - The baseline described by the Energy Cost Budget Method (Section 11) of ASHRAE 90.1-2016 with amendments per Appendix CA of the 2020 New York City Energy Conservation Code.

GSG Baseline- the baseline described by the Performance Rating Method (Appendix G) of ASHRAE 90.1-2010.

Ribbon – Major dialog box that contains multiple sub-tabs. Divides the data input into major disciplines.

Default Value – A value assumed by the modeling software to operate. Does not require user input. Shows up as "green" in the dialog box in eQuest.

Input Summary Report – Shorthand notation for the "eQuest Input Summary for SCA Energy Models", which is a report defining all major input values for a typical SCA building model.

Work Around- Non-standard modeling approach to approximate systems or equipment which cannot be directly modeled in the software package

2   Project & Site

The majority of the information required for this ribbon item is provided in the templates. Heating and cooling design days for Manhattan projects are defined as Kennedy International Airport values, as these values are not available for Central Park. The following items will need to be updated for the project-specific models:

2.1.1   Project Properties Dialog

Tab	Description	Value
Project Data	Project Name	Proposed
	Site Address	Proposed
	City, State, Zip	Proposed
	Weather File	The following are acceptable locations for the weather files. User shall select the weather file closest to the location of construction: NY_NewYork_Cent-Park_TMY3, NY_New_York_J_F_Kennedy_I, or NY_New_York_Laguardia_Arp. When using the Central Park Weather file, the design day conditions shall come from one of the other two locations.
Contact Information	Building Owner Name, Phone, Address	Proposed
		Proposed
		Proposed

2.1.2   Global Parameters

Values defined here apply across the entire model. Global parameters are defined by a parameter name and a value. The parameter names can then be used as a "value" elsewhere in the model. Parameters have been defined in the template for lighting power density (LPD) to provide a quick and central location for current lighting values as the design changes. For all parameters, provide a descriptive name to facilitate assigning the appropriate baseline lighting value to each space. Actual design should be at or below those values indicated in the proposed design column.

Parameter Name	Value		
	Proposed Design	GSG Baseline	NYCECC 2020 Baseline
AUD-LPD	0.63	0.79	0.63
CAFETERIA-LPD	0.53	0.65	0.53
CFTRM-LPD	0.53	0.65	0.53
CLASS-LPD	0.5	1.24	0.74
COMMUN-LPD	0.7	1.23	0.93
COMP-CLASS-LPD	0.74	1.24	0.74
CONF-LPD	0.7	1.23	0.93
COPY-LPD	0.5	0.98	0.50
CORR-LPD	0.58	0.66	0.58
AUX-GYM-LPD	0.75	1.2	0.75

ELEC-LPD	0.39	0.95	0.39
NURSE-LPD	0.8	1.66	1.16
LOCKER-G-LPD	0.45	0.75	0.45
GYM-LPD	0.75	1.2	0.75
GYMTRM-LPD	0.75	1.2	0.75
KITCHEN-LPD	0.8	0.99	0.92
LAB-CLASS-LPD	1.0	1.28	1.04
LIB-GEN-LPD	0.8	1.24	0.94
LIB-READ-LPD	0.77	0.93	0.77
LIB-STAC-LPD	0.8	1.71	1.20
ELEV-LOB-LPD	0.52	0.64	0.52
LOBBY-LPD	0.8	0.9	0.9
DATA-LPD	0.39	0.95	0.39
MECH-LPD	0.39	0.95	0.39
MEDIA-LPD	0.74	1.24	0.74
MUSIC-LPD	0.5	1.24	0.74
OFFICE-LPD	0.6	1.1	0.85
LOCKER-O-LPD	0.45	0.75	0.45
PLAY-LPD	0.75	1.2	0.75
RECORDS-LPD	0.8	0.98	0.85
RESOURCE-LPD	0.8	1.23	0.93
RESTROOM-LPD	0.7	0.98	0.75
RESTRM-PRIV-LPD	0.7	0.98	0.75
LOUNGE-LPD	0.44	0.73	0.44
STAIR-LPD	0.4	0.69	0.50
STORAGE-LPD	0.4	0.63	0.43
WORKSHOP-LPD	0.9	1.59	1.09

2.1.3   Site Properties

These values should all be left as "default". The variables defined here are intended to be read by the assigned weather file to ensure the building is calibrated to the appropriate climate conditions.

3   Building Shell

This ribbon defines the building's geometry and thermal properties of the envelope components. Geometry should be input to match the building design as closely as is feasible, paying specific attention to matching the gross envelope areas, fenestration area, orientation, and gross building floor area. Techniques for geometry input and space definition are not covered by this document.

The acceptable deviation from the architectural area takeoffs is ±1% overall. The overall design building proportions should be reflected as much as possible, especially in terms of window percentage distribution on each façade.

3.1 Surface Construction, Layers, and Material Properties

3.1.1 Wall Constructions

The materials, layers and constructions inputs for typical masonry wall constructions have been included in the template, and are described in the input guide. The constructions correspond to description in DR 4.2.1. The 'Achieved U-value' includes the effects of thermal bridging.

The energy modeler may be required to create design specific wall constructions where applicable. The preferred Specification Method is "Layers Input". Material names should be descriptive to assist in a SCA review. Where feasible, distinct materials should be defined for each layer in the wall construction.

Overall construction U-value shall be equal to a value found in ASHRAE 90.1 Appendix A- "Rated R-Value of Insulation and Assembly U-Factor, C-Factor and F-Factor Determinations", or a defensible source approved by the Authority Having Jurisdiction (AHJ). For wall constructions or insulation attachment methods that are not adequately described in ASHRAE 90.1 Appendix A, 2-D finite element modeling, such as THERM, shall be used to determine the effective insulation value and overall construction U-value. A copy of such analysis shall be provided to the SCA for their records. Perform a dewpoint analysis where appropriate to avoid potential condensation within the wall assembly.

3.1.2 Slab-On-Grade Constructions°

Baseline requirements for slab-on-grade constructions are based on the F-factor, which is based on the perimeter length. Projects may have sections of insulated and non-insulated slab on grade and should be accounted for. Utilize u-value of insulation in determining overall U-value of slab. eQuest construction thermal properties are based on the assembly area (U-factor, C-factor, R-value). To properly input the baseline floor construction, the F-factor needs to be converted to a U-factor[1].

$$U_{slab} = \frac{F-factor * L_{slab\ perimeter}}{Area_{Slab}}$$

U_{slab} = U-factor of slab, Btu/hr-ft^2-F

F-Factor = F-Factor, Btu/hr-ft-F

L = length of exposed slab perimeter, ft

Area$_{slab}$ = area of slab-on-grade, ft^2

The modeler should use the "F-Factor Calculations for Slab-On-Grade" in the Envelope tab of the SCA Energy Model Calculation spreadsheet to determine the required thermal properties for the slab insulation used in the template.

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[1] The slab-on-grade construction will have an air-film on the inside, but not the outside.

Case	Layer to update
Proposed Design, unheated slab	UFMAT-UH-PROP
NYCECC 2020 Baseline, unheated slab	UFMAT-UH-NYC20
GSG 2019 Baseline, unheated slab	UFMAT-UH-ASH10
Proposed Design, heated slab	UFMAT-HT-PROP
NYCECC 2020 Baseline, heated slab	UFMAT-HT-NYC20
GSG 2019 Baseline, heated slab	UFMAT-HT-ASH10

3.2   Glass Type Properties

3.2.1   Simplified

Proposed and baseline windows included in the templates have been specified using the "simplified" methodology. The glass conductance has been calculated in accordance with the DOE2.2 Dictionary. The characteristics of the new or replacement typical punched window is taken from DR4.3.1. The characteristics of existing punched windows are taken from ASHRAE 90.1 Appendix A - "Rated R-Value of Insulation and Assembly U-Factor, C-Factor and F-Factor Determinations". The U-factor in the table below has been adjusted to remove the exterior air films.

Window Type		Proposed Design	GSG Baseline	NYCECC 2020 Baseline
Typical Punched & Ribbon Windows *New & Replacement Fixed*	Template Glass Type	GL-1-FIX	GL-ASH10-MF-AO	GL-NYC20-MF-AO
	Conductance[2]	Project specific	0.607 Btu/hr-ft-°F	0.316 Btu/hr-ft-°F
	Shading Coefficient	0.419	0.465	0.419
	Visible Transmittance[3]	40%	44%	40%
Typical Punched & Ribbon Windows *New & Replacement, Operable*	Template Glass Type	GL-1-OP	GL-ASH10-MF-AO	GL-NYC20-MF-OP
	Conductance[4]	Project specific	0.607 Btu/hr-ft-°F	0.429 Btu/hr-ft-°F
	Shading Coefficient	0.419	0.465	0.419
	Visible Transmittance[5]	40%	44%	40%
Typical Punched & Ribbon	Template Glass Type	GL-1-AVG	GL-ASH10-MF-AO	GL-NYC20-MF-AVG
	Conductance[6]	0.261 Btu/hr-ft-°F	0.607 Btu/hr-ft-°F	0.353 Btu/hr-ft-°F

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[2] Conductance @ a 7.5 mph wind speed is the typical model input. Formula: Conductance Factor = 1/(1/U-value – 0.17) @ 7.5 mph wind speed.

[3] Visible transmittance is not regulated under ASHRAE 90.1-2010. ASHRAE 90.1-2016 and the 2018 International Energy Conservation Code, Section C402.4.1.1 specifies that the visible transmittance must be at least 1.1x the SHGC.

[4] Conductance @ a 7.5 mph wind speed is the typical model input. Formula: Conductance Factor = 1/(1/U-value – 0.17) @ 7.5 mph wind speed.

[5] Visible transmittance is not regulated under ASHRAE 90.1-2010. ASHRAE 90.1-2016 and the 2018 International Energy Conservation Code, Section C402.4.1.1 specifies that the visible transmittance must be at least 1.1x the SHGC.

[6] Conductance @ a 7.5 mph wind speed is the typical model input. Formula: Conductance Factor = 1/(1/U-value – 0.17) @ 7.5 mph wind speed.

Windows *New & Replacement, Average*	Shading Coefficient	0.419	0.465	0.419
	Visible Transmittance[7]	40%	44%	40%
Typical Punched Window, *Existing*, Dual Pane, metal frame other	Template Glass Type	GL-EXIST	GL-EXIST	GL-EXIST
	Conductance[1]	1.063	Same as proposed	Same as proposed
	Shading Coefficient	0.79	Same as proposed	Same as proposed
	Visible Transmittance	66%	Same as proposed	Same as proposed
Storefront	Template Glass Type	Project specific	GL-ASG10-MF-CW	GL-NYC20-MF-CW
	Conductance[1]	Project specific	0.546	0.383
	Shading Coefficient	Project specific	0.465	0.419
	Visible Transmittance	Project specific	44%	40%
Glass Block, steel framed	Template Glass Type	Project specific	GL-ASG10-MF-AO	GL-NYC20-MF-AO
	Conductance[1]	0.668	0.607	0.316
	Shading Coefficient	Project specific	0.465	0.419
	Visible Transmittance	Project specific	44%	44%
Insulated light dispersion panels	Template Glass Type	Project specific	GL-ASG10-MF-AO	GL-NYC20-MF-AO
	Conductance[1]	0.078	0.607	0.316
	Shading Coefficient	Project specific	0.465	0.419
	Visible Transmittance	Project specific	44%	44%
Skylight[8]	Template Glass Type	GL-SKYLIGHT	GL-ASG10-SKY	GL-NYC20-SKY
	Conductance[1]	0.361	0.782	0.522
	Shading Coefficient	0.325	0.45	0.442
	Visible Transmittance	31%	43%	42%

3.2.2   Project Specific

For project specific window assemblies that are not included in the template, the following values should be used to determine the input to the Glass Type Property Dialog, Basic Specifications tab.

Description	Value

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[7] Visible transmittance is not regulated under ASHRAE 90.1-2010. ASHRAE 90.1-2016 and the 2018 International Energy Conservation Code, Section C402.4.1.1 specifies that the visible transmittance must be at least 1.1x the SHGC.

[8] Skylights are currently not addressed in DR or model template. Values minimally compliant with ASHRAE 90.1-2016 are used for the design. Skylight w/o curb is assumed for the baselines.

Glass Type	*NAME*
Specification	Simplified
Shading Coefficient	SHGC/0.86
Glass Conductance	$\left(\dfrac{1}{U_{assembly}} - 0.17\right)^{-1}$
Visible transmittance	Actual
Outside Emissivity	Default

The modeler should use the Glazing calculations in the Envelope tab of the SCA Energy Model Calculation spreadsheet to determine the required.

No changes should be made to the "Component Details" or "Solar/Optical Details" tabs.

In the event that it is advantageous and there is enough available data to provide a "GLASS-LIBRARY" definition of a glazing assembly, the modeler shall provide a copy of the WINDOW 5/6 output used to generate the glazing object to the SCA.

3.3   Window Properties

Windows shall be modeled with the following characteristics:

Window Properties Dialog, Basic Specs Tab

Description	Value	Notes
Window Name	*NAME*	
Parent Wall	*NAME*	
Multiplier	*	
Diffusing	Default	
Specification Method	Composite	
Type of Glass	*NAME*	
X	*	
Y	*	
Height	*	
Width	*	
Setback	*	Setback = 0 for NYCECC 2020 or GSG Baseline
Glass Type	*	
Frame Width	0	Frame effects accounted for in Type of Glass definition
Frame Conductance	Default	
Frame Absorptance	Default	
Frame Spacer Type	Default	

Under normal circumstances, there shall be no changes to the "Blinds/Drapes – Switching", "Skylights", or "Daylighting – Light Well/Tube" tab defaults, which is to not be modeled. Modeling of "Fins-Overhang" tab are project specific and self-explanatory. Note that for new construction, window

setback should not be modeled in the baseline. In existing construction, any existing setbacks, overhangs, or fins should be modeled the same between the baseline and proposed.

4   Internal Loads

4.1   Space Properties

4.1.1   Space Properties Dialog, Basic Specs Tab

Description	Value
Space Name	*NAME*
Parent Floor	*NAME*
Zone Type	Conditioned with the exception of shafts (unconditioned), plenums within dropped ceilings (unconditioned), over ceiling space in public assembly spaces more than 25 feet above floor (plenum)
Description	Not Required
Sunspace	No
Temperature	72°F
Space Multiplier	*
Floor Multiplier	*
Location	*
Shape	Use a Polygon
Polygon	*
X	Default
Y	Default
Z	Default
Azimuth	Default
Height	Default
Width	Not used
Depth	Not used
Area	Default
Volume	Default
Occupancy Schedule	Space type dependent values according to Table 4 of "Input Summary Report"
Area/Person	Space type dependent values according to Table 4 of "Input Summary Report"
Number of People	Not Used
Total Heat Gain	Not Used
Sensible Heat Gain	Space type dependent values according to Table 3 of "Input Summary Report"
Latent Heat Gain	Space type dependent values according to Table 3 of "Input Summary Report"

4.1.2   Space Properties Dialog, Equipment Tab

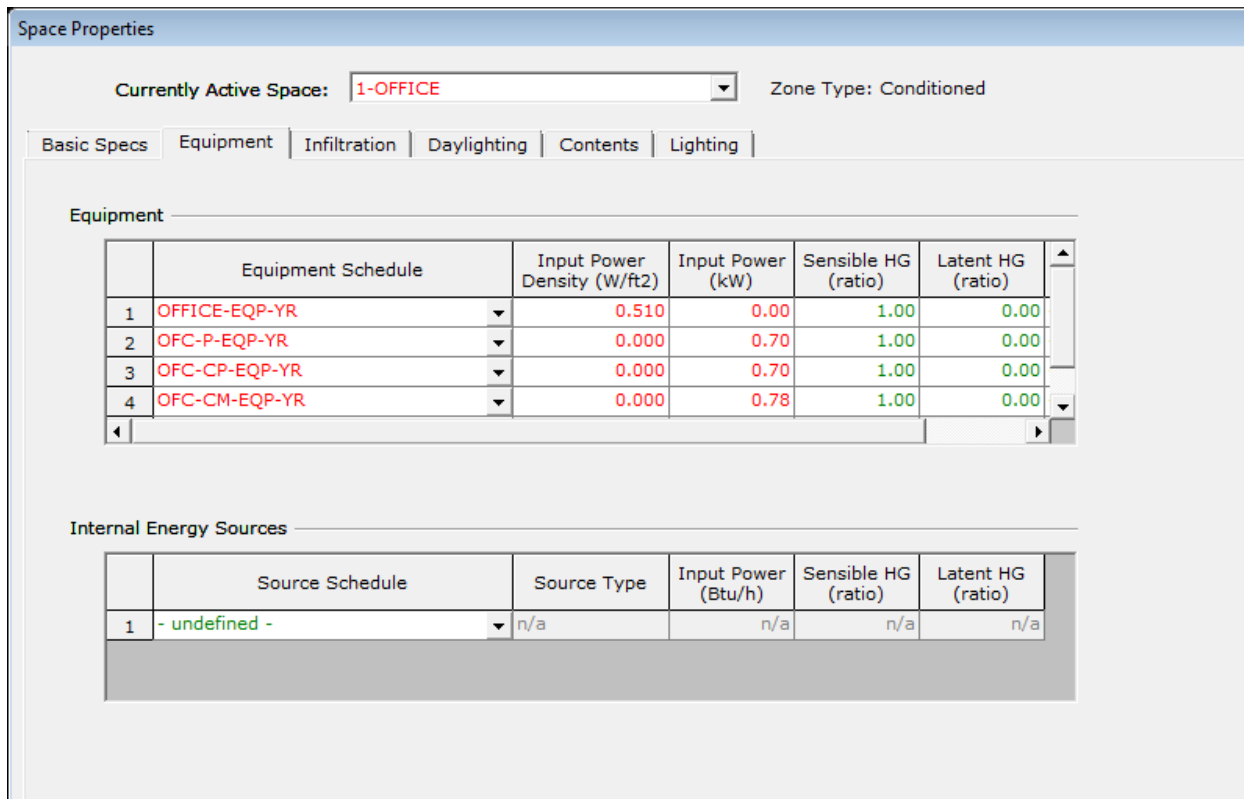The following values need to be included in the model. All other inputs on this tab should default.

Description	Value
Equipment Schedule	Space type dependent values according to Section 4.2 of "Input Summary Report"

Input Power Density (W/ft^2)	Space type dependent values according to Section 4.2 of "Input Summary Report"
Source Schedule	Kitchens/Serveries only. values according to Section 4.2 of "Input Summary Report"
Source Type	Kitchens/Serveries only. Natural Gas or electric per design.
Source Sensible HG (Ratio)	Kitchens/Serveries only. ASHRAE Fundamentals Tables 5A-5D Standby values (0.25 default)
Source Latent HG (Ratio)	Kitchens/Serveries only, unhooded equipment. (0.25 default)

4.1.2.1   Office Equipment

Offices will need additional inputs to account for printers, copiers, and coffee makers. A screen shot of the preferred input has been provided for clarity

Description	Value
Equipment Schedule, General office equipment	Schedule per Section 4.1 of "Input Summary Report", based on area for general office equipment (OFFICE-EQP-YR)
Input Power Density (W/ft^2), General office equipment	Office equipment load per Section 4.1 of "Input Summary Report", based on area for general office equipment
Input Power (kW), General office equipment	0
Equipment Schedule, Specific office equipment (printers, copiers, coffee makers)	Appropriate schedule per Section 4.3 of "Input Summary Report", based on equipment type
Input Power Density (W/ft^2), Specific office equipment (printers, copiers, coffee makers)	0
Input Power (kW)	Appropriate full load power per Section 4.3 of "Input Summary Report", based on equipment type
Source Schedule, Type, etc.	No input

4.1.3 Space Properties Dialog, Infiltration Tab

Description	Value
Infiltration Method	Air Change
Schedule	See "Input Summary Report" Table 11
Air Changes/Hour	0.10, typical spaces with 1 major dimension on an exterior wall 0.075, cafeterias, auditoriums, and other deep spaces with at least 1 major dimension on an exterior wall 0.025, spaces with limited area on exterior walls 0.0, interior zones with no exterior walls 0.30, for vestibules with swinging doors
Infiltration Flow	Default (0.00) Note: this value will not be used- overridden by ACH input.

4.1.4 Space Properties Dialog, Daylighting Tab

Description	Value	Notes
Daylighting	*	
Report Schedule	Default	
System 1 Scenario	Default	
System 2 Scenario	Default	
Minimum Power Fraction	0.33	Update proposed model when project specific information is available

Minimum Light Fraction	0.30	Update proposed model when project specific information is available
Lt Control Steps		Only used if project specific DL system is stepped
Lt Control Probability		Only used if project specific daylighting system is stepped
Controlled kW Fraction	{Primary Sidelit Area} / {Thermal block Area}	Actual value should be used for Proposed Design when available. Baseline value is in accordance with 2020 NYC Energy Conservation Code Appendix CA
Light Set Point (fc)	Space Specific	See "Input Summary Report" Table 7 for design set points listed by space type.
Discomfort Glare Max Value	Default	
View Azimuth	*	Perpendicular and facing away from dominant window
Control System Operation Mode	Continuous	Can be changed if system specific information is available
Light Ref Point 1 X	Center of the sidelit Area	Can be based on 2020 NYC Energy Conservation Code Appendix CA for systems not fully designed. Actual value should be used for Proposed Design when the zone encompasses one room. Representative point should be used when the zone encompasses several rooms and/or sensors.
Light Ref Point 1 Y	Center of the sidelit Area	Like Light Ref Point 1 X
Light Ref Point 1 Z	2.5	
Light Ref Point 2	Center of second orientation	Can be based on 2020 NYC Energy Conservation Code Appendix CA for systems not fully designed. If thermal zone includes glazing on a façade that differs by more than 45 deg from primary glazing then provide second point in both baseline and proposed models.

4.1.5   Space Properties, Contents

Skylight daylighting is not typical for most buildings and should be addressed as a project specific item. When modeling this feature, provide the SCA a spreadsheet for all areas with top-lighting and demonstrate where the baseline is required/not required to have daylighting per ASHRAE 90.1-2010 OR NYC ECC 2020 Appendix CA Section 9.4.1.5. Where top-lighting contributes to a thermal zone's daylighting, model inputs shall be similar to the *Daylighting Tab* and be in compliance with 2020 NYC Energy Conservation Code Appendix CA requirements.

Custom Calculated Weighting Factors shall be used to properly account for the differences in baseline and proposed construction type. "Floor Weight" should be default 0.00 lb/ft^2 and the "Calculated Custom Weighting Factor" shall be default to what is calculated based upon the constructions used in the project.

The furniture factors throughout the building shall be specified as follows:

Description	Value
Furniture Type	Light {Controls radiant/convective fractions not quantity}
Fraction of Floor Area	Classroom - 0.50 Gym – 0.20 Corridor – 0.05
Weight	Interior partitions modeled - 0.50 lb/ft^2 {floor area} Interior partitions not modeled – 5 lb/ft^2 {floor area}

4.1.6 Space Properties, Lighting

Description	Value	Notes
Power Density (W/ft^2)	Use global parameter values where feasible. All values should be based on the proposed lighting design.	Lighting power density shall be defined by space type preferably, or total building. See "Input Summary Report" Table 12 for baseline and proposed values.
Power (kW)	*	Use only if Lighting Power Density is not provided. Do not use for baseline cases.
Lighting Type	DEFAULT "Sus Fluor" {short for suspended fluorescent lighting}	This determines the radiant/convective split of the lighting. Recessed fixtures can be defined where used in the proposed design, but the difference is not significant. Both the proposed and baseline lighting shall be modeled with the same lighting type.
Schedule	Space type dependent, See Table 6 of "Input Summary Report"	
Light to Space (ratio)	DEFAULT "1"	Defines the fraction of the lighting power that is a load on the space. Leave this value as default unless the design includes a return air plenum instead of ducted return.
Light to Adj Spc (ratio)	"0"	Inter-zone lighting trespasses shall not be modeled unless specifically defined on the electrical drawings as part of the daylighting plan. If defined on the electrical drawings, provide a copy of the ratio calculation/rational to the SCA with your modeling report.
Light to Return (ratio)	DEFAULT "0.0"	Defines the fraction of lighting power that is a heat gain to the return. Define only if the design includes a return air plenum instead of ducted return.

4.1.7 Task Lighting

Lighting that falls under ASHRAE 90.1 Section 9.2.2.3 Exceptions (k), (m), (n), (p), and/or (q), and has the qualifying additional controls shall be modeled as "Task Lighting" under this tab and shall be modeled the same between the proposed and baseline. Lighting that falls under any of the other exceptions to

9.2.2.3 is considered to be part of the equipment densities listed in the "Input Summary Report" and can be ignored.

A separate schedule that is project specific shall be used to model task lighting, and shall be consistent with the number of hours this type of lighting is expected to operate during a typical year. A copy of the schedule shall be submitted for approval by the SCA.

If the Electrical Designer takes an additional allowance under Section 9.6.2 (1), then this additional lighting power density shall be modeled as "Task Lighting" under this tab, with the same schedule as the primary lighting. This additional lighting power density shall be modeled the same between the proposed and baseline up to the power allowance. Such fixtures and controls shall be specifically called out in the Energy Model Report to assist in the SCA's review.

4.1.8   General: Lighting Power Density

Per ASHRAE 90.1-2010/ Table G3.1-6.a and NYC 2020 Appendix CA Table 11.5.1, the lighting power or lighting power density for each thermal block should be input in the model for situations where a complete lighting plan exists. Average lighting power density by space type is an acceptable approximation. The same method shall be used in the design and baseline. Calculating and inputting the LPD for each energy model space is recommended in cases when there is a significant variation between different spaces of the same type.

For spaces using standard controls (see Table 6 of the Input Summary), the actual lighting power density should be entered. If additional lighting controls are included in the design, they can be accounted for by:

- Reduce the lighting power density
    a. 5% for additional partial occupancy controls
    b. 10% for additional full occupancy controls
    c. Other amount if supported by documentation
- Reduce the lighting schedule
    a. 5% for additional partial occupancy controls
    b. 10% for additional full occupancy controls
    c. Other amount if supported by documentation

Either the LPD OR the schedule should be reduced, not both. Reductions should only be applied in spaces with additional controls.

5   Water-Side HVAC

5.1   Overview

The SCA has developed a scheme to efficiently provide heating via electricity. Due to shortcomings in the software, some work arounds are required. It is recommended that the modeler review Appendix B Electric Heating before modeling a project with electric heat.

The software allows for accurate control over the HVAC system. The acceptable deviation of modeled equipment sizes relative to the mechanical systems is ±1% for general equipment and ±5% for motors smaller than 1 HP or water flows less than 20 GPM.

5.2   Natural Gas Heating Systems

5.2.1   General

No stand-by equipment shall be included in the model. For chilled water loops, primary pumps shall be attached to the chiller, and secondary pumps, if present, shall be attached to the loop. For hot water loops with primary-only pumps, the pumps shall be attached to the loop. If the hot water loop has primary and secondary pumps, the primary pumps shall be attached to the boiler and the secondary pumps shall be attached to the loop.

5.2.1.1   Chilled Water Loop

5.2.1.2   Chilled Water Loop Dialog, Basic Specifications Tab

Description	Value	Notes
Loop Name	*NAME*	
Loop Type	Chilled Water	Each loop must be one of six available types
Loop Subtype	Primary	Secondary loops are served exclusively by primary loops
Primary Loop	Not used	Name of the primary loop that this secondary loop is attached to (and served by)
% Trans to Primary	Not used	Percentage of secondary loop flow that transfers to primary loop flow (at design conditions)
Sizing Option	Default	Size per "Secondary" if chiller size unknown, and "Primary" if chiller size is known. Baseline will always be "Secondary".
Design CHW Temp	Proposed 45°F Baseline 44°F	Design leaving water temperature on plant. May be different than rated discharge water temperature of chiller.
Loop Design DT	*	Design temperature change of the fluid in the loop
Fluid Volume	Default	Total volume of the fluid in the loop
Avg Circ Time	Default	Average time it takes for the fluid to circulate through the loop (at the design flow rate)
Loop Recirc Flow	Default	Recirculating flow rate of the fluid in the loop when the pump is running
Pipe Head	Pump Pressure drop minus Coil Pressure drop	Friction loss in the loop due to the piping and related trim

Static Head	0	Closed Loop – No Static Head (no lift against atmosphere)
Loop Pump	*NAME*	Name of the dedicated Pump that pumps this loop
Loop Minimum Flow	Prop: As Design Base: No less than 30%	Minimum allowable flow rate in the loop, expressed as a fraction of the design flow rate
Loop Size Ratio	Default (1.0)	No safety factor applied to loop sizing. Required safety factor for baseline applied at the airside cooling and heating loads.

5.2.1.3   Chilled Water Loop Dialog, Process Loads Tab

Description	Value	Notes
Process Load	n/a	Process Load (not used)
Process Flow	Not used	Peak Process Load flow rate
Process Load Schedule	n/a	Schedule of multipliers applied to the Process Load
Process Load Delta T	n/a	Delta T of the process load fluid (used to calculate Process Flow Rate, sign is irrelevant)

5.2.1.4   Chilled Water Loop Dialog, Losses Tab

No pipe losses shall be modeled in either proposed or baseline for compliance models.

5.2.1.5   Chilled Water Loop Dialog, Head Tab

Description	Value	Notes
Head Setpoint Control	Valve-Reset	Type of control sequence used to control the head setpoint of the loop circulation pumps. Consistent with SCA sequence of operations.
Head Sensor Location	At Coils	When shown in the design use the actual location of the differential pressure sensor
Head Setpoint	5 ft	Typical Coil Pressure drop, actual value may be used
Head Setpoint Range	Default (2 ft)	Throttling range of the head setpoint controller
Head Setpoint Ratio	Default (1.0)	No safety factor applied for compliance model.

5.2.1.6   Chilled Water Loop Dialog, Operation Tab

Description	Value	Notes
Loop Operation	Demand	Chilled water is scheduled to be available per the cooling schedule in the zones, but the plant only operates when there is a demand, not continuously during occupied times if "standby" were used.
Cooling Schedule	n/a	Specified if Loop Operation set to "scheduled"
Heating Schedule	n/a	Specified if Loop Operation set to "scheduled"
Pump Schedule	-undefined-	Pumps shall run when the chiller runs.
Snap Temp	n/a	If CHW Loop operation set to "snap" this would be the temperature above which the Loop would be indexed "on"

Snap Location	n/a	Location of the snap-acting temperature sensor that turns the loop on or off
Snap Zone	n/a	The zone whose temperature is monitored to determine whether the loop is active

5.2.1.7 Chilled Water Loop Dialog, Controls Tab

Description	Value	Notes
Loop Flow Reset	n/a	Fraction of design flow rate to which the flow is reduced, prior to initiating a temperature reset. To be used in project specific applications where controls call for flow throttling and then loop flow reset, not loop flow reset first.
Loop Setpoint Range	3.0°F	Throttling range of the loop temperature controller. Should be put to three to ensure convergence of water loop subroutines.
Cool Setpoint Control	Proposed: Fixed Baseline: OA Reset	Control to reset supply water temperature. Baseline shall always be reset per outdoor air temperature. The chilled water temperature should not be reset for the proposed design.
Cool Setpoint Temperature	Proposed: 45°F Baseline: n/a	The loop cooling setpoint when setpoint control is set to "Fixed"
Cool Reset Schedule	Baseline: CHILLER-RESET-YR	The name of a schedule that defines the rules of an outdoor air reset. Schedule must be type "RESET-TEMP"
Cool Setpoint Schedule	n/a	When Cool Setpoint Control is set to "scheduled" this specifies the loop cooling setpoint (a Temperature Schedule)
Cool Equipment Control	n/a	The name of an Equipment Control sequence for the primary cooling equipment that serves this loop. May be required in project specific applications where the engineer has specified certain equipment should only be used to handle certain loads or only operate certain times of year.
Max Reset Temp	Proposed: n/a Baseline: 54°F	The maximum allowable supply-side loop temperature (only used in Chilled Water or Two Pipe loops)
Min Reset Temp	Proposed: n/a Baseline: n/a	The minimum allowable supply-side loop temperature (only used in Hot Water or Two Pipe loops)

5.2.1.8 Chilled Water Loop Dialog, Auxiliaries Tab

Auxiliary load shall be modeled as zero. This input is intended to be used to model an auxiliary electrical load associated with the operation of the chilled water loop that does not affect the cooling load, which is not in the scope of these compliance models.
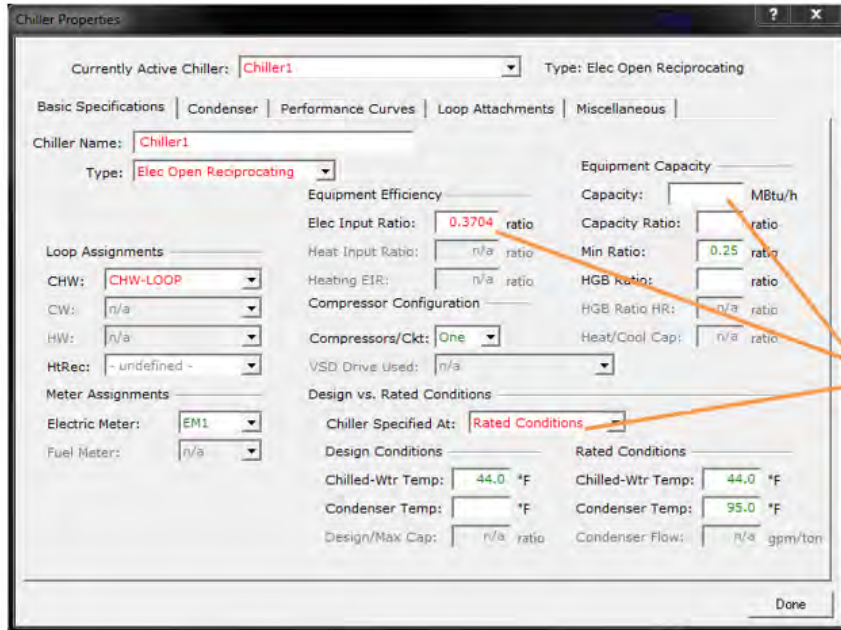
5.2.2 Chiller

Only the standard air-cooled chiller used in the SCA design is covered in this guide. Baseline chillers shall be modeled according to the appropriate standard with input features as outlined in the "Input Summary Report"

5.2.2.1 Chiller Dialog, Basic Specifications Tab

Description	Value	Notes
Chiller Name	*NAME*	The name of the chiller component, should match mechanical drawing tag.
Chiller Type	Elec-Screw	Hermetic Screw Chiller best approximates SCA specified scroll chiller. Where a chiller is required in the baseline, the type will be dictated by ASHRAE 90.1.
CHW Loop assignment	*	Name of the primary Chiller Water Loop that this chiller serves
CW Loop assignment	*	Air-cooled chiller not applicable.
HW Loop assignment	n/a	Name of HW loop that provides heat to an absorption chiller; or that a chiller/heater heats
HtRec Loop assignment	n/a	Name of the Heat Recovery Loop if available.
Electric Meter	Default (EM1)	Name of the Electric Meter that tallies the electric consumption of this chiller
Fuel Meter	n/a	Name of the Fuel Meter that tallies the fuel consumption of this chiller
Elec Input Ratio	*	EIR at AHRI rated conditions (see graphic after table), or design conditions. Must include performance degradation due to glycol.
Heat Input Ratio	n/a	Ratio of heat input (in Btus) to full load heating capacity (in Btus), at rated conditions
Heating EIR	n/a	EIR at design or rated conditions used for heating equipment
Compressors/Ckt	Default (one)	This input has no effect on actual operation for all chiller types other than hermetic centrifugal with vsd drive and sml frictionless compressors. Software will read the part-load-ratio-curves to determine power use at different operating conditions.
VSD Drive Used	n/a	This selection changes the default curves. The part load curves have been adjusted to accommodate typical SCA chillers with multiple compressors as standard
Capacity	*	Nominal chiller cooling capacity in MBTU/hr (e.g., 100 ton=1.2 MBTU/hr). Leave blank if chiller sizes are not yet known. The chiller capacity should be based on the same full load conditions used for the electric input ratio and should include all effects of glycol.
Capacity Ratio	1.00	Allows for a safety factor in chiller size. Do not adjust. If capacity is known, populate the field above. Safety factors are applied at airside coils.

Min Ratio	0.15	Typical minimum chiller operating ratio (a fraction of the Capacity); below this, it cycles on & off. Use actual value if available.
Max Ratio	Not used	Maximum allowable chiller operating ratio (fraction of Capacity, also called max overload ratio)
HGB Ratio	n/a	Maximum allowable part-load ratio of the chiller, above which hot gas bypass occurs
HGB Ratio HR	n/a	The hot gas bypass ratio when the chiller is in the heat recovery mode
Heat/Cool Cap	n/a	Used by gas-fired absorption chillers only.
Chiller Specified at	Rated Conditions	Conditions should correspond to value in Electric Input Ratio. This adjusts the hourly EIR and capacity based on condenser temperature and chilled water temperature. Rated conditions may be different from AHRI conditions. All effects of glycol need to be accounted for in the EIR & capacity inputs.
Design Chilled-Wtr Temp	44°F	Match the chilled water loop design setpoint based on the design documents
Design Condenser Temp	*	
Design/Max Cap	n/a	Used for centrifugal chiller inputs only.
Rated Chilled-Wtr Temp	44°F	Conditions should correspond to values that the Electric Input Ratio is specified at. These can be the same as the design conditions if this is how the mechanical schedule is presented.
Rated Condenser Temp	95°F	Conditions should correspond to value in Electric Input Ratio. These can be the same as the design conditions if this is how the mechanical schedule is presented.
Rated Condenser Flow	n/a	Air-cooled chiller

5.2.2.2   Chiller Dialog, Condenser Tab

Condenser Type shall be set to "Air Cooled". Unless known all other values shall be left Default.

5.2.2.3   Chiller Dialog, Performance Curves Tab

The names of the three functions that control how the chiller operates are defined in this tab. The curves should be selected per the Input Summary. If project specific chiller curve information is available, it should be included in the energy model.

The three functions that define chiller performance are:

eQuest Dialog Name	DOE2.2 Command	Description
Performance Curve f (t evap leaving, t cond entering)	EIR-FT	Name of a curve that adjusts the electric input ratio as a function of the leaving chilled water temperature and the condenser temperature (Drybulb temp for air-cooled chillers)
Performance Curve f(part load ratio)	EIR-FPLR	Name of a curve that adjusts the electric input ratio as a function of the part load ratio (PLR)
Cooling Capacity	CAPACITY-FT	Name of curve that adjusts the capacity of the chiller as a function of the leaving evaporator water temperature and the condenser temperature (Drybulb temp for air-cooled chillers)

If the project specific information includes enough information, all of the curves can be defined. Typically, chiller manufacturers will provide part load information at the test points specified in AHRI 550/590. The test points have varying outdoor air temperature and part load. In this case, only the EIR-FPLR should be revised. See Appendix A1 of this document.

5.2.2.4 Chiller Dialog, Loop Attachments

Defines the associated loop pump, establishes variable flow loop control, and defines the delta T of the loop. Head should be input equal to the pump head minus the control head. Static head should be modeled as zero, as this is a closed loop.   No oversizing loop flow as the oversizing factors have been implemented in the air-side HVAC definitions

5.2.2.5 Chiller Dialog, Misc.

Default start-up time and standby time should be used. All other inputs should be greyed out for this specific chiller.

5.2.3 Hot Water Loop

5.2.3.1 Hot Water Loop Dialog, Basic Specifications Tab

For the proposed design model, a single primary loop is modeled with primary pumps attached to the boilers and secondary pumps attached to the loop definition. The various heating coils then call this loop to connect to it.

It is acceptable to model separate secondary loops, each with their own setpoint temperature and return temperature for each load type (baseboard/radiators, primary DIU heating coil, DOAS heating coil) in the proposed design only.

Description	Value	Notes
Loop Name	*NAME*	
Loop Type	Hot Water	Each loop must be one of six available types
Loop Subtype	Primary	Secondary loops are served exclusively by primary loops
Primary Loop	Not used	Name of the primary loop that this secondary loop is attached to (and served by)
% Trans to Primary	Not used	Percentage of secondary loop flow that transfers to primary loop flow (at design conditions)
Sizing Option	Default	Size per "Secondary" if Boiler size unknown, and "Primary" if boiler size is known. Baseline will always be "Secondary".
Design HW Temp	Proposed 160°F Baseline 180°F	Design leaving water temperature from the plant. May be different than rated discharge water temperature of boiler.
Loop Design DT	Proposed: Primary - 40°F Secondary – 25°F Baseline: 50°F	Design temperature change of the fluid in the loop
Fluid Volume	Default	Total volume of the fluid in the loop
Avg Circ Time	Default	Average time it takes for the fluid to circulate through the loop (at the design flow rate)
Loop Recirc Flow	Default	Recirculating flow rate of the fluid in the loop when the pump is running

Pipe Head	Pump Pressure drop minus Coil Pressure drop	Friction loss in the loop due to the piping and related trim
Static Head	0	Closed Loop – No Static Head (no lift against atmosphere)
Loop Pump	*NAME*	Name of the dedicated Pump that pumps this loop
Loop Minimum Flow	Prop: As Design Base: No less than 30%	Minimum allowable flow rate in the loop, expressed as a fraction of the design flow rate
Loop Size Ratio	Default (1.0)	No safety factor applied to loop sizing. Required safety factor for baseline applied at the airside cooling and heating loads.

5.2.3.2   Hot Water Loop Dialog, Process/DHW Loads

This shall be zero and the domestic hot water shall be served by a separate proposed system.

If a project requires a process hot water load, then this load shall be entered here as designed and the schedule of operation shall be approved by the SCA.

5.2.3.3   Hot Water Loop Dialog, Losses

No pipe losses shall be modeled in either proposed or baseline for compliance models.

5.2.3.4   Hot Water Loop Dialog, Head Tab

Description	Value	Notes
Head Setpoint Control	Valve-Reset	Type of control sequence used to control the head setpoint of the loop circulation pumps
Head Sensor Location	At Coils	When shown in the design use the actual location of the differential pressure sensor
Head Setpoint	5 ft	Typical Coil Pressure drop.
Head Setpoint Range	Default (2 ft)	Throttling range of the head setpoint controller
Head Setpoint Ratio	Default (1.0)	No safety factor applied for compliance model.

5.2.3.5   Hot Water Loop Dialog, Operation Tab

Description	Value	Notes
Loop Operation	Demand	Hot Water is scheduled to be available per the Heating schedule in the zones, but the plant only operates when there is a demand, not continuously during occupied times if "standby" were used.
Cooling Schedule	n/a	Specified if Loop Operation set to "scheduled"
Heating Schedule	n/a	Specified if Loop Operation set to "scheduled"
Pump Schedule	-undefined-	Pumps shall run when the boilers runs.
Snap Temp	n/a	If HW Loop operation set to "snap" this would be the temperature below which the Loop would be indexed "on"

Snap Location	n/a	Location of the snap-acting temperature sensor that turns the loop on or off (may be outside)
Snap Zone	n/a	The zone whose temperature is monitored to determine whether the loop is active

5.2.3.6   Hot Water Loop Dialog, Controls Tab

Description	Value	Notes
Loop Flow Reset	n/a	Fraction of design flow rate to which the flow is reduced, prior to initiating a temperature reset
Loop Setpoint Range	Default 2.0°F	Throttling range of the loop temperature controller. Needed to allow subroutines to converge.
Heat Setpoint Control	OA Reset	The loop temperature control sequence
Heat Setpoint Temperature	n/a	The loop heating setpoint. Applicable when Heat Setpoint Control set to "Fixed"
Heat Reset Schedule	Proposed: PROP-HW-RESET-SCH Baseline: ASHG-HW-RESET-SCH	The name of a schedule that defines the rules of an outdoor air reset. Schedule must be type "RESET-TEMP"
Heat Setpoint Schedule	n/a	Specifies the loop heating setpoint schedule. Applicable when Heat Setpoint Control set to "Fixed"
Heat Equipment Control	n/a	The name of an Equipment Control sequence for the primary heating equipment that serves this loop. May be required in project specific applications where the engineer has specified certain equipment should only be used to handle certain loads or only operate certain times of year.
Max Reset Temp	Proposed: n/a Baseline: n/a °F	The maximum allowable supply-side loop temperature (only used in Chilled Water or Two Pipe loops)
Min Reset Temp	Proposed: 80°F Baseline: 80°F	The minimum allowable supply-side loop temperature (only used in Hot Water or Two Pipe loops)

5.2.3.7   Hot Water Loop Dialog, Auxiliaries Tab

Auxiliary load shall be modeled as zero. This input is intended to be used to model an auxiliary electrical load associated with the operation of the hot water loop that does not affect the heating load, which is not in the scope of these compliance models. To model the electrical controls consumption on a proposed boiler go to the Boiler Properties Dialog box and input this value under the miscellaneous tab.

5.2.4   Boiler

Only the SCA design condensing boiler is covered in this guide. Baseline boilers shall be modeled according to the appropriate standard, with input features as outlined in the "Input Summary Report". Note that the number of boilers defined should match the number scheduled to operate normally (no stand-by), to properly account for complex control schemes, and to provide the reviewer a way to check against the baseline boiler sizing and number requirements.

5.2.4.1 Boiler Properties, Basic Specifications Tab

Description	Value	Notes
Boiler Name	*NAME*	The name of the boiler component, should match mechanical drawing tag.
Boiler Type	Condensing HW Boiler	Allows for custom performance Curves to model condensing boiler
HW Loop assignment	*	Name of the primary HW Loop this boiler is assigned to
Electric Meter	Default (EM1)	Name of the Electric Meter that tallies the electric consumption
Fuel Meter	Default (FM1)	Name of the Fuel Meter that tallies the fuel consumption
Capacity	*	Nominal boiler capacity in MBTU/hr. Leave blank if boiler sizes are not yet known.
Capacity Ratio	0.50	Fraction of the design heating load used to size boiler when capacity is not known.
Min Ratio	0.25	Defines the minimum fraction that the boiler will operate down to.
Max Ratio	Default (1.00)	This is the maximum ratio. Should be set to 1 as there should be no oversizing.
Heat Input Ratio	1.1198	Ratio of heat input (in Btus) to full load heating capacity (in Btus), at rated conditions. Should be derated in the proposed model by 4% for the 30% glycol.
Elec Input Ratio	Default (0.0033)	Ratio of electrical input (in Btus) to full load heating capacity (in Btus), at rated conditions. Used to approximate the contribution of controls and draft fan as a percentage of boiler capacity
Return Water Tmp.	80°F	For condensing HW boilers this is the boiler's entering water temperature that the HIR and EIR are defined for. The design water temperature should be defined in the HW loop.
Location	Zone	Location Zone is used to approximate the boiler's contribution to the zone's air temperature. Using "outdoor" is equally as acceptable.
Boiler Zone	*NAME*	Name of the zone boiler is located
Aquastat Setpoint T	n/a	Not applicable for condensing boilers. Only significant if the boiler is set to maintain a temperature much higher than the loop temperature.

5.2.4.2 Boiler Properties, Performance Curves Tab

The names of the three functions that control how the condensing boiler operates are defined in this tab. Unless the manufacturer has a specific set of curves available to the modeler, these curves should be called from the eQuest Library of inputs based upon the boiler type. In this case all curves should be from the Fuel Boiler Category for "Cond Blr-HiEff". The Electric Input Ratio should be set to Draft-Fan-EIR-fPLR and if none exists the EIR shall be modeled as zero.

5.2.4.3 Boiler Properties, Loop Attachments

Defines the associated loop pump if modeling primary/secondary, establishes variable flow loop control, and defines the delta T of the loop. Head should be input equal to the pump head minus the control head. Static head should be modeled as zero as this is a closed loop. No oversizing loop flow as the oversizing factors have been implemented in the air-side HVAC definitions

5.2.4.4 Boiler Properties, Misc.

Default start-up time and standby time should be used. Auxiliaries should be specified if controls are known, and should operate in SCHEDULE: "When On" with the default electrical meter.

5.3 Electric Heating Systems

5.3.1 General

This section includes work-arounds for modeling electric heat pumps and VAV systems. The modeler should review Appendix B before proceeding. The following eQuest elements will need to be created:

- Two-pipe loop to simulate heating from rooftop units (provides heating only)
  - Variable speed pump with minimal pumping power (all pumping load is fake)
  - Heat-pump chiller (performance should be similar to rooftop unit)
  - Multiple loops with served by different chillers should be created for rooftop units with significantly different operating schedules or efficiencies
  - Classroom units may be grouped, but units serving public assembly spaces (cafeteria, auditorium, gymnasium) should be on their own loop
  - The NYCECC 2020 Baseline and GSG Baseline will not have a two-pipe loop serving the classrooms because heating is electric resistance
- Hot-water loop to simulate heating from baseboards (proposed design only)
  - Option 1: Electric Resistance Baseboards
    - Variable speed pump with minimal pumping power (all pumping load is fake)
    - Electric boiler
    - Heat-pump chiller with same performance as rooftop unit (classroom loop only)
  - Option 2: Hot Water Baseboards served by central air-to-water HP and electric boiler boost
    - Variable speed pump per design
    - Electric boiler
    - Heat-pump chiller with same performance as central heat pump
- Equipment controls to properly stage the heating equipment per the intended sequence of operation

5.3.2 Chilled Water Loop

No chilled water is included in the proposed design. For the GSG Baseline > 150,000 ft^2, the chillers shall be modeled according to the appropriate standard with input features as outlined in the "Input Summary Report".

5.3.3 Hot Water Loop/Two-Pipe Loop to Simulate Rooftop Heat Pump Heating

5.3.3.1 Hot Water Loop Dialog, Basic Specifications Tab

Description	Value	Notes
Loop Name	*NAME*	
Loop Type	2-Pipe	Each loop must be one of six available types
Loop Subtype	Primary	Secondary loops are served exclusively by primary loops
Sizing Option	Default	Size per "Secondary" if Boiler size unknown, and "Primary" if boiler size is known. Baseline will always be "Secondary".
Design CHW Temp	Default	Unit is never used for cooling
Design HW Temp	105°F	The HW supply temperature needs to be at least 10°F higher than the air supply temperature, or eQuest will produce an error. The performance curves have been revised to account for the difference
Loop Design DT	10°F	Design temperature change of the fluid in the loop
Fluid Volume	Default	Total volume of the fluid in the loop
Avg Circ Time	Default	Average time it takes for the fluid to circulate through the loop (at the design flow rate)
Loop Recirc Flow	Default	Recirculating flow rate of the fluid in the loop when the pump is running
Pipe Head	0.01	Should be minimal
Static Head	0	Closed Loop – No Static Head (no lift against atmosphere)
Loop Pump	*NAME*	Name of the dedicated Pump that pumps this loop
Loop Minimum Flow	Default	Minimize Pumping Power
Loop Size Ratio	Default (1.0)	No safety factor applied to loop sizing. Required safety factor for baseline applied at the airside cooling and heating loads.

5.3.3.2 Hot Water Loop Dialog, Process/DHW Loads

This shall be zero and the domestic hot water shall be served by a separate loop.

5.3.3.3 Hot Water Loop Dialog, Losses

No pipe losses shall be modeled in either proposed or baseline for compliance models.

5.3.3.4 Hot Water Loop Dialog, Head Tab

Description	Value	Notes
Head Setpoint Control	Valve-Reset	Type of control sequence used to control the head setpoint of the loop circulation pumps
Head Sensor Location	At Coils	When shown in the design use the actual location of the differential pressure sensor
Head Setpoint	0.1 ft	Typical Coil Pressure drop.
Head Setpoint Range	Default (2 ft)	Throttling range of the head setpoint controller
Head Setpoint Ratio	Default (1.0)	No safety factor applied for compliance model.

5.3.3.5 Hot Water Loop Dialog, Operation Tab

Description	Value	Notes
Loop Operation	Snap	Hot Water is scheduled to be available per the Heating schedule in the zones, but the plant only operates when there is a demand, not continuously during occupied times if "standby" were used.
Cooling Schedule	n/a	Specified if Loop Operation set to "scheduled"
Heating Schedule	n/a	Specified if Loop Operation set to "scheduled"
Pump Schedule	-undefined-	Pumps shall run when needed
Snap Temp	70°F	This is the temperature below which the Loop would be indexed "on" for heating. Although this loop type and chiller type can provide both heating and cooling, this loop is intended to supply heating only.
Snap Location	Outdoor	Location of the snap-acting temperature sensor that turns the loop on or off (Outdoor or zone)
Snap Zone	n/a	The zone whose temperature is monitored to determine whether the loop is active

5.3.3.6 Hot Water Loop Dialog, Controls Tab

Description	Value	Notes
Loop Flow Reset	n/a	Fraction of design flow rate to which the flow is reduced, prior to initiating a temperature reset
Loop Setpoint Range	Default 2.0°F	Throttling range of the loop temperature controller. Needed to allow subroutines to converge.
Heat Setpoint Control	Fixed	The loop temperature control sequence. The curves have been developed using 100°F supply temperature.
Heat Setpoint Temperature	105°F	The loop heating setpoint. Applicable when Heat Setpoint Control set to "Fixed"
Heat Reset Schedule	n/a	The name of a schedule that defines the rules of an outdoor air reset. Schedule must be type "RESET-TEMP"
Heat Setpoint Schedule	n/a	Specifies the loop heating setpoint schedule. Applicable when Heat Setpoint Control set to "Fixed"
Heat Equipment Control	n/a	The name of an Equipment Control sequence for the primary heating equipment that serves this loop.

		Equipment controls are not required for the rooftop heatpump loop.
Max Reset Temp	Proposed: n/a Baseline: n/a °F	The maximum allowable supply-side loop temperature (only used in Chilled Water or Two Pipe loops)
Min Reset Temp	Proposed: n/a Baseline: n/a	The minimum allowable supply-side loop temperature (only used in Hot Water or Two Pipe loops)

5.3.3.7   Hot Water Loop Dialog, Auxiliaries Tab

Auxiliary load shall be modeled as zero.

5.3.4   Air-Source Heat Pump

The air-source heat pump should be modeled as a chiller of TYPE = HEAT-PUMP

5.3.4.1   Heat Pump Chiller Properties, Basic Specifications Tab

Description	Value	Notes
HP Chiller Name	*NAME*	The name of the chiller component, should match mechanical drawing tag for the HP units.
Chiller Type	HEAT-PUMP	Air-source heat pumps are included in the chiller equipment
CHW Loop assignment	*	This is the Two-pipe loop the unit is attached to. Although it is listed as a chilled water loop, the plant unit will provide heating only. Cooling will be performed by DX in the air handling unit.
Electric Meter	Default (EM1)	Name of the Electric Meter that tallies the electric consumption
Fuel Meter	Default (FM1)	Name of the Fuel Meter that tallies the fuel consumption
Capacity	*	Nominal heating capacity in MBTU/hr. Leave blank if HP sizes are not yet known.
Capacity Ratio	1.25	Fraction of the design heating load used to size boiler when capacity is not known.
Min Ratio	0.25	Defines the minimum fraction that the heat pump can turn down to.
HGB Ratio	Default (blank)	This is the maximum allowable part-load ratio of the chiller, above which hot gas bypass occurs
Heat/Cool Cap	1	The ratio between the cooling capacity and the heating capacity
Elec Input Ratio	Default (0.391)	Ratio of electrical input (in Btus) to full load cooling capacity (in Btus), at rated conditions. The unit is not used for cooling, so this value is not important
Heating EIR	*	Heating electric input ratio (1/COP) of unit at rated conditions. The COP should not include the fan power component, per the standard ASHRAE modeling methodology, since the fans are already accounted for in the air-side systems.

5.3.4.2 Heat Pump Chiller Properties, Condenser Tab

Description	Value	Notes
Condenser Type	Air-cooled	Sometimes eQuest will give an error that air-cooled is of an incompatible type. If this happens, leave the entry blank.
Elec to Condenser	1 (default)	The amount of heat that is rejected through the condenser
Min Cond Temp	60°F	The minimum allowable value for the condensing temperature setpoint. The program will allow an input of 60°F minimum. The default is 65°F.

5.3.4.3 Heat Pump Chiller Properties, Performance Curves

Description	Value	Notes
Electric Input Ratio, F(t evap leaving, t cond entering)	Default	Not used- the unit is not used for cooling
Electric Input Ratio, F(part load ratio)	Default	Not used- the unit is not used for cooling
Cooling Capacity, F(t evap leaving, t cond entering)	Default	Not used- the unit is not used for cooling
Heating Elec Input Ratio, nf & frst F(t evap leaving, t cond entering)	PROP-HPC-HT-EIR-FT	The curve has been modified to account for different rating conditions of central air-to-water heat pump chillers and rooftop air-to-air heat pumps. The same curve should be used for frost and no frost conditions.[9]
Heating Electric Input Ratio, F(part load ratio)	PROP-HPC-HT-EIR-FPLR	The curve has been modified to account for different rating conditions of central air-to-water heat pump chillers and rooftop air-to-air heat pumps
Electric Heating Capacity, nf & frst F(t evap leaving, t cond entering)	PROP-HPC-HT-CAP-FT	The curve has been modified to account for different rating conditions of central air-to-water heat pump chillers and rooftop air-to-air heat pumps. The same curve should be used for frost and no frost conditions.

5.3.4.4 Heat Pump Chiller Properties, Loop Attachments Tab

Description	Value	Notes
Pump	Default	Only loop pump is needed
Delta T	Default	Default is adequate
Head	1	This is the lowest acceptable value
Static Head	1	This is the lowest acceptable value

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[9] Air-to-air heat pumps do not have provisions for frost and no-frost conditions

5.3.4.5 Heat Pump Chiller Properties, Miscellaneous Tab

Use all defaults.

5.3.5 Hot Water Loop/Two-Pipe Loop to Simulate Baseboard Heating, Option 1

This section describes how to model electric resistance baseboards with morning warm-up via the air-source heat pump. eQuest does not have controls which adequately control the baseboard heating. Additional baseboard loops are required.

5.3.5.1 Baseboard Loops Serving Classrooms, Option 1

This section describes how to model baseboard loop for a system where the rooftop unit is not intended to provide high temperature air during normal operating conditions, such as the systems serving classrooms. To avoid overheating, the classroom systems provide tempered air during occupied hours, and the baseboards pick up the skin loads as needed.

1. Create a 2-pipe loop as described in 5.3.3
2. Create a heat pump chiller that is the same as the one serving the rooftop units with adjustments
3. Create an electric boiler with efficiency = 1 and head = 1 (loop attachments tab). Assign to loop
4. Create equipment controls
5. Assign load management

5.3.5.1.1 Heat Pump Chiller, Option 1

The heat pump chiller will be identical to the one used for the heat pump heating loop, but adjustments need to be made to account for fan power. The heat pump will be providing heating via the baseboards. To estimate the fan power, the following changes should be made to the miscellaneous tab.

Description	Value	Notes
Power	0.3 * full load fan power of rooftop units serving baseboard loop area	This estimates that the fans will operate at 50% of full load during warm-up
Schedule	When On	
Meter	HP-FAN-METER	

5.3.5.1.2 Equipment controls, Option 1

Three equipment controls need to be created. Template names may be updated as needed.

Keyword	Equipment Control 1	Equipment Control 2	Equipment Control 3
Template Name	BBRD-ELC-EQP-CTRL	BBRD-MIX-EQP-CTRL	BBRD-HP-EQP-CTRL
Description	Electric boiler only	Mix of electric boiler and heat pump chiller	Heat pump chiller only
When Used	Occupied hours, when skin loads are present	During warm-up, when weather is very cold	During warm-up, normal conditions
TYPE	Heating	Heating	Heating
Circulation Loop	Baseboard loop	Baseboard loop	Baseboard loop
LOADS-THRU-1	99 (all loads)	99 (all loads)	99 (all loads)
BOILER-1	Name of electric boiler	Name of electric boiler	Not Used

CHLR/HTR-1	Not Used	Name of heat pump chiller	Name of heat pump chiller
BOILERS-SEQ-1	1	1	Not used
CHLR/HTRS-SEQ-1	Not used	1	1

5.3.5.1.3   Load Management for Baseboards, Option 1

Two Load Management sequences need to be created. Template names may be updated as needed. The load management temperatures may be adjusted as needed. The temperature where the baseboards turn off for the daytime sequence should be set to the minimum required to avoid excessive underheated hours. This value will depend on the wall construction.

For the nighttime sequence, the outdoor air temperature where the baseboards are served by electric only should be adjusted to reflect the minimum operating temperature of the outdoor air unit. The temperature used for mixed-mode heating should be set to the minimum required to avoid excessive underheated hours.

Keyword	Load Management 1	Load Management 2
Template Name	BBRD-DAY-LM	BBRD-NGT-LM
Description	Electric Heating to baseboards during day	Heat pump heating during warm-up
When Used	Occupied hours	During warm-up
TYPE	Outside Air Temperature	Outside Air Temperature
Qualification Schedule	BBRD-LP-LM-SCH	BBRD-LP-LM-SCH
Qualification Schedule Flag	1	2
Max OSA Temp/ TEMPS-THRU-1	30 (temperature where baseboards turn off during day. Will be project specific. Put in minimum value possible with acceptable underheated hours)	10 (minimum temperature heat pump can operate at. This will depend on heat pump equipment. Electric heat only used below this temperature)
EQUIP-CTRLS-1	BBRD-ELC-EQP-CTRL	BBRD-ELC-EQP-CTRL
Max OSA Temp/ TEMPS-THRU-2	100	20 (temperature where heat pump needs supplemental electric heat)
EQUIP-CTRLS-2	Not Used	BBRD-MIX-EQP-CTRL
LOOPS-OFF-2	Name of Baseboard Loop	Not Used
Max OSA Temp/ TEMPS-THRU-3	Not Used	55 (Max temperature heating is expected to be used)
EQUIP-CTRLS-3	Not Used	BBRD-HP-EQP-CTRL
Max OSA Temp/ TEMPS-THRU-4	Not Used	100
LOOPS-OFF-4	Not Used	Name of Baseboard Loop

5.3.6 Hot Water Loop/Two-Pipe Loop to for Baseboard Heating with Central Heat Pump, Option 2

This section describes how to model the baseboard heating loop where heat is provided by a central air-to-water heat pump. Air-to-water heat pumps are limited in the maximum temperature water they can provide. Depending on the design selection, an additional electric boiler may be required to boost the water temperature.

5.3.6.1 Baseboard Loops, Option 2

This section describes how to model baseboard loop for a system where heat is provided by a central air-to-water heat pump. This method applies to all hydronic radiators in the building.

1. Create a 2-pipe loop
2. Create baseboard pumps
3. Create a heat pump chiller that represents the proposed central air-to-water heat pump equipment
4. Create an electric boiler with efficiency = 1.
5. Create equipment controls
6. Assign load management

5.3.6.1.1 2 pipe loop, Baseboard Option 2

Create a 2-pipe loop as described in 5.3.3 with the following changes:

Hot Water Loop Dialog, Basic Specifications Tab

Description	Value	Notes
Loop Name	*NAME*	
Loop Type	2-Pipe	Each loop must be one of six available types
Loop Subtype	Primary	Secondary loops are served exclusively by primary loops
Design CHW Temp	Default	Unit is never used for cooling
Design HW Temp	Per design, 100°F as starting point	The maximum HW temperature that can be provided by the heat pump unit. This may be different than the design temperature of the baseboard
Loop Design DT	10°F	Design temperature change of the fluid in the loop
Pipe Head	0.01	As required by design to get correct head for pumps
Loop Minimum Flow	30%	Per design document

Notes: The performance of the heat pump depends on the leaving water temperature. The outlet temperature from the air-to-water heat pump is limited by the equipment selection. If the Design HW Temp is set based on the baseboard temperature, then the model will allow the air-to-water heat pump to provide water at that temperature, even though the equipment cannot operate this way in reality. This may underestimate the heating energy. The heating energy split between the air-to-water heat pump and the electric boost will be addressed in the electric boiler and equipment controls sections.

5.3.6.1.2 Heat Pump Chiller, Baseboard Option 2

The heat pump chiller should be modeled per the design documents. Unlike the heat pump chiller described in 5.3.4, which is actually an air-to-air heat pump and requires special curves to account for the change in rating conditions, the central heat pump is an air-to-water heat pump and can be modeled directly in eQuest. The heat pump chiller should be modeled in the same manner as described in 5.3.4, using design data where available. The performance curves are as follows:

Heat Pump Chiller Properties, Performance Curves

Description	Value	Notes
Electric Input Ratio, F(t evap leaving, t cond entering)	Default	The eQuest default is RecipAir-EIR-fPLR-4Comp/Ckt
Electric Input Ratio, F(part load ratio)	Default	The eQuest default is ChlrHPAirCoolEIR-fCHW&OAT
Cooling Capacity, F(t evap leaving, t cond entering)	Default	The eQuest default is ChlrHPAirCoolCap-fCHW&OAT
Heating Elec Input Ratio, nf F(t evap leaving, t cond entering)	Default	The eQuest default ChlrHPAirHeatEIR-fHW&39+
Heating Elec Input Ratio, frst F(t evap leaving, t cond entering)	Default	The eQuest default is ChlrHPAirHeatEIR-fHW&39-
Heating Electric Input Ratio, F(part load ratio)	DX-Heat-EIR-fPLR	There is no eQuest default
Electric Heating Capacity, nf F(t evap leaving, t cond entering)	Default	The eQuest default is ChlrHPAirHeatCap-fHW&39+
Electric Heating Capacity, frst F(t evap leaving, t cond entering)	Default	The eQuest default is ChlrHPAirHeatCap-fHW&39-

5.3.6.1.3 Electric Boiler, Baseboard Option 2

The hot water boost to the baseboard loop will be provided by an electric boiler. The electric boiler should be modeled per the design documents, with the exception of the capacity. To allow the proper split between the heating from the central heat pump and the electric boost, the boiler needs to be sized based on the inlet and outlet temperatures of the baseboards, and the maximum supply temperature of the central heat pump.

Note: The modeled size may be significantly different from the design documents. However, this should have little impact on the energy use since the performance of electric resistance boilers typically vary

linearly based on load. This sizing difference is needed to allow eQuest to prorate the load in the equipment controls.

$$\%Q_{EBLR} = \left(\frac{T_{BB,Supply} - T_{Max,HP}}{T_{BB,Supply} - T_{BB,Return}}\right)$$

$$Cap_{EBLR} = \frac{Cap_{HP}}{(1 - \%Q_{EBLR})}$$

Where:

$\%Q_{EBLR}$ = % of baseboard load provided by electric boiler

$T_{BB,supply}$= Design inlet temperature of baseboards

$T_{Max,HP}$ = Maximum water temperature the heat pump can supply

$T_{BB,Return}$ = Design return temperature of baseboards

Cap_{EBLR} = Modeled capacity of electric boiler

Cap_{HP} = Design (and modeled) capacity of heat pump

If the modeled capacity of the boiler is less than the design capacity, a second boiler should be created to meet the load when the outdoor air temperature does not allow operation of the heat pump. In this case, the total modeled boiler capacity should match the design document. If the modeled capacity of the boiler is greater than the design value, no additional action needs to be taken, but the modeler should verify that the peak demand does not exceed the design capacity.

5.3.6.1.4   Equipment controls
Two equipment controls need to be created. Template names may be updated as needed.

Keyword	Equipment Control 1	Equipment Control 2
Template Name	HBBRD-ELC-EQP-CTRL	HBBRD-MIX-EQP-CTRL
Description	Electric boiler only	Mix of electric boiler and heat pump chiller
When Used	When temperature is below heat pump operating point	When temperature is above heat pump operating point
TYPE	Heating	Heating
Circulation Loop	Baseboard loop	Baseboard loop
Prorate Load?	Yes	Yes
LOADS-THRU-1	99 (all loads)	99 (all loads)
BOILER-1	Name of electric boiler(s)	Name of electric boiler sized as described in 5.3.6.1.3

CHLR/HTR-1	Not Used	Name of heat pump chiller
BOILERS-SEQ-1	1	1
CHLR/HTRS-SEQ-1	Not used	1

5.3.6.1.5   Load Management

One Load Management sequence needs to be created. Template names may be updated as needed. The load management temperatures may be adjusted as needed. The temperature where the baseboard hot water is provided by the electric boiler(s) only should be adjusted based on the minimum operating temperature of the heat pump. The temperature where the baseboards turn off should be set to the minimum required to avoid excessive underheated hours. This value will depend on the wall construction.

Keyword	Load Management 1
Template Name	HYD-BBRD-LM
Description	Electric Heating to baseboards during day
TYPE	Outside Air Temperature
Max OSA Temp/ TEMPS-THRU-1	10 (minimum temperature heat pump can operate at)
EQUIP-CTRLS-1	HBBRD-ELC-EQP-CTRL
Max OSA Temp/ TEMPS-THRU-2	30 (max outdoor temp baseboards should operate. Will be project specific. Put in minimum value possible with acceptable underheated hours)
EQUIP-CTRLS-2	HBBRD-MIX-EQP-CTRL
LOOPS-OFF-3	Name of Baseboard Loop
Max OSA Temp/ TEMPS-THRU-3	100
EQUIP-CTRLS-3	Not Used

5.4   Service Water Loop (DHW)

A separate Domestic Hot Water Loop shall be specified for both the proposed and baseline.

5.4.1   DHW Loop Dialog, Basic Specifications Tab

Description	Value	Notes
Loop Name	*NAME*	
Loop Type	Domestic Hot Water	Each loop must be one of six available types
Loop Subtype	Primary	Secondary loops are served exclusively by primary loops
Sizing Option	Secondary	DHW loop properties shall always be sized by the load.

Design HW Temp	140°F	Domestic Hot Water tank setpoint to prevent Lysteria growth.
Loop Design DT	80°F (Water Main Temp 40°F)	Design temperature change of the fluid in the loop
Fluid Volume	Default	Total volume of the fluid in the loop
Avg Circ Time	Default	Average time it takes for the fluid to circulate through the loop (at the design flow rate)
Loop Recirc Flow	2 gpm	Nominal flow to maintain recirculation line temperature. Note, this flow is applied for full hour to determine pump energy use. For designs where pumps shall operate for only a portion of the hour, estimate this flow accordingly.
Pipe Head	Pump Pressure drop minus Coil Pressure drop	Friction loss in the loop due to the piping and related trim
Static Head	0	Closed Loop – No Static Head (no lift against atmosphere)
Loop Pump	*NAME*	Name of the dedicated recirculation pump that pumps this loop
Loop Minimum Flow	0	Minimum allowable flow rate in the loop, expressed as a fraction of the design flow rate
Loop Size Ratio	Default (1.0)	No safety factor applied to loop sizing.

5.4.2   DHW Loop Dialog, Process/DHW Loads

Under the NYCECC 2020, the domestic hot water load shall be the same for the proposed and baseline models. For the GSG model, savings in load may be modeled as long as the numbers are consistent with those reported in credit W2.1R for hot water load only. The same schedule of use is required for both, and should be consistent with the Equivalent Full Load hours calculated in the GSG W2.1R.

5.4.3   DHW Loop Dialog, Losses

No pipe losses shall be modeled in either proposed or baseline for compliance models.

5.4.4   DHW Loop Dialog, Head Tab

No pressure controls are allowed to be modeled with a DHW Loop.

5.4.5   DHW Loop Dialog, Operation Tab

Description	Value	Notes
Loop Operation	Standby	To model water heater cycling to maintain tank temperature the loop operation should be modeled as "standby". If instantaneous hot water heaters are used then loop operation may be modeled as "demand".
Cooling Schedule	n/a	Specified if Loop Operation set to "scheduled"
Heating Schedule	n/a	Specified if Loop Operation set to "scheduled"

Pump Schedule	-undefined-	Define a pump schedule to set the number of hours the recirculation pump functions, if the pump contribution is unrealistic.
Snap Temp	n/a	
Snap Location	n/a	
Snap Zone	n/a	

5.4.6 DHW Loop Dialog, Controls Tab

Description	Value	Notes
Loop Flow Reset	n/a	Fraction of design flow rate to which the flow is reduced, prior to initiating a temperature reset
Loop Setpoint Range	n/a	Throttling range of the loop temperature controller. Needed to allow subroutines to converge.
Heat Setpoint Control	Fixed	The loop temperature control sequence
Heat Setpoint Temperature	120°F	The loop heating setpoint. This is the temperature of the water delivered to the fixture.
Heat Reset Schedule	n/a	
Heat Setpoint Schedule	n/a	
Heat Equipment Control	n/a	The name of an Equipment Control sequence for the primary heating equipment that serves this loop. May be required in project specific applications where the engineer has specified certain equipment should only be used to handle certain loads or only operate certain times of year.
Max Reset Temp	n/a	The maximum allowable supply-side loop temperature (only used in Chilled Water or Two Pipe loops)
Min Reset Temp	n/a	The minimum allowable supply-side loop temperature (only used in Hot Water or Two Pipe loops)
Min Alarm Temp	Default (110°F)	Defines alarm conditions to assist in debugging model.

5.4.7 DHW Loop Dialog, Auxiliaries Tab

Auxiliary load shall be modeled as zero. This input is intended to be used to model an auxiliary electrical load associated with the operation of the hot water loop that does not affect the heating load, which is not in the scope of these compliance models. To model the electrical controls consumption on a proposed Water Heater go to the Water Heater Properties Dialog box and input this value under the miscellaneous tab.

5.5 Electric Heat Pump Domestic Water Heater

The gas-fired hot water heater is not part of the SCA standard and has been removed from the template. Direction on modeling a gas-fired DHW heater has been moved to Appendix.

5.5.1 Domestic Water Heater Properties, Basic Specifications Tab

Description	Value	Notes
DHW Heater Name	*NAME*	The name of the component, should match the plumbing drawing tag.
Type	Heat Pump	Proposed
	Electric	GSG & NYC ECC Baselines
DHW Loop assignment	*	Name of the Domestic Hot Water Loop that this equipment is assigned to
Fuel Meter	n/a	Name of Fuel Meter.
Electric Meter	Default	Name of the Electric Meter.
Equipment Capacity	*	Leave Capacity Blank until design intent or schedule values are available. Should match the input rating of proposed hot water heater, and in the baseline should be the proposed hot water heater output divided by the baseline efficiency.
Capacity Ratio	1	No oversizing factor in DHW equipment sizing.
Heating Input Ratio (HIR)	n/a	Used for gas-fired
Elec Input Ratio	1/COP or 1/EF	Per design documents or baseline requirements
Tank Volume	*	Size of equipment tank. Match between baseline and proposed (per design documents.
Tank UA	*	Nominal Tank UA from manufacturer's literature.
Location	Outdoor	Location the hot water tank exists. May be modeled as outdoors if too much heat for the assigned space.
DHW Zone	*	Generally found in mechanical rooms.
Max HP Tank T	100	Maximum temperature that can be provided by heat pump portion of heater- remainder is provided by supplemental electric heat. Used only for heat pump equipment, per design documents.

5.5.2 Domestic Water Heater Properties, Performance Curves

Use default values for performance curves.

5.5.3 Domestic Water Heater Properties, Pump

If a DHW circulation pump is included in the design, specify the pump in the Attachments tab. The pump power should be the same in the design and baseline.

5.5.4 Domestic Water Heater Properties, Miscellaneous

Use default values for auxiliaries.

5.6 Pump

The following tables cover general pump input details. Loop specific pump information is self-explanatory.

Description	Value	Notes
Pump Name	*NAME*	The name of the pump component
Number of Pumps	*	Model exact number of normal operating pumps in the proposed (no standby pumps), one single pump shall be modeled in the baseline.
Pump Head	*	Design pressure rise of the fluid across the pump at rated flow. Shall equal the Control Head + Pipe Head at rated flow to avoid errors in running the model.
Pump Flow	*	Leave blank unless design flowrate of the pump is known.
Flow Ratio	Default (1.0)	When autosizing, DOE 2.2 oversizes the head imparted by the Loop Pump using this ratio
Max Pump Ratio	Default(1.3)	When autosizing, DOE 2.2 oversizes the design flowrate of the Loop Pump using this ratio
Pump Head Setpoint	Default	The design setpoint of the pump's differential head pressure sensor
Head Setpoint Ratio	n/a	Head Setpoint Ratio shall be 1.0 to avoid oversizing.
Pump Power	*	Alternate pump sizing input. Power input shall be at the design flow condition.
Motor Efficiency	0.895	Efficiency of the pump motor (default is based on Motor Class & Pump Power). Should be avoided in the proposed model unless the size of the pump motor is constant throughout the design, but is very useful in the baseline model.
Mech Efficiency	0.65	Mechanical Efficiency of the pump impeller. Assume 0.65 for all baseline inputs to assist SCA in their review.
Minimum Speed	0.30	The lower speed of a 2-speed pump, or the minimum speed of a variable-speed pump
Motor Class	*	Efficiency classification of the motor (High & Premium Efficiency are based on NEMA standards). Selecting this input allows the software to calculate the motor efficiency based on the design motor size.
Capacity Ctrl	Variable Speed Pumps	Both cases shall model the associated coil valves as "Two-Way" to make sure the secondary loop is variable flow. To model a baseline pump "riding-pump-curve" then the capacity control should be set to "One Speed Pump" with two way valves on coils.
Pump Head f(flow)		Name of Cubic Curve Fit: the part load head imparted by the pump as a function of the flow rate. Same curve should be used between proposed and baseline.
Pump Power f(flow)		Name of Cubic Curve Fit: the part load horsepower input to the pump as a function of the flow rate. Same curve should be used between proposed and baseline.
Pump Power Exponent	Default (3.05)	How pump horsepower varies with speed (when all other parameters obey the ideal pump laws)
Electric Meter	Default (EM1)	Name of the Electric Meter that tallies the electricity consumption of the pump.

5.6.1 Baseline pump inputs

5.6.1.1 ECB method pump inputs

The NYC ECC 2020/LL32 baseline is based on ASHRAE 90.1-2016 Chapter 11 – Energy Cost Budget method. The methodology for determining the inputs for the pumping power is described in the following sections:

- Table 11.5.2-1.e – If the design has no chilled water pumps, the baseline shall have a CHW pumping efficiency of 22 W/GPM. If the design has no condenser water pumps, the baseline shall have a CW efficiency of 19W/GPM.
- Table 11.5.2-1.f – If the design has no hot water pumps, the baseline shall have a HW pumping efficiency of 19W/GPM.

While notes e and f for Table 11.5.1-1 do call for the pumping system power to be the same in the baseline as in the design, the general modeling practice has been to interpret this as "same W/GPM" rather than "same kW (and flow rate)". This is because the baseline very often has different sizes for the equipment, running at different temperature drops across the loops than the design. Loop flow rates are a function of equipment size and temperature drops. Using the design case flow rate and pump power can lead to situations where the pumps are mismatched to the baseline loop and operate in unrealistic conditions, potentially with efficiencies greater than 100%.

Also, to support the kW/GPM interpretation, the HVAC equipment in the ECB method should be sized using the same sizing factors as the design (11.5.2.i), and the fans should have the same bhp/CFM efficiency up to the fan power limit (11.5.2.h). It therefore seems more in line with the general intent of the ECB method to use the same pump system efficiency in the baseline as in the design, rather than the same absolute power.

5.6.1.2 General baseline pump inputs

In the LL32 and GSG Baseline models the pump power is defined in the code as a power density: 19 W/gpm for hot water, 22 W/gpm for chilled water, and 19 W/gpm for condenser water. These numbers represent the entire water loop power allowance. When modeling a primary/secondary loop the baseline, the model shall mimic the proposed model breakdown of primary to secondary pump power, or use a 50/50 split of primary to secondary pump power if the proposed is primary only.

Pump power can also be entered into equipment specifications (chiller, boiler). The primary pumps in a primary/secondary configuration should be entered as equipment pumps to properly model sequentially loading (i.e. chiller 1 operates up to design, and then chiller 2 is indexed "on" in a typical baseline model) of the equipment.

Dialog	Tab	Description	Value
Equipment	Loop Attachments	Delta T (match chiller value)	10.0
	Loop Attachments	Flow Ctrl	Variable Flow
	Loop Attachments	Head	*
	Loop Attachments	Static Head	0
	Loop Attachments	Minimum Flow	0.3 unless actual is known
	Loop Attachments	Maximum Flow	1.0

6 Air-Side HVAC

6.1 General

This section features those inputs that are significant to represent the standard proposed design, and typical associated baselines. This section does not explicitly cover all baseline systems available for use. It is up to the user to ensure the baseline is properly modeled in accordance with the standards, PRM method/ECB method. The path of compliance is slightly different for each method, which leads to slighting different outcomes.

The PRM primary system type is selected in a straightforward manner by using the tables, proposed energy sources, and the numerous sections that stipulate baseline features; but to model another system type is not as simple. The user must make the argument that a certain set of proposed spaces fall under one of the exceptions and thus can be modeled in the baseline as being served by an alternate system. Different sets of spaces may fall under different exceptions and get to be assigned to their own system type.

Additionally, the PRM has specific rules about how many systems are required in the baseline based upon the number of floors for Systems 5-8 or the number of thermal zones modeled, for all other system types. Due to these rules, the number of systems does not necessarily match up with the proposed model, and some thermal zones served by a constant volume system in the proposed model may end up being served by a variable volume system in the baseline. While it is outside the scope of this document to dictate when a user should use an exception, the user should review and use the allowances when determining what spaces fall under an exception. All choices should be defensible, and back-up documentation should be available.

The ECB method is not as straightforward in selecting and modeling a system because many of the rules are system specific and all the rules are table footnotes. The ECB method does allow for easier comparison between the proposed systems and the baseline systems because under this method each proposed system is mapped one-to-one to a baseline system.

For packaged system types such as PSZ, PVAVS, PTAC, PVVT and HP the software expects the cooling and heating EIR values to be specified at AHRI testing conditions. The design case model should use EER, SEER, COP and HSPF values specified at AHRI conditions, not at project-specific design conditions. The baseline values from the ASHRAE 90.1 standards are already specified at AHRI testing conditions.

The ASHRAE 90.1 standard requires the packaged efficiency ratings that include cooling and heating coil fans to be entered without this component, and the fans be modeled separately (ASHRAE 90.1-2010 G3.1.2.1 and ASHRAE 90.1-2016 11.5.2.c). The formulas provided in ASHRAE 90.1-2016 11.5.2.c should be used for calculating the efficiency ratings without the fan power for the design case as well as the LL32 and GSG baselines, since ASHRAE 90.1-2010 does not include any guidance in this regard.

The software allows for accurate control over the HVAC system. The acceptable deviation of modeled equipment sizes relative to the mechanical systems is ±1% for general systems and ±5% for motors smaller than 1HP, air flows less than 20 CFM and coil sizes less than 6 kBtu/h.

6.1.1 CLASS-SYS, Natural Gas Heating

The standard proposed systems for classrooms are central air handling units serving variable volume boxes. Core areas may have reheat coils. The proposed system overrides the supply air reset controls

to maintain appropriate supply air conditions to maintain space humidity setpoint. The proposed hot water and chilled water loops are glycol mixes so the variable air volume boxes can back off to the minimum outdoor air before requiring reheat. The baseline should be modeled in a manner consistent with 6.5.2.3.

Basics Tab		
Description	Value	Notes
System Name	*CLASS-SYS*	The name of the component
System Type	VAVS	Variable Air Volume System, allows for use of chilled water and hot water coils (Proposed design and GSG Baseline >150,000 ft^2)
	Pkgd Var Vol	Packaged VAV system (NYCECC 2020 Baseline & GSG Baseline < 150,000 ft^2)
Return Air Path	Default (Duct)	A "Direct" return air path is also acceptable as no duct losses are to be modeled. "Plenum" return shall not be used.
Control Zone	n/a	It is assumed that each thermal block consists of one control zone.
System Reports	Default (Yes)	
System Sizing	Default (1.0)	Adjust as necessary for design to match design documents. No System oversizing in baseline. Oversizing shall take place at heating/cooling coils.
Duct Air Loss, Supply Duct UA, Duct Delta T	n/a	No duct losses shall be modeled for compliance.
Maximum Humidity	Default (100%)	Zone humidity indirectly controlled via minimum supply temperature
Minimum Humidity	Default (0.0%)	No humidifier, so left as default.

Fans Tab		
Description	Value	Notes
Supply Static (in W.G.)	*	Weighted Average of all actual systems that this unit encapsulates.
Tot Eff. Frac	Default (0.63)	This input should be adjusted when scheduled values are available to make the modeled design fan power match the scheduled AHU fan power.
Mech Eff Frac	Default (0.72)	This input should be adjusted when scheduled values are available to make the modeled design fan power match the scheduled AHU fan power.
Fan Schedule	"Class-Fan-Yr"	This defines the occupied and unoccupied schedule
Fan Control	FAN EIR FPLR	This allows variable volume operation with a defined fan curve
Fan EIR = f(PLR)	VAR-SPD-FAN	

Fan Placement	Default (Draw Through)	Typical fan placement.
Motor Placement	Default (In Airflow)	Fans expected to be in the airflow.
Flow Parameters, Design CFM	n/a	Supply flow should be defined here, may be different than the sum of the terminal unit airflows.
Flow Parameters, Min Flow (cfm/ft^2)	n/a	Should only be used as a last resort to eliminate an excess amount of unmet load hours.
Flow Parameters, Min Flow Ratio	n/a	Should only be used as a last resort to eliminate an excess amount of unmet load hours.
Min Fan Ratio	Default (0.30)	Minimum fraction the fan is allowed to back off to.
Max Fan Ratio	1.00	Maximum
Night Venting	Default (Not Available)	This control is not typical in this climate zone.
Night Cycle Control	Proposed Design "Stay-off"	Heating setpoints will be met by baseboards
	NYCECC 2020 & GSG baselines "CYCLE-ON-ANY"	When "any" zone exceeds their setback temperature, then the system shall come on to meet the setback temperature.

Credit for natural ventilation should not be modeled unless the proposed design is an active system. This can be a system that monitors the outdoor air conditions and automatically opens/closes intake dampers in each space, or uses a building management system to notify occupants in each room when to take advantage of natural ventilation by opening a window. Such a system should first be discussed with the SCA and approved for use.

Outdoor Air Tab, Outdoor Air and Economizer		
Description	Value	Notes
Minimum Outside Air	n/a	No Ratio should be defined for system.
Min. OA Control Method	DCV Zone Sensors (Proposed & NYCECC 2020) Fraction of Design Flow (GSG)	This control will maintain the design flow of outdoor air over various primary flows. The baseline should be modeled with the same control method.

In the event that the proposed system has demand control ventilation the value should be changed to the appropriate demand control value of space sensor or return sensor. |
| Min. OA Sizing Method | Sum of Zone OA | It is recommended that the design outdoor air flow be defined for each thermal zone to assist in reusing zone definitions for the baseline systems.

When using demand control space sensor this value will need to be changed to "Set by Critical Zone" and the |

		outdoor air input method revised to get the appropriate design value at the system.
Min Air Schedule	"CLASS-OA-YR"	Defines when the outdoor air damper is allowed to be open. Should be allowed during occupied times, and forced closed during unoccupied times.
Outside Air From System	n/a	Name of the 100% outdoor air system serving the system In project specific applications requiring duel heat recovery.
Air-side economizer cycle	Dual Enthalpy	Differential Enthalpy controls to limit economizer operation when outdoor air enthalpy exceeds return air enthalpy.
Drybulb High Limit	n/a	No drybulb high limit for Differential Enthalpy economizer controls.
Enthalpy High Limit	n/a	No Enthalpy limit for differential Enthalpy sensor. Baseline with a fixed enthalpy sensor shall have an Enthalpy High Limit of 28 Btu per the standard.
Lockout compressor	Default (no)	Cooling shall be allowed when economizer is not able to meet load alone.
Economizer Low Limit	n/a	A lower limit may be used when project specific controls require the heat recovery be available at a specific outdoor air temperature.
Maximum OA fraction	Default (1.0)	Define as less if designed. Should be 1.0 for baseline system.

Outdoor Air Tab, Heat Recovery 1		
Description	**Value**	**Notes**
ERV Device Installed	Yes	It is typical for the proposed system to have at least one stage of heat recovery. When construction documents are issued the actual heat recovery efficiency should be modeled.
ERV Device Type	Enthalpy Wheel	Revise if design documents include a different type of ERV device
Design Outdoor Airflow/Exhaust Airflow	Default (self-sizing)	The actual airflow should be included if available
HX Configuration	Counter Flow	Revise if design documents include a different type of ERV device
Effectiveness	50%*	Use this value as a starting point for both sensible and latent effectiveness. Revise based on design documents when information is available.
HX Air Film Resistance	Default	Use the default unless information is available from the ERV manufacturer
Air Film Resist Expo	Default	Use the default unless information is available from the ERV manufacturer
Operation	When Minimum OA	The ERV device should not operate if the system is in economizer mode, or during warm-up/cool-down

Make-up Air Temp Ctrl	Float	The heat wheel runs at full speed
Capacity Control	Modulate HX	Required for frost protection

* The effectiveness should be based on balanced flow.

$$\varepsilon = \frac{h_{OA,entering} - h_{OA,after\ recovery\ device}}{h_{OA,entering} - h_{return,,before\ recovery\ device}}$$

Outdoor Air Tab, Heat Recovery 2		
Description	Value	Notes
HX Power	Default	Use default kW/cfm unless additional data is available from the manufacturer
ERV Pwr f(PLR)	Default	
ERV Fans	HVAC Supply/Return	If the ERV in the design has its own fans, choose self-contained
ERV Fan Efficiency	Default (60%)	If the ERV in the design has its own fans, use the manufacturer's motor efficiency
Fan motor efficiency	Default (Standard)	
Fan Pwr @ Design Flow	Per Design Documents	Use only if ERV has its own fans
Fan Pwr/Unit Flow	Per Design Documents	Use only if ERV has its own fans
Delta P @ Dsgn Flow	0.5	Revise per manufacturer's data. Make sure that total system supply/return fan power matches design documents in SV-A
Pressure Drop Exponent	Default (1.01)	
Cond/Frost Ctrl	Use Cap Control	

Cooling Tab		
Description	Value	Notes
Cool Source	Chilled Water	
Total Cooling Capacity	*	Leave this value blank to let the software calculate based upon the supply air temperature and the supply air flow
Sensible Cooling Capacity	*	Leave this value blank to let the software calculate based upon the supply air temperature and the supply air flow
Cool Sizing Ratio	1.15	Oversizing ratio of cooling capacity, match the baseline requirement to minimize unmet load hours.
CHW Coil Head	*	This should match the "control Head" modeled in the chilled water loop definition to ensure proper pump modulation.
CHW Coil Delta T	12°F	Match baseline until actual values are available.

CHW Valve Type	Two Way	To allow the variable speed pumps to have an energy savings effect, all coils should be modeled with two-way valves.
CHW Loop	*NAME*	Name of the chilled water loop attached to
Coil Design Bypass Factor	Default (0.03)	Leave as default.
Min Supply Temp	56°F for GSG & NYCECC 2020 Design value when available	The lower bound of what is allowed off of the central cooling coil when supply air temperature needs to be reset.
Cool Control range	Default (4.0°F)	This default range is used to help the cooling components converge.
Availability Sch	*NAME*	Name of schedule that controls when cooling is available. Schedule is used to prevent the unintentional simultaneous heating and cooling with in a system.
Cool Control	Warmest	Telling the software to reset the temperature as part of the cooling controls sequence
Reset Priority	Airflow First	This resets the airflow down to minimum first, afterward the supply air temperature is allowed to vary between the stops setup previously.
Maximum Cooling Reset Temp.	55.0°F (design) 65.0°F (baselines	Maximum allowable reset temperature from the central cooling coil.
Minimum Cooling Reset Temp.	56.0°F for GSG &ECC, Design value when available	Minimum allowable reset temperature central cooling coil.
Cap. Curves	Default	The coil curves should all be default values.
Water-Side Economizer	Default (No)	There is not expected to be a water-side economizer in the proposed system.

Heating Tab		
Description	Value	Notes
Heat Source	Hot Water Loop	
Zone Heat Source	Hot Water Loop	
Heating Capacity	*	Leave this value blank to let the software calculate based upon the supply air temperature and the supply air flow
Heat Sizing Ratio	1.25	Oversizing ratio of heating capacity, match the baseline requirement to minimize unmet load hours.
HW Coil Head	*	This should match the "Control Head" modeled in the hot water loop definition to ensure proper pump modulation.
HW Coil Delta T	Proposed: 40°F Baseline: 50°F	Delta-T across coil used to determine the design GPM
HW Valve Type	Two Way	To allow the variable speed pumps to have an effect, all coils should be modeled with two-way valves.
HW Loop	*NAME*	Name of the water loop the coil is attached to

Zone HW Loop	*NAME*	Name of the water loop the coil is attached to
Max Supply Temp	92°F (ECC/GSG) Greater of 72°F and design value	The upper bound of what is allowed off of heating coil. Different than the heating setpoint.
Availability Sch.	*NAME*	Name of schedule that controls when heating is available. Schedule is used to prevent the unintentional simultaneous heating and cooling with in a system.
Unitary Power	*	Provide details of Furnace, if one of the sources is set to furnace.
Preheat Source	n/a	The preheat coil in the proposed design is in the 100% outdoor air system. Provide a preheat coil in the baseline model.
Baseboard Source	Hot Water Loop	
Baseboard Sched	n/a	Schedule that provides the relationship between the baseboard setpoint and the outside air. Not used for typical proposed designs
Baseboard Coil Head	*	Should match what is defined for the control head in the loop definition.
Baseboard Delta T	Proposed: 20-25°F Baseline: NA	No baseboard heat in baseline. Should be modeled as a reheat coil.
Baseboard Valve Type	Two-Way	To allow the variable speed pumps to have an effect, all coils should be modeled with two-way valves.
Baseboard Loop	*NAME*	Name of loop that coil is assigned to.
Cap. Curves	Default	Coil operating curves should be the default values from the library
Waste Heat	n/a	Hot water system waste heat recovery is not typical for proposed design

6.1.2   CLASS-SYS, Electric Heating

The standard proposed systems for classrooms are rooftop air-to-air heat pumps with supplemental radiant heating. The heat pumps provide heating during the warm-up period, and space-neutral air during occupied periods. Additional heating is provided by baseboards.

6.1.2.1   Basics Tab

Description	Value	Notes
System Name	*CLASS-SYS*	The name of the component
System Type	Proposed- PVAVS	Packaged Variable Air Volume System, cooling via DX, heating from hot water (work-around)
	Baselines- Powered Induction Unit	Packaged induction unit.

Return Air Path	Default (Duct)	A "Direct" return air path is also acceptable as no duct losses are to be modeled. "Plenum" return shall not be used.
Control Zone	n/a	It is assumed that each thermal block consists of one control zone.
System Reports	Default (Yes)	
System Sizing	Default (1.0)	Adjust as necessary for design to match design documents. No System oversizing in baseline. Oversizing shall take place at heating/cooling coils.
Duct Air Loss, Supply Duct UA, Duct Delta T	n/a	No duct losses shall be modeled for compliance.
Maximum Humidity	Default (100%)	Zone humidity indirectly controlled via minimum supply temperature
Minimum Humidity	Default (0.0%)	No humidifier, so left as default.

6.1.2.2   Fans Tab
Same as gas-heating.

6.1.2.3   Outdoor Air Tabs
Same as Gas heat.

6.1.2.4   Cooling Tab, Basic Specifications
The modifications to the cooling tab apply to systems with DX cooling (proposed design, NYC ECC Baseline, and the GSG Baseline <150,000). Systems taking cooling from a chiller should refer to the CLASS-SYS with gas heating section.

Description	Value	Notes
Cool Source	n/a	Proposed- DX cooling
	Electric DX	NYC ECC Baseline, GSG Baseline < 150,000 Required for Power Induction Units
	Chilled Water	GSG Baseline > 150,000 Required for Power Induction Units, see gas heating section for all other inputs
Total Cooling Capacity	Per design documents	Leave this value blank to let the software calculate based upon the supply air temperature and the supply air flow for baselines
Sensible Cooling Capacity	Per Design Documents	Leave this value blank to let the software calculate based upon the supply air temperature and the supply air flow for baselines
Cool Sizing Ratio	1	Proposed. Adjust As required to match design capacity.
	1.15	Oversizing ratio of cooling capacity. Match the baseline requirement to minimize unmet load hours. NYC ECC baseline should be oversized the same amount as design based on sizing runs

CHW Coil Head	na	Used for chilled water cooling only
CHW Coil Delta T	na	Used for chilled water cooling only
CHW Valve Type	na	Used for chilled water cooling only
CHW Loop	na	Used for chilled water cooling only
Coil Design Bypass Factor	Default (0.03)	Leave as default.
Min Supply Temp	56°F for GSG & ECC Design value when available	The lower bound of what is allowed off of the central cooling coil when supply air temperature needs to be reset.
Cold Deck min Leaving Temp	Blank	Not used
Cool Control range	Default (4.0°F)	This default range is used to help the cooling components converge.
Availability Sch	*NAME*	Name of schedule that controls when cooling is available. Schedule is used to prevent the unintentional simultaneous heating and cooling with in a system.
Cool Control	Warmest	Telling the software to reset the temperature as part of the cooling controls sequence
Reset Priority	Airflow First	This resets the airflow down to minimum first, afterward the supply air temperature is allowed to vary between the stops setup previously.
Maximum Cooling Reset Temp.	55.0°F (design) 65.0°F (baselines)	Maximum allowable reset temperature from the central cooling coil.
Minimum Cooling Reset Temp.	56.0°F for GSG & ECC, Design value when available	Minimum allowable reset temperature central cooling coil.
Minimum Reset Flow	Default	Controls minimum flow in cooling

6.1.2.5   Cooling Tab, Unitary Power

Description	Value	Notes
Cooling Electric Input Ratio	Project Specific	Cooling efficiency at AHRI testing conditions with fans removed per NYC ECC 2020 Appendix CA, Section 11.5.1.
Cooling Compressor Unload Ratio	Default	
Cooling Compressor Min Hot Gas Bypass Ratio	Default	
Crankcase Heat	0.0	Revise for proposed if crankcase heating is used
Crankcase Max temperature	Default (50F)	Max temperature crankcase heating is allowed. Revise for proposed if necessary
Performance Curves	Project Specific	See Input Guide for appropriate performance curves if no project specific information is available.

6.1.2.6   Cooling Tab, Condenser

Description	Value	Notes
Condenser Type	Air Cooled	No water-cooled equipment is expected
All Other Values	Default	Use defaults for other values on this tab

6.1.2.7   Cooling Tab, Other

Use defaults for the Capacity Curves, Evaporative Cooling, Economizer, and Staged-Volume Tabs.

6.1.2.8   Heating Tab, Basics

Description	Value	Notes
Heat Source	Hot Water Loop	Proposed Design
	Electric	Baselines
Zone Heat Source	Hot Water Loop	Proposed Design
	Electric	Baselines
Heating Capacity	*	Leave this value blank to let the software calculate based upon the supply air temperature and the supply air flow
Heat Sizing Ratio	1.0	Proposed. Adjust As required to match design capacity.
	1.25	Oversizing ratio of cooling capacity. Match the baseline requirement to minimize unmet load hours. NYC ECC baseline should be oversized the same amount as design based on sizing runs
HW Coil Head	1	Pumps must be modeled for system to run, but pump load is false and should be minimized
HW Coil Delta T	Proposed: 40°F	Delta-T across coil used to determine the design GPM. Value doesn't really matter, but higher values will reduce false pumping power.
HW Valve Type	Two Way	To allow the variable speed pumps to have an effect, all coils should be modeled with two-way valves.
HW Loop	*NAME*	Name of the water loop the coil is attached to
Zone HW Loop	*NAME*	Name of the water loop the coil is attached to
Max Supply Temp	92°F (ECC/GSG)	GSG & NYC ECC Baselines. The upper bound of what is allowed off of heating coil. Different than the heating setpoint.
	*	Proposed design per design documents
Availability Sch.	*NAME*	Name of schedule that controls when heating is available. Schedule is used to prevent the unintentional simultaneous heating and cooling with in a system.

6.1.2.9   Heating, Preht/Basebrd Tab

There are no baseboards in the GSG or NYC ECC Baselines.

Description	Value	Notes
Preheat Source	Not installed	Do not include preheat.
Baseboard Source	Hot Water Loop	This is a work-around to provide controls more similar to the intended strategy. Setting the value to Electric will overestimate the heating energy
Baseboard Sched	Default	No schedule is used
Baseboard Sched	n/a	Schedule that provides the relationship between the baseboard setpoint and the outside air. Not used for typical proposed designs
Baseboard Coil Head	1	False pumping energy should be minimized.
Baseboard Delta T	Proposed: 20°F Baseline: NA	False pumping energy should be minimized.
Baseboard Valve Type	Two-Way	To allow the variable speed pumps to have an effect, all coils should be modeled with two-way valves.
Baseboard Loop	*NAME*	Name of loop that coil is assigned to.

6.1.2.10   Heating Tab, Other

Use defaults for the Unitary Power, Supp Heat/Defrost, Capacity Curves, and Stages.

6.1.3   EXISTING SYSTEMS GENERAL

For major renovations, the standard proposed design system, as defined in the "Input Summary Report" is a packaged rooftop unit serving VAV boxes with terminal heat. As such the associated system type is a PVAV. The fan, heating, and cooling tabs shall not be covered again. The unit setpoint should be consistent with the design, but are otherwise exactly like those inputs listed for "CLASS-SYS".

Basics Tab		
Description	Value	Notes
System Name	*CORR-SYS*	The name of the component
System Type	Pkgd Var Vol	For new construction, the design may consist of an air handling unit with CHW and HW coils. In this case the system type should be defined as "Var Vol" to allow for the appropriate sources to be selected.
Return Air Path	Default (Duct)	A "Direct" return air path is also acceptable as no duct losses are to be modeled. "Plenum" return shall be not be modeled
Control Zone	n/a	It is assumed that each thermal block consists of one control zone.
System Reports	Default (Yes)	
System Sizing	Default (1.0)	No System air oversizing. Oversizing shall take place at heating/cooling coils.

DX Performance Data	n/a	standard proposed design model shall be chilled water.
Duct Air Loss, Supply Duct UA, Duct Delta T	n/a	No duct losses shall be modeled for compliance.
Maximum Humidity	60%	Typical renovation projects do have humidity controls, but are not as tightly controlled as new construction projects.
Minimum Humidity	Default (0.0%)	No humidifier, so left as default.

For this system type it is acceptable to model the heat recovery unit directly in the system outdoor air tab. When modeling heat recovery directly, the modeler should use the ERV report to verify that the system is operating during both the heating and cooling seasons and in a limited capacity during the spring/fall.

Outdoor Air Tab		
Description	**Value**	**Notes**
Minimum Outside Air	n/a	No Ratio should be defined for system.
Min. OA Control Method	Default (Fraction of Design Flow)	This control will maintain a constant flow of outdoor air over various primary flows. The baseline should be modeled with the same control method. If the proposed system has a fixed outdoor air intake damper minimum then "Fraction of hourly" should be selected.
Min. OA Sizing Method	Sum of Zone OA	It is recommended that the design outdoor air flow be defined for each thermal zone, to assist in reusing zone definitions for the baseline systems.
Min Air Schedule	"CORR-OA-YR"	Defines when the outdoor air damper is allowed to be open. Should be allowed during occupied times, and closed during unoccupied times.
Outside Air From System	n/a	Outdoor air is provided to system directly and feeds the model mixing box.
Air-side economizer cycle	Delta Enthalpy	Differential Enthalpy unless the 100% outdoor air system is fixed, then this should be set to "fixed".
Drybulb High Limit	n/a	Typically no drybulb high limit for differential enthalpy economizer controls. Provide a high limit if proposed design calls for one.
Enthalpy High Limit	n/a	No Enthalpy limit for differential Enthalpy sensor. Baseline with a fixed enthalpy sensor shall have an Enthalpy High Limit of 28 Btu per the standard.
Lockout compressor	Default (no)	Cooling allowed when economizer is not able to meet load alone.
Economizer Low Limit	n/a	
Maximum OA fraction	Default (1.0)	Define as less as designed. Should be 1.0 for baseline system.
Heat Recovery 1	Enthalpy Wheel with 75% Effective Coil	For major renovations it is typical for the proposed system to have heat recovery. When construction documents are issued the actual heat recovery should be modeled.

Heat Recovery 1: Operation	When Minimum OA	Heat wheel should be locked out when the economizer cycle is active. A lower limit economizer temperature may be required to ensure the heat recovery operates during heating season.

6.1.4 MAJOR AUXILIARY SYSTEMS

The gym, auditorium, cafeteria, multiuse assemblies are modeled as being served by individual variable air volume systems. In the real world these are considered single zone systems as the small storage rooms do not have independent controls. For the standard proposed design model, it is suggested, but not required, that a Variable-Volume system type be used and the associated small rooms be modeled as discrete zones. The advantage of this method is that the internal loads of these small rooms can be modeled discretely and a weighted average value does not need to be propagated through the design process, and explained in the report. The disadvantage is that if you model these zones discretely, the model will predict slightly higher reheat coil (or baseboard in the proposed case) energy use when these zones are not loaded as significantly as the main use. This can be mitigated by defining interior walls in the geometry.

It is also suggested, but not required, that the "packaged single-zone" system type be avoided for these systems. This system type requires a "control zone" which dictates what mode the system operates. This system type can avoid the extra reheat energy since all other zones are "slave" to the "control zone", but if the small spaces associated with the system do not have the same load profile then unmet load hours will be generated. These unmet load hours are difficult to remove without adjusting schedules of operation and/or heating/cooling setpoints in these zones which must be propagated into the baseline as well.

6.1.4.1 Kitchen Exhaust- Systems with Hoods (Cooking Kitchens)

To follow the standard sequence of operations for the system serving the cafeteria and the kitchen the AHU return and kitchen exhaust fans should be modeled as scheduled fan energy in the Design and NYCECC 2020 Baseline. While the manual indicates that a scheduled zone-level exhaust fan can be modeled for the kitchen zone, in practice it acts like a constant volume box which supplies the exhaust CFM to the space whenever the AHU is operational. It is therefore making the central AHU fan for the kitchen system operate at a very high PLR, contrary to how it should work in the real world.

The energy for the cafeteria AHU return kitchen exhaust fans is part of the fan power allowance in the GSG Baseline model. In the Design and NYCECC 2020 models the kitchen system should only include the return air flow with no energy use (0.01" Static Pressure and 1.00 Efficiency).

The kitchen exhaust fan should be modeled using the same schedule as the kitchen exhaust hood KIT-HOOD-YR (since they are connected) and the cafeteria return fan should be modeled using a complementary return schedule, KIT-RETURN-YR, which excludes the operating hours of the exhaust fan. These loads should be directly input into "KIT-FAN-METER". See Utility & Economics section for input.

6.1.4.2   Kitchen Exhaust- Systems without Hoods (Small Kitchens)

The return fan should be modeled at the system level, like a standard return fan. No additional fan power should be directly modeled at the electric meter.

6.1.5   MECHANICAL & STORAGE SYSTEMS

The mechanical, storage, and stair spaces shall be served by individual single zone systems. The preferred system type is the PTAC. This system type is a terminal unit system so the software automatically generates single zone systems for each zone assigned, based upon the system definition. This simplifies the input process. It also allows each zone to operate according to their own thermostat. This system type's inputs may be confusing for a reviewer since a single definition represents multiple systems. A "Packaged Single-zone" can be used, but since you have to define a "control zone" all of the other assigned zones must operate in a similar fashion to avoid unmet load hours.

A Variable Air Volume system type with the boxes set to have a minimum flow ratio of 1 and warmest control should be avoided for these zones, unless the zone airflows are defined. If all zone airflows are not defined, this system type is prone to be sized according to the cooling load which is very small for these spaces based upon their assigned thermostat setpoint.

6.1.6   Specific inputs for the baseline air-side systems

The NYC ECC 2020/LL32 baseline is based on ASHRAE 90.1-2016 Chapter 11 – Energy Cost Budget method. The methodology for determining the inputs for the air-side HVAC systems is described in the following sections:

- 11.5.2.c – The heating and cooling efficiencies for packaged equipment (EER, SEER, COP and HSPF) should be input after removing the fan power from the values determined at AHRI conditions.
- 11.5.2.d – Minimum outdoor ventilation rates.
  Please note that the baseline ventilation rates will not be the same as in the design case if the requirements of section 6.5.3.7 are exceeded.
- 11.5.2.g – Calculation of supply air flow rates based on a 20°F temperature difference between the supply air and room air. For typical conditions this means that the heating air should be modeled at 92°F for a heating setpoint of 72°F. The cooling air should be modeled at 55°F for a cooling setpoint of 75°F.
- 11.5.2.h - The fans should have the same bhp/CFM underline efficiency as the design case, up to the fan power limit from section 6.5.3.1. Fan motor bhp should be converted to kW by taking into account the appropriate motor efficiency from section 10.4.1.
  Please note that this sizing method will not necessarily result in the baseline having the same fan kW as the proposed design for the same air flow. Also, this should not be understood as the baseline having the same fan kW as the design regardless of air flow.
- 11.5.2.i – The baseline system capacities shall be sized proportionally to the design case.
  Please note that this will generally result in each baseline system having its supply CFM, cooling size and heating size in the same order of magnitude as its design case counterpart. Baseline

systems that differ from the design case counterparts by more than 50% should undergo additional review by the modeling team.

- 11.5.2.j - The ECB energy model should follow the HVAC system selection tree from Figure 11.5.2.
  Please note that if a design case system lacks cooling capacity (such as a cabinet unit heater), the baseline requires cooling capacity to be modeled, even if it is not used. This is also explicitly stated in the ASHRAE 90.1 user manual. The baseline energy model should use either the PTAC or PSZ system types, as detailed in section 6.1.5 of this document. Also, electric unit heaters should be modeled in the LL32 baseline as using System 9 – packaged rooftop heat pump.

The 2019 GSG baseline is based on ASHRAE 90.1-2010 Appendix G. The methodology for determining the inputs for the air-side HVAC systems is described in the following sections:

- G3.1.2.2 – Cooling and heating equipment sizing factors. These can be input in the energy model by suing the HEAT-SIZING-RATIO and COOL-SIZING-RATIO commands at each system.
- G3.1.2.6 – Minimum ventilation rates in the baseline will most often be subject to Exception c, therefore lower than the design and LL32 cases.
- G3.1.2.9.1 – For system types 1 through 8, the supply air flow rates shall be based on a 20°F temperature difference between the supply air and room air. For typical conditions this means that the heating air should be modeled at 92°F for a heating setpoint of 72°F. The cooling air should be modeled at 55°F for a cooling setpoint of 75°F.
- G3.1.2.9.2 – As clarified in the ASHRAE 90.1-2010 User's Manual, for system types 9 and 10, the temperature of the supply heating air shall be 105°F.
- G3.1.2.10 – System fan power should also take into account the motor efficiencies from section 10.8, using the values for totally enclosed fan cooled motors at 1800 rpm.

6.2 ZONE DEFINITIONS

A zone should be defined for each space defined in the model. Zones that are defined as "plenum" should have their "Zone Report" set to "No" to avoid confusion when reviewing the area tallies in the zone reports.

6.2.1 Basic Specification

Basics Specifications Tab		
Description	Value	Notes
Thermal Zone Name	*NAME*	A unique name for the thermal zone. It is best to name a zone in a way that relates to the space assigned to zone, or to the associated terminal unit serving it.
Corresponding Space	*NAME*	Name of space assigned to zone. Only one space can be assigned to each thermal zone in model software.
Parent HVAV System	*NAME*	Name of the airside system that zone is served by
Zone Type	"Conditioned"	Zone type conditioned requires at least a thermostat.
Sizing Option	"Adjust Loads"	This adjusts the zone load based upon the design thermostat setpoints if it differs from the loads design

		setpoint. This is useful to define to avoid unmet load hours.
Zone Report	Default (Yes)	This allows the zone to be reported and area included in zone reports. This should be marked as "No" for plenum zones or attic zones.
Thermostat Type	Proportional	For VAV systems this zone thermostat type will modulate the airflow down to the minimum flow allowed, and then modulate the system discharge temperature up to meet the thermostat heating/cooling setpoint. For VAV systems that allow the box to reset back open to meet the heating setpoint, then the thermostat type should be set to "Reverse-Action".
Throttle Range	2 °R	Range allowed around the thermostat setpoint. This range assists in the model subroutines to converge, setting this range to be too small may cause the model to crash or loads to vary wildly from hour to hour.
Zone Design Flow Rate, Min Design Flow	n/a	Defines a prescriptive flow per area (CFM/sq ft) that is used to set a lower limit on the allowable zone airflow. If the load calculation determined zone airflow is under this value then this value is used, otherwise the calculated airflow is used. This is useful when code requires a certain number of air changes per hour. Should only be used in the baseline as a last resort method of eliminating unmet loads as it can violate the requirement that the baseline airflows be calculated from a sizing run.
Zone Design Flow Rate, OA Flow/Person	17.1 CFM	This defines the zone required outdoor air based upon the design population in the zone. This is then read by the system definition and the minimum outdoor air rate is calculated. This input is useful when modeling demand control ventilation. A detailed calculation can be done in the System outdoor air tab and will overwrite this value if a higher flow is calculated. The actual design value should be used once available from the HVAC engineer.
Zone Design Flow Rate, Minimum Flow Ratio	Default (0.30)	The minimum flow ratio should be defined for the proposed design to match the baseline until actual values are known.
Zone Cooling and Heating: Cooling	78.0, "SCHEDULE NAME"	Defines the design day cooling set point as well as a schedule of cooling setpoints to account for setback and seasonal effects. If the schedule occupied temperature differs significantly from the design cooling, then the "adjust Loads" sizing option will adjust the zone design airflow to avoid oversizing.
Zone Cooling and Heating: Heating	72, "SCHEDULE NAME"	Defines the design day heating set point as well as a schedule of heating setpoints to account for setback and seasonal effects. If the schedule occupied temperature differs significantly from the design heating, then the

| | | "adjust Loads" sizing option will adjust the zone design airflow to avoid oversizing. |

6.2.2 Zone Airflow Tab

Airflow Tab		
Description	**Value**	**Notes**
Design Flow	*	Airflow delivered to zone. Left blank if the zone airflow is autosized.
Minimum Flow	Default	For VAV systems this is the minimum box setpoint. Set to match baseline if design intent or schedule value is not known.
Minimum Flow Schedule	*NAME*	For typical applications this is blank. Used if the minimum flow is controlled by other factors such as a fume hood.
Minimum Flow Control	Default (Fixed/Scheduled)	Where the zone has demand controlled ventilation this should be set to "DCV-RESET-UP/DOWN". This allows the VAV box minimum to be reset down or up to correspond to changes in the required minimum outdoor air flow as the people load in the zone changes.
Zone Terminal and Fans		Zones in Power Induction Unit systems only (Electric heating cases, NYCECC 2020 Baseline & GSG Baselines). All other systems should use defaults
Terminal Type	Parallel PIU	Use for all zones except interior corridors and deep lobbies. Interior corridors and deep lobbies should be set to "Std VAV Terminal"
Air From Zone	Nearest interior corridor, deep lobby, or other interior zone	The nearest interior zone that is served by the same system should be used. Applies to zones with parallel PIU's only.
Temperature Sch		Applies to zones with parallel PIU's only.
Zone Fan Ratio	0.5	Applies to zones with parallel PIU's only.
Zone Fan Flow	Leave blank	Flow set by zone fan ratio
Zone Fan Power	0.00035 kW/cfm	Applies to zones with parallel PIU's only.

6.2.3 Outdoor Air/Exhaust Air Definition

When defining the outdoor air, if multiple values are defined, the software will select the worst case of those defined. The outdoor air calculation method as described in the "Input Summary Report" should be done outside the software, and one of these methods should be used to define the outdoor air to the zone. It is acceptable to come up with a common outdoor air density based upon a space type to simplify inputs, but this should not be applied to space types or spaces with different outdoor air control strategies.   Flow per person should be used when demand controlled ventilation is used to assist in the SCA's review of results.

Inputs for exhaust in this section should generally be ignored. As long as the local exhaust fan is not directly interlocked with the HVAC system's operation, then only the fan power contribution to annual

energy use needs to be modeled. If the exhaust fan system is interlocked with the HVAC system, then the user should be conscious of the fact that the software is not able to account for transfer air as a make-up air source for the exhaust flow rate. This means that if the exhaust air rate exceeds the supply air rate to the zone then, this feature will override the supply air flow to the zone to match the exhaust airflow. For this reason, this feature tends to be used mostly for lab exhaust hoods or medical operating room applications.

When just the exhaust fan power needs to be modeled, it shall be input as a utility load with a schedule that mimics the HVAC operation schedule. When modeled this way, no credit for fan power shall be taken.

Kitchen system hood exhaust should be modeled as the systems return fan load with a design outdoor air flow rate as is designed.   This procedure is used to generally avoid unmet load hours.

Outdoor Air Tab		
Description	Value	Notes
Air Flow	*	Defines the CFM of outdoor air required by the zone
Flow Per Person	*	Defines the CFM/person of outdoor air required by the zone. Define a combined Flow Per Person to take into account the required Flow Per Area (both cannot be used)
Air Changes	*	Defines the number of air changes of outdoor air required by the zone.
Flow per Area	*	Defines the CFM/sq ft of outdoor air required by the zones. If Flow Per Person is defined, this keyword will be ignored.
Exhaust Air Tracking	Default (No Airflow Tracking)	The fan power used for restroom exhaust should be modeled as a direct load in the utility section unless it is interlocked with the HVAC system and credit for the fan power is taken. Central exhaust should not be modeled here and is handled by the airside HVAC subroutine
Exhaust Flow	*	Defines the design exhaust flow rate. Leave blank if the exhaust flow is made up of transfer air (will induce extra outside air)
KW per flow	*	Defines the power density of a local exhaust system
Static Pressure	*	Alternate input as the total static pressure required by the system at design
Efficiency	*	Part of the static pressure definition of a local exhaust system to calculate the design fan power
Control	Default (cycling)	Defines how the local exhaust airflow fan is controlled. If exhaust air flow is variable this allows the fan to capitalize on this behavior.

6.2.4 Cooling Tab

CoolingTab		
Description	**Value**	**Notes**
Cooling Design Temperature	78°F	Defines the design Cooling setpoint for the zone. This matches the input in the "Basic Specifications" Tab.
Maximum Cooling Rate	n/a	The user should let the software calculate this value.
Loop Connections	n/a	Defined if a water-side economizer is used for this specific zone, but not generally at the system level.

6.2.5 Heating Tab

Heating Tab		
Description	**Value**	**Notes**
Heating Design Temperature	72°F	Defines the design Heating setpoint for the zone. This matches the input in the "Basic Specifications" Tab.
Heating Capacity	n/a	The user may let the software calculate this value.
Reheat Delta T	n/a	Should only be defined if this zone's value differs from the value defined in the system input.
Maximum Heating Rate	n/a	The user may let the software calculate this value.
Baseboard Capacity	n/a	
Baseboard Controls	Default (thermostatic)	Define the baseboard controls if they differ from what is defined in the system.
Loop Connections	Default	Defines the connection with the zone hot water loop or the baseboard loop. Should be left as default values which will match the system inputs, unless the associated zone's inputs will differ.

6.3 Meters Tab

The meters by end-use may be defined on a zone by zone basis. Generally, they are defined at the system and all zones served by the system have the same utility meters assigned to each end use.

7 Utility & Economics

Utility rates should be based on the DCAS rates provided by the Mayor's Office and should be modeled as they are stated (an effective rate without a demand clause is not acceptable). The most recent rates available, based on 2020, are included in the template.

Direct Loads for elevators, exterior lighting, sub-slab depressurization system, kitchen exhaust and restroom exhaust should be defined here. Please see the Input Summary for details on the elevator and exhaust inputs. Exterior lighting is project specific.

8   Energy Conservation Measures

8.1   General

Designs that do not meet the source energy targets of LL31 may include additional energy efficiency measures. Measures may be input via the Parametric Run tool, or a separate input file may be created. There are some measures which may be easier to implement this way, such as changing the solar heat gain coefficient on south facing windows.

8.2   Window ECM's

8.2.1   Applicable Measures

The window ECM applies to upgrades to the U-value or SHGC of the glazing.

ECM: Insulated Light Dispersion Panels (R-13)
Insulated light dispersion panels are installed in place of some glazing to improve the U-values and interior daylight. Typical window arrangement is changed to have a large low vision zone with clear glazing and an upper daylight zone with the insulated light dispersion panels. In areas such as gymatoriums and gymnasiums, where daylight is more important than views to the exterior, the dispersion panels would replace all clear glazing.

8.2.2   Implementation

Window improvements will affect the modeled U-value, shading coefficient, and visible transmittance of the vision glazing.

Option 1: Reassign Window Glass Type

1.   Define ECM Glass Type

ECM Glass types should be defined as described in Section 3.2.2.

If the glazing upgrade will apply to entire window, then the ECM glass type should reflect the proposed upgrade. If the glazing upgrade applies to part of a window, for example, installing light dispersion panels to the top of typical classroom panel, it acceptable to use a weighted average based on area.

2.   Reassign glass type at windows

Category	Keyword
Basic Specifications	Glass Type

In the parametric run definitions, select Window as the component type.

Option 2: Redefine Glass Type

The glass type is redefined as necessary. This method is appropriate In the parametric run definitions, select Glass Type as the Component Type. Select the glass type that is being upgraded. The following items should be updated as appropriate:

Category	Keyword
Glass Type	Shading Coefficient
	Glass Conductance
	Visible Transmittance

Appendix A. Supplemental Calculations

SCA Appendix A
with Matching Calcs

A.1.   Air-Cooled Chiller Part Load Performance Curve

Use the "Air Cooled Chiller Calc" in the SCA calculations spreadsheet to calculate the chiller part load curve if chiller data is provided at multiple outdoor air temperatures. This calculator is only valid for air-cooled chillers of eQuest type "Elec Open-Recip" in cooling mode. It is not valid for heat pump chillers, water cooled chillers, or air cooled chillers not using the default temperature curves associated with Elec Open Recip.

A.2.   DX IPLV Performance Curve

Use the "Air Cooled DX IEER" in the SCA calculations spreadsheet to calculate the air-cooled DX part load curve when the IPLV is given. This calculator is only valid for air-cooled packaged units of eQuest type "Packaged Single Zone" or "Packaged Var Vol". It is not valid for heat pump or water-cooled units.

A.3.   Envelope

Use the "Envelope" Tab to calculate the F-Factors for slab-on-grade floors and window, as described in Section 3.

A.4.   Domestic Hot Water Load

Use the "Domestic Hot Water" Tab to calculate the service water gpm inputs for the domestic hot water loop. The Kitchen Equipment tab should be first completed, as the DHW load for the kitchen depends on the fit-out.

A.5.   Kitchen Equipment Loads

Use the orange tabs to calculate the kitchen equipment inputs for the kitchen loads. Instructions are given in the "Kitchen Instructions" tab.

Appendix B. Electric Heating

B.1. Background

This section details how to model electric heating in eQuest for based on the SCA's proposed operating scheme. Packaged air-source heat pumps will provide heating and cooling to most spaces. Selected spaces that were served by unit heaters, such as mechanical rooms, vestibules, and stairs, may be heated by electric resistance.

B.2. System Types

B.2.1 Systems serving Classrooms- Proposed Design

Classrooms, offices, most corridors, and other similar spaces will be served by packaged air-source heat pumps with heat recovery wheels and supplemental electric resistance baseboards. The heat pumps will provide heating during the warm-up period. The supply temperature during warm-up is assumed to be 90°F, but may be revised. Electric resistance heating is not expected to be needed during the warm-up. During occupied hours, the heat pump will heat the outdoor air to space temperature, or 72°F. The electric resistance baseboards will pick up any skin loads as needed.

Software shortcomings

There are a few issues with eQuest software which will require the modeler to incorporate the following instructions for workarounds.

Issue 1: Air-source heat pumps with VAV fan operations

Although DOE2.2 has "HEAT-PUMP" as an option for the heat-source commands (HEAT-SOURCE, ZONE-HEAT-SOURCE, etc.), the command does not work properly unless the system type is set to Packaged Single Zone (PSZ). If "HEAT-PUMP" is used with a packaged variable volume system (PVAVS), which appears to be the most straightforward approach, very little heating will be used by the packaged system. If the system includes electric baseboards, the energy used by the baseboards will appear in the model output, giving the impression that the model is functioning properly. If the system type is set to PSZ, then the system cannot operate on multiple thermostats and the fan cannot operate as a VAV.

Work Around:

Model the heat source as a PVAVS with heat-source commands set to "HOT-WATER". Create a dummy PIPE2 loop served by a chiller of type "HEAT-PUMP" that has the same operating parameters as the packaged heat pump.   Make sure all of the associated pump head commands are set to a very low value, such as 0.1, to minimize the false pumping load.

At Chiller:
        CHW-HEAD = 0.1 (Chiller Properties> Loop Attachments)
        CHW-STATIC-HEAD = 0.1 (Chiller Properties> Loop Attachments)
At Loop:
        PIPE-HEAD = 0.1 (Circulation Loop Properties > Basic Specifications)

At System:
        HW-COIL-HEAD = 0.1 (Air-Side System Parameters>Heating>Coil Cap/Control)
        BBRD-COIL-HEAD = 0.1 (Air-Side System Parameters>Heating>Preht/Basebrd)

Issue 2: Baseboard operations

The baseboards are intended to pick up the skin loads during occupied hours only. DOE2.2 has two methods of control: "OUTDOOR-RESET" and "THERMOSTATIC". OUTDOOR-RESET is a crude control that linearly ramps the baseboard output based on the outdoor air temperature with no regard to the space temperature. This control is not appropriate. The THERMOSTATIC control is a better fit, but still inaccurate. It controls the baseboard output based on the space temperature, but DOE2 will activate the baseboard to its full capacity to meet the heating demand before increasing the heating from the air-side system, and there is no availability schedule to limit operation. Using THERMOSTATIC control on electric baseboards will overestimate the heating electricity use since the baseboards would come on full power during the warm-up, when the air-source heat pump is providing the heating. It is expected that the baseboards would provide minimal heating to offset skin loads in colder weather.

Work Around:

Model the baseboards as hot-water baseboards served by a hot water loop. The hot water loop availability can be scheduled based on time of day and outdoor air temperature. Minimize the pumping by setting all associated head commands to a very low number, such as 0.1 (See above). Create a 100% efficient electric hot water boiler and attach it to the baseboard loop. The commands below allow the baseboards to operate during occupied hours during the heating season, and when the outdoor air temperature is below 20°F. This is an estimate and may be adjusted based on the actual design. The 20°F value is the minimum estimated temperature where the heat pump is expected to operate in HP mode AND provide enough heat to maintain the space temperature. At lower temperatures, electric resistance heating would be used, and the baseboards would be more efficient since there is no associated fan power. The HP units will still operate to provide ventilation air as needed.

B.2.2 Systems serving Classrooms- Baselines

The NYCECC 2020 Baseline (Appendix CA Energy Cost Budget Method) and GSG Baseline (ASHRAE 90.1-2010 Appendix G) use electric heating for these systems. Powered induction type systems should be used. All zones should have parallel PIU terminals with the induced air zone set to the corridor on that floor.

B.2.3 Systems serving Public Assembly Space- Proposed and Baseline

All cases will be served by a rooftop heat-pump. The proposed design and NYCECC 2020 Baseline will have VAV fan controls, so they cannot use the PSZ system type and should follow the guidance for Classrooms- Proposed Design, without baseboards. If possible, a separate loop and boiler should be used for each HP system, so that the part load operation is as close to reality as possible. Systems with similar loads and performance characteristics may be combined. Although the GSG baseline has a constant volume fan and could be modeled using a PSZ with HEAT-SOURCE = HEAT-PUMP, it should be

modeled like the proposed and NYCECC 2020 Baselines, but with constant volume fans. This will prevent differences in the heating algorithms from creating false penalties or savings.

Appendix C. Obsolete Equipment

Equipment that was included in older versions of the template, but is no longer part of the standard design, is included in this section.

C.1.1 Gas Domestic Water Heater

Use of gas DHW is at the discretion of the Authority. Electric heat pump is the standard.

C.1.1.1.   Domestic Water Heater Properties, Basic Specifications Tab

Description	Value	Notes
DHW Heater Name	*NAME*	The name of the component, should match the plumbing drawing tag.
Type	Gas	Fuel source of water heater
DHW Loop assignment	*	Name of the Domestic Hot Water Loop that this equipment is assigned to
Fuel Meter	FM1	Name of Fuel Meter.
Electric Meter	n/a	Name of the Electric Meter.
Equipment Capacity	*	Leave Capacity Blank until design intent or schedule values are available. Should match the input rating of proposed hot water heater, and in the baseline should be the proposed hot water heater output divided by the baseline efficiency.
Capacity Ratio	1	No oversizing factor in DHW equipment sizing.
Heating Input Ratio (HIR)	1.23	1/heating efficiency. Include control and draft fan electric use under Miscellaneous tab Auxiliary Power. Early in the design you may derate proposed efficiency by up to 8% (4% typical) in anticipation of such equipment.
Elec Input Ratio	n/a	Used with Type "electric"
Tank Volume	100	Size of equipment tank. Match between baseline and proposed.
Tank UA	*	Nominal Tank UA from manufacturer's literature. Model the baseline with the same UA unless the SL is defined in the standard.
Location	Zone	Location the hot water tank exists. May be modeled as outdoors if too much heat for the assigned space.
DHW Zone	Mechanical	Generally found in mechanical rooms.
Max HP Tank T	n/a	Used only for heat pump equipment

C.1.1.2.   Domestic Water Heater Properties, Performance Curves

Part Load ratio curve should be the library "DW-Gas-Pilotless-HIR-fPLR". If the specific project defines a sealed combustion condensing hot water heater, then the set of library curves for a "low efficiency condensing boiler" shall be used instead.

C.1.1.3.   Domestic Water Heater Properties, Miscellaneous

Define parasitic losses to the proposed hot water heater such as integral controls and draft fan. These parasitic losses shall be modeled in Mode: "when on" for draft fans or "always for integral controls. The "Tank UA" under the Basic Specifications Tab should be used to model the effect of the integral insulation for all models and any additional jacket specified for the proposed model.