Exhaust Ventilation Modeling in eQUST for MF NCP

Relevant 90.1 Baseline Rules

G3.1.2.4 Fan System Operation

Supply and return fans shall operate continuously whenever *spaces* are occupied and shall be cycled to meet heating and cooling loads during unoccupied hours.

G3.1.2.9 System Fan Power

System fan electrical power for supply, return, exhaust, and relief for *Systems* 1 and 2:

$$Pfan = \text{CFMs} \times 0.3$$

Relevant 90.1 Rules

G3.1.2.5 Ventilation

Minimum *ventilation system outdoor air* intake flow shall be the same for the *proposed design* and *baseline building design*.

Exception to G3.1.2.5

……

3. Where the minimum *outdoor air* intake flow in the *proposed design* is provided in excess of the amount required by the *building* code or the *rating authority*, the *baseline building design* shall be modeled to reflect the greater of that required by either the *rating authority* or the *building* code and will be less than the *proposed design*.

Example 1: Continuous Exhaust + Trickle Vents

Proposed In-Unit HVAC:

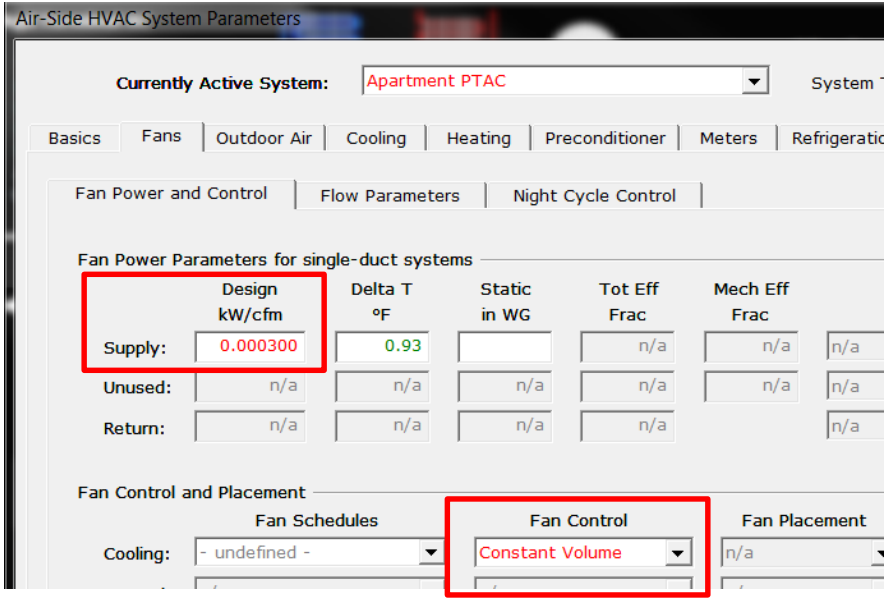
- PTACs that cycle with load to provide heating and cooling; PTAC fan power is 0.2 W/CFM, 2-speed fan
- Continuous 100 CFM exhaust from kitchens and bathrooms via rooftop exhaust fan (EF) @ 0.4 W/CFM
- Make-up air through trickle vents

Proposed Corridor HVAC

- Roof-top unit (RTU) provides heating, cooling and ventilation to corridors
- 0.7 W/CFM RTU supply fan

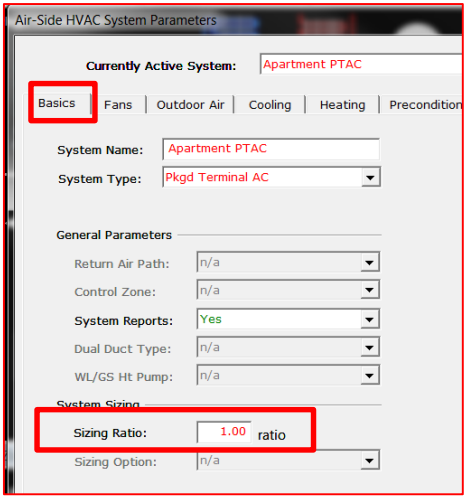
Exhaust and make-up ventilation rates meet applicable codes (i.e. no over-ventilation penalty)

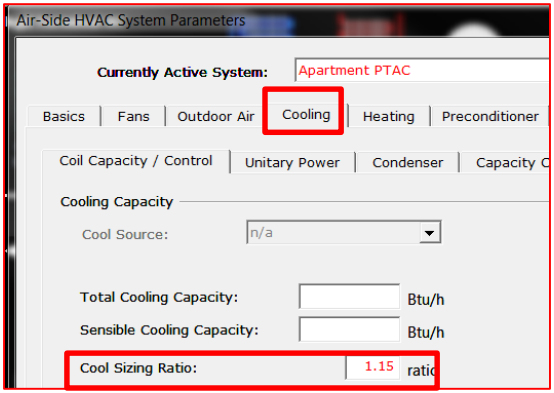
Baseline In-Unit PTAC Fan Power and Control

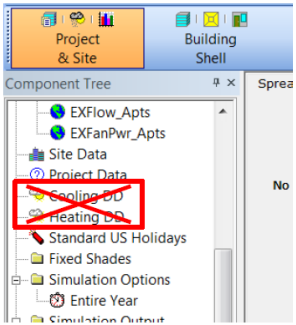


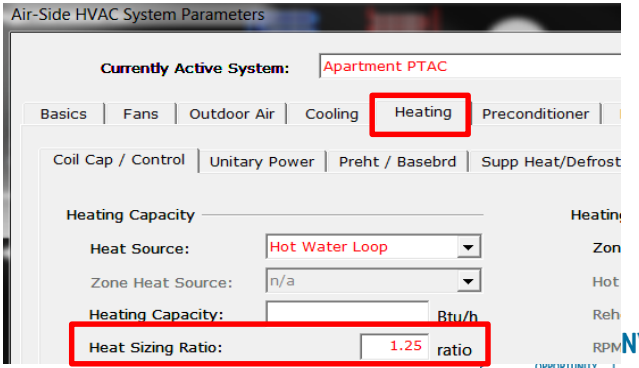
NEW YORK STATE OF OPPORTUNITY. NYSERDA

Baseline In-Unit PTAC Sizing

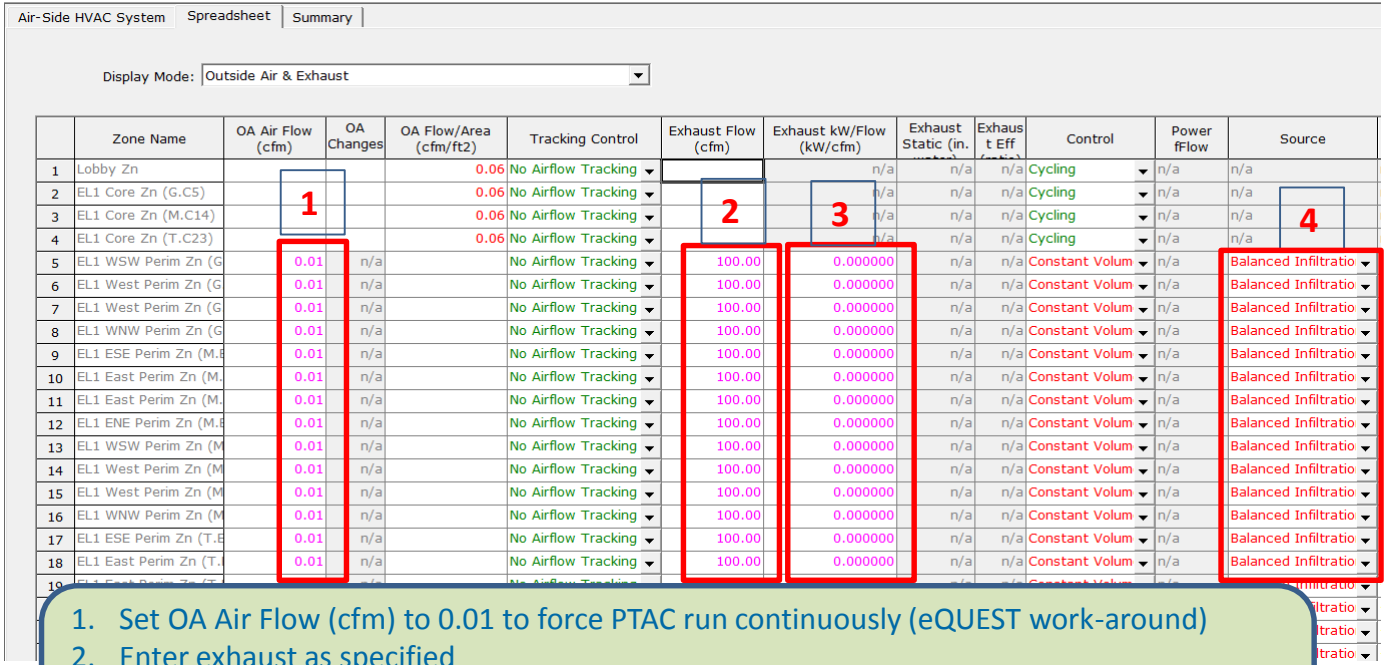








Baseline In-Unit PTAC Ventilation Rate



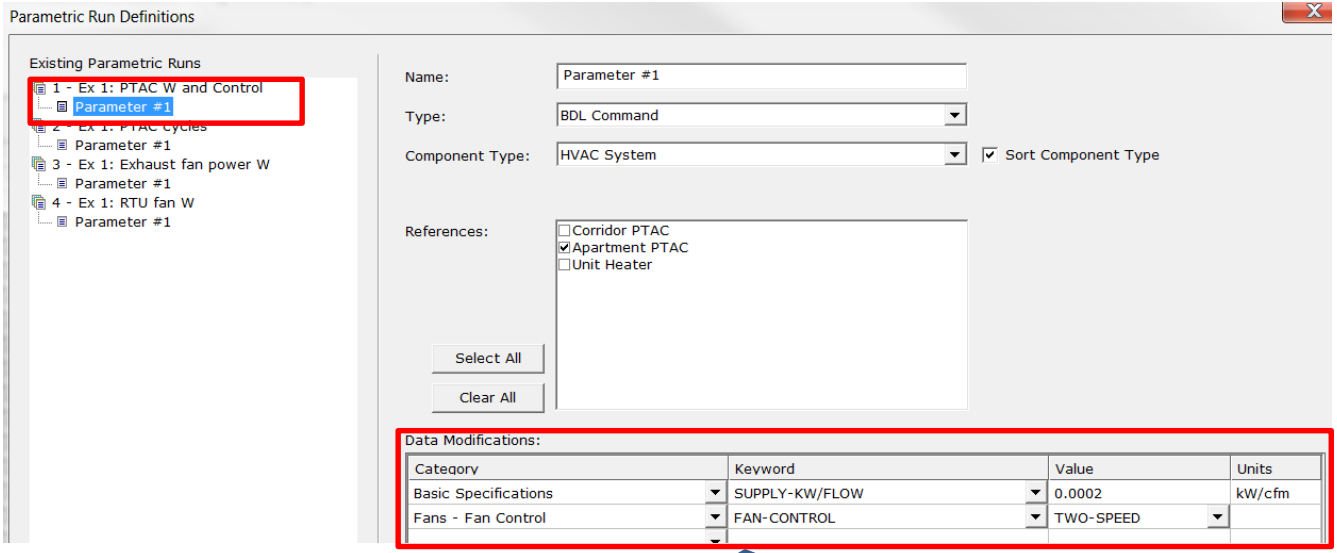
Air-Side HVAC System | Spreadsheet | Summary

Display Mode: Outside Air & Exhaust

	Zone Name	OA Air Flow (cfm)	OA Changes	OA Flow/Area (cfm/ft2)	Tracking Control	Exhaust Flow (cfm)	Exhaust kW/Flow (kW/cfm)	Exhaust Static (in.	Exhaust Eff	Control	Power fFlow	Source
1	Lobby Zn			0.06	No Airflow Tracking		n/a	n/a	n/a	Cycling	n/a	n/a
2	EL1 Core Zn (G.C5)			0.06	No Airflow Tracking		n/a	n/a	n/a	Cycling	n/a	n/a
3	EL1 Core Zn (M.C14)			0.06	No Airflow Tracking		n/a	n/a	n/a	Cycling	n/a	n/a
4	EL1 Core Zn (T.C23)			0.06	No Airflow Tracking		n/a	n/a	n/a	Cycling	n/a	n/a
5	EL1 WSW Perim Zn (G	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
6	EL1 West Perim Zn (G	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
7	EL1 West Perim Zn (G	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
8	EL1 WNW Perim Zn (G	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
9	EL1 ESE Perim Zn (M.E	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
10	EL1 East Perim Zn (M.	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
11	EL1 East Perim Zn (M.	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
12	EL1 ENE Perim Zn (M.E	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
13	EL1 WSW Perim Zn (M	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
14	EL1 West Perim Zn (M	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
15	EL1 West Perim Zn (M	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
16	EL1 WNW Perim Zn (M	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
17	EL1 ESE Perim Zn (T.E	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio
18	EL1 East Perim Zn (T.	0.01	n/a		No Airflow Tracking	100.00	0.000000	n/a	n/a	Constant Volum	n/a	Balanced Infiltratio

1. Set OA Air Flow (cfm) to 0.01 to force PTAC run continuously (eQUEST work-around)
2. Enter exhaust as specified
3. Enter 0 W/CFM exhaust, since we allocated the full baseline fan power to PTAC supply fan (an acceptable simplification with negligible impact on results)
4. Set “Source” as shown, to indicate that make-up air is provided via infiltration

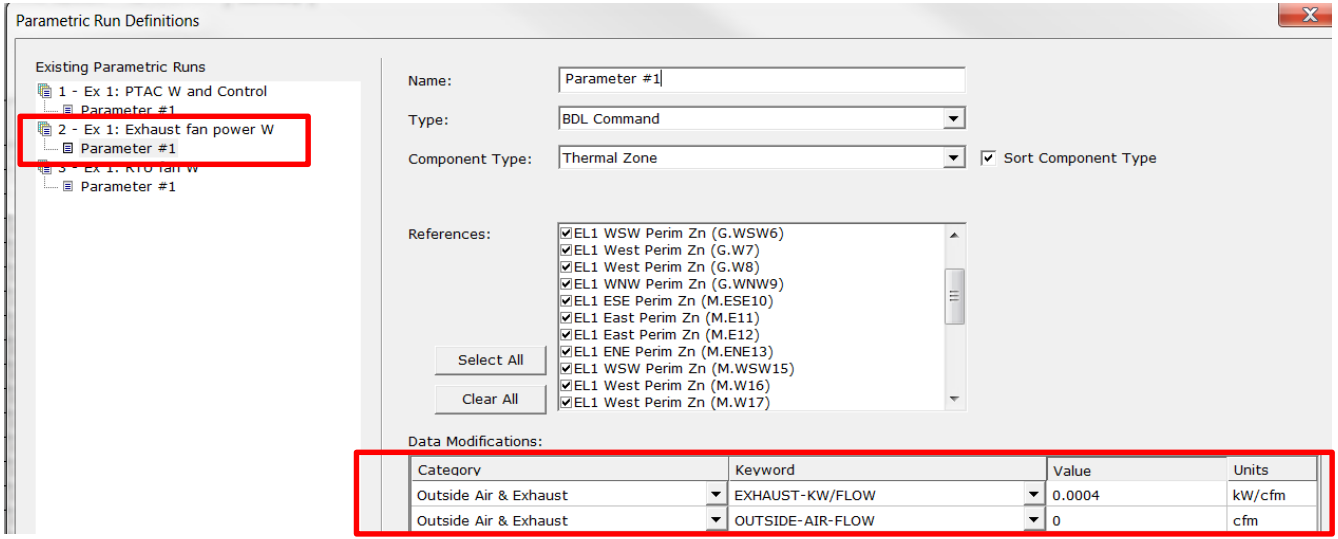
Proposed Design: PTAC Fan Power and Control



- Set PTAC fan power and control as specified

NEW YORK STATE OF OPPORTUNITY. NYSERDA

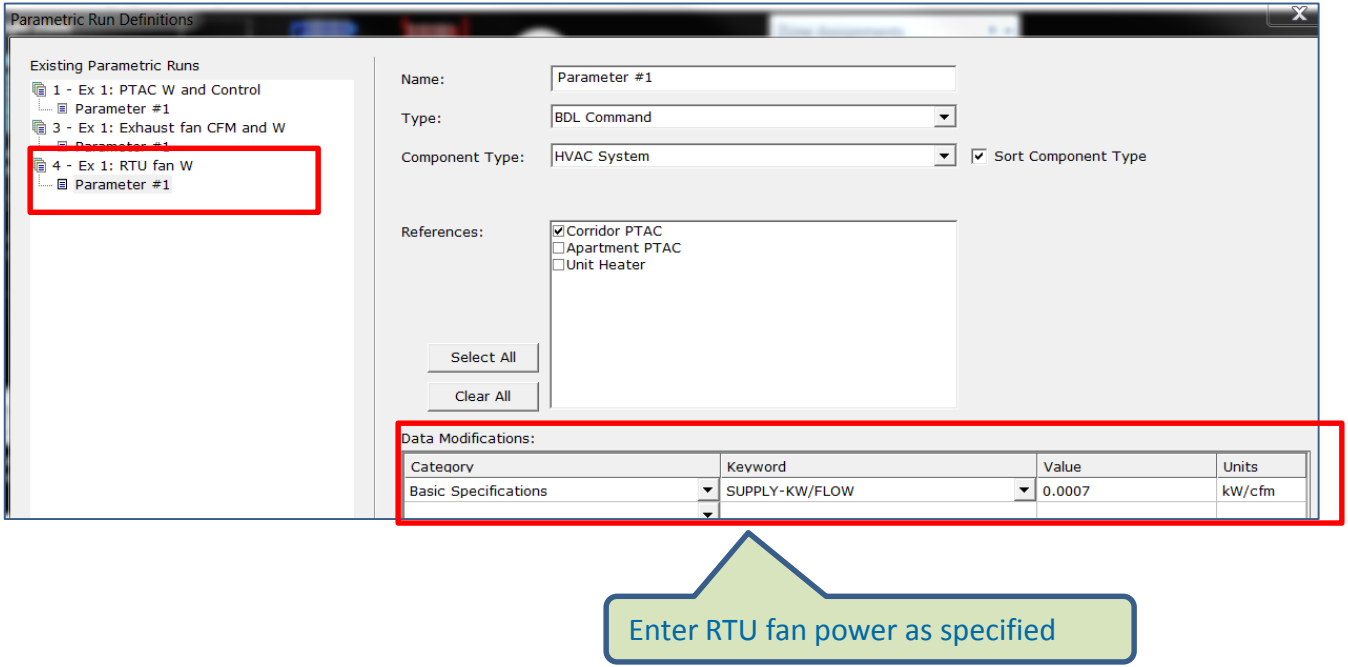
Proposed Design: In-Unit Exhaust Fans



1. Set exhaust fan power as specified
2. Set PTAC supply air flow to 0, to allow PTAC cycle with load

NEW YORK STATE OF OPPORTUNITY. NYSERDA

Proposed Design: Corridor RTU



Enter RTU fan power as specified

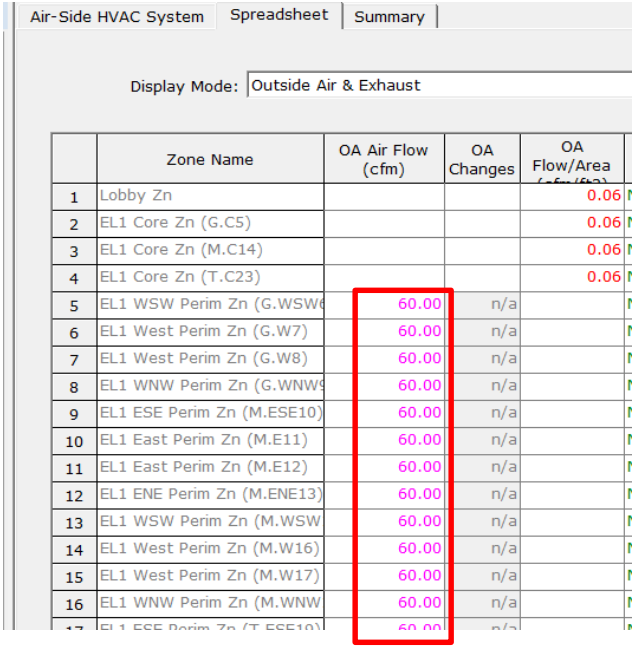
NEW YORK STATE OF OPPORTUNITY. NYSERDA

Example 2: Continuous Exhaust + Mechanical Supply Ventilation

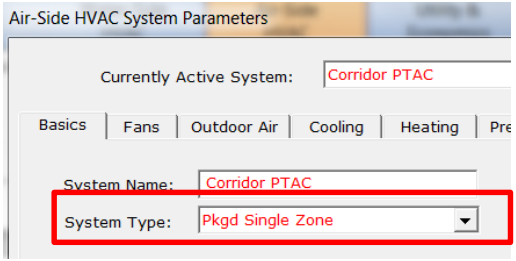
Same as Example 1, except corridor RTU is ducted to supply 60 CFM make-up air to each apartment

Baseline HVAC

Same as Example 1, except…



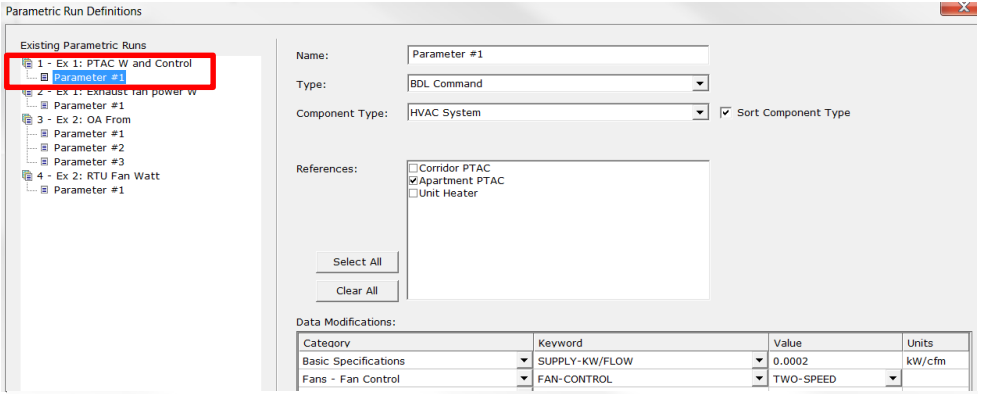
	Zone Name	OA Air Flow (cfm)	OA Changes	OA Flow/Area
1	Lobby Zn			0.06
2	EL1 Core Zn (G.C5)			0.06
3	EL1 Core Zn (M.C14)			0.06
4	EL1 Core Zn (T.C23)			0.06
5	EL1 WSW Perim Zn (G.WSW6	60.00	n/a	
6	EL1 West Perim Zn (G.W7)	60.00	n/a	
7	EL1 West Perim Zn (G.W8)	60.00	n/a	
8	EL1 WNW Perim Zn (G.WNW9	60.00	n/a	
9	EL1 ESE Perim Zn (M.ESE10)	60.00	n/a	
10	EL1 East Perim Zn (M.E11)	60.00	n/a	
11	EL1 East Perim Zn (M.E12)	60.00	n/a	
12	EL1 ENE Perim Zn (M.ENE13)	60.00	n/a	
13	EL1 WSW Perim Zn (M.WSW	60.00	n/a	
14	EL1 West Perim Zn (M.W16)	60.00	n/a	
15	EL1 West Perim Zn (M.W17)	60.00	n/a	
16	EL1 WNW Perim Zn (M.WNW	60.00	n/a	

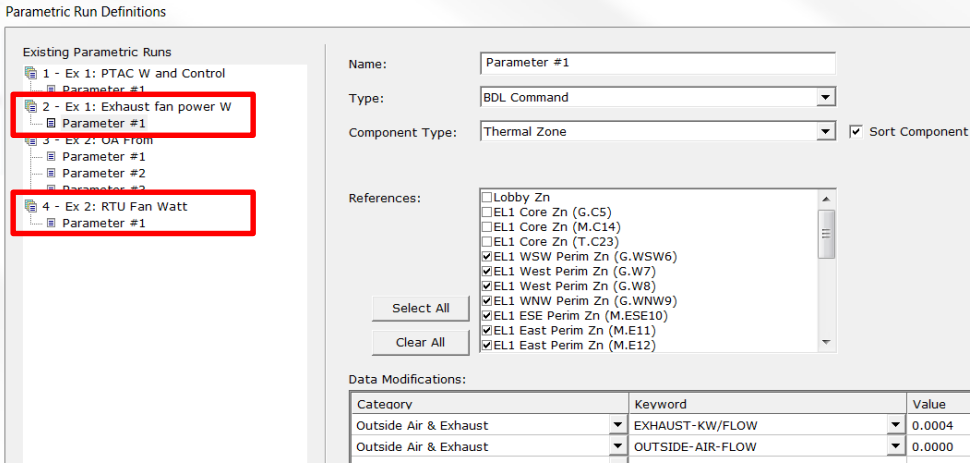


Model RTU as PSZ system type instead of PTAC, to simplify modeling proposed design

In-unit supply CFM as specified

Proposed In-Unit Systems

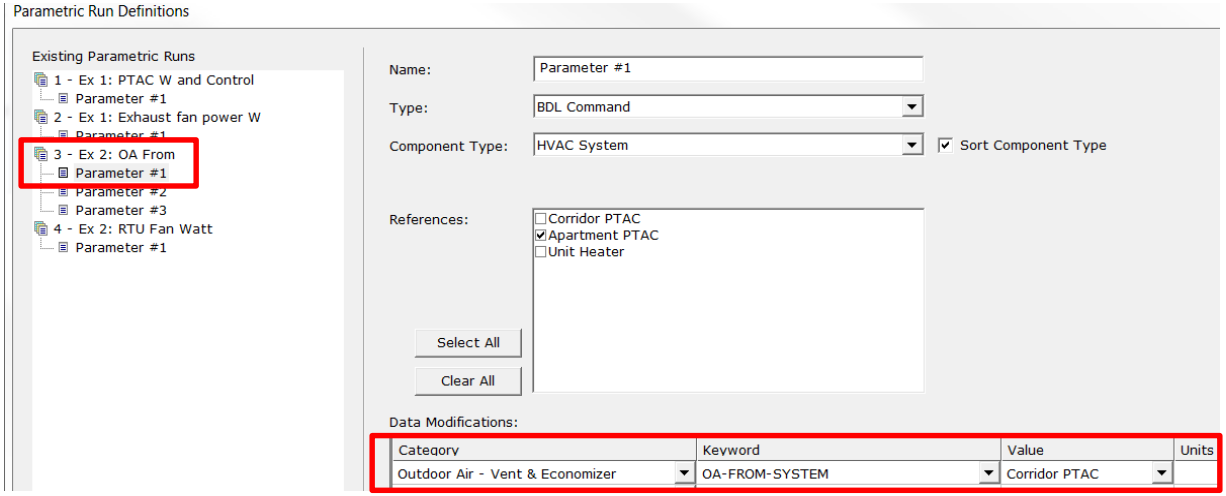




Enter in-unit exhaust fans, PTAC fans, and corridor RTU fans the same as in Example #1

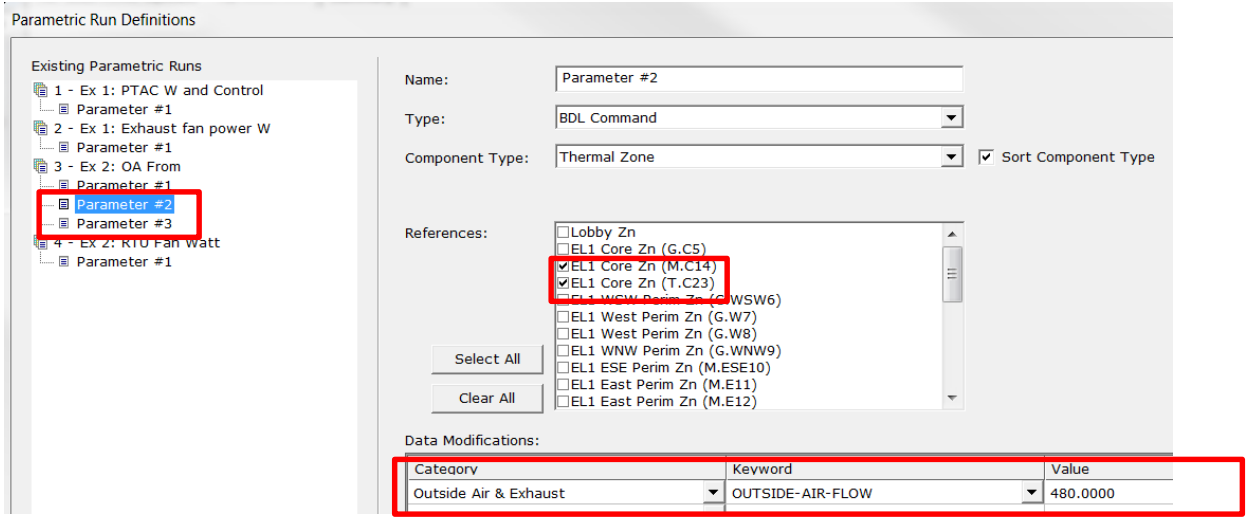
NEW YORK STATE OF OPPORTUNITY. NYSERDA

RTU Make-up to Apartments



Reference corridor RTU as the unit that supplies mechanical ventilation to apartments

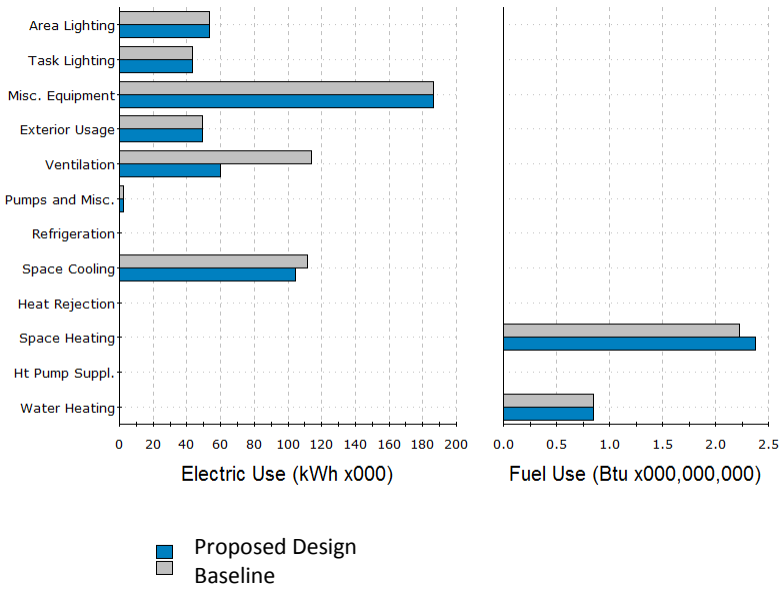
RTU Make-up to Apartments



RTU OA CFM must be increased to include in-unit ventilation

1. Floors 2-10 each have 8 apartments; in order to supply 60 CFM OA ducted to each apartment, the corridor ventilation on these floors must be increased by 60 x 8 = 480 CFM
2. First floor has 4 apartments, so 4*60=240 CFM must be added to the corresponding Thermal Zone (Parameter #3 above, not shown)

Impact on Energy Consumption



- Similar changes in energy use between the baseline and proposed for both examples
- Ventilation (fan) energy is the area of greatest impact
- Savings strongly depend on efficient fan system design
- Example 2 has slightly higher overall energy use for both the baseline and proposed design

Note: The examples demonstrate methods for modeling different ventilation designs. Additional inputs, such as specified supply flow rates, heating and cooling capacities for RTU and PTACs will be required to meet 90.1 requirements.

NEW YORK STATE OF OPPORTUNITY. NYSERDA

Recommended Reading

Measure Guideline: Ventilation Guidance for Residential High Performance New Construction—Multifamily

Building America Report - 1507

September 2015

Joseph Lstiburek

Abstract:

The measure guideline provides ventilation guidance for residential high performance mulitfamily construction that incorporates the requirements of the ASHRAE 62.2 2013 standard. The measure guideline focus is on the decision criteria for weighing cost and performance of various ventilation systems.

The measure guideline is intended for contractors, builders, developers, designers and building code officials. The guide may also be helpful to building owners wishing to learn more about ventilation strategies available for their buildings.

The measure guideline includes specific design and installation instructions for the most cost effective and performance effective solutions for ventilation in multifamily units that satisfies the requirements of ASHRAE 62.2 2013.

NEW YORK STATE OF OPPORTUNITY. NYSERDA

Questions?