

# **Modeling the Washington State Energy Code – 2006 & 2018 Baseline Energy Consumption Appendix E – Commercial Building Modeling Inputs**



## **Final Report – Appendix E**

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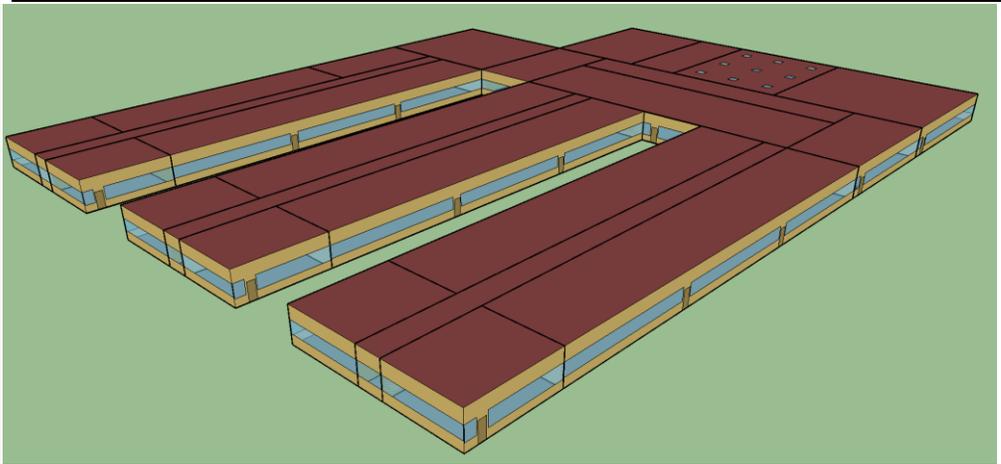
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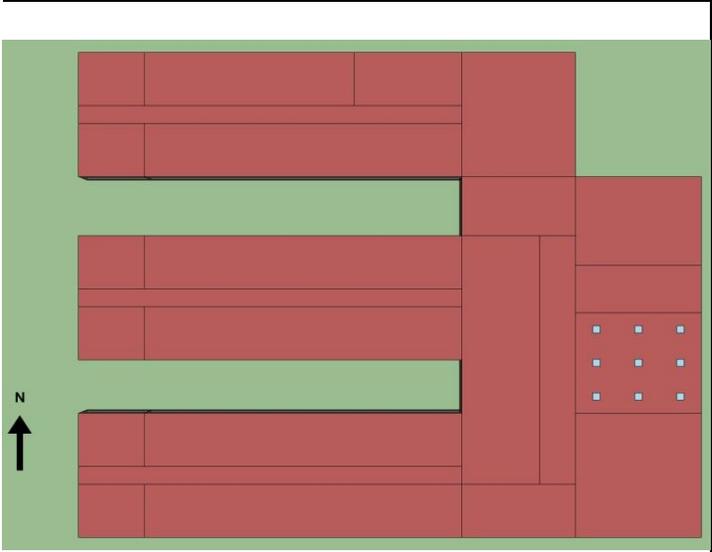
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**APPENDIX E – COMMERCIAL BUILDING MODELING INPUTS**

**Table 1.** Primary School Modeling Input Summary

Item	Descriptions	
<b>Program</b>		
Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Education</b>	
Building Prototype	<b>Primary School</b>	
<b>Form</b>		
Total Floor Area (sq feet)	73, 960 (340 ft x 270 ft)	

<p>Building shape</p>	
<p>Aspect Ratio</p>	<p>1.3</p>
<p>Number of Floors</p>	<p>1</p>
<p>Window Fraction (Window-to-Wall Ratio)</p>	<p>25% for all facades Ribbon window across all facades</p>
<p>Window Locations</p>	<p>Continuous Band</p>
<p>Shading Geometry</p>	<p>none</p>
<p>Azimuth</p>	<p>non-directional</p>

<p>Thermal Zoning</p>	<p>Classrooms zoned by exposure. Corner classrooms separated out from single exposure classrooms.</p> <p>Double loaded corridors zoned separately.</p> <p>Administrative area, Gymnasium, mechanical, media center, lobby, kitchen, and cafeteria are single zones.</p> <p>See <b>Zone Summary</b>.</p> 
<p>Floor to floor height (feet)</p>	<p>13</p>
<p>Floor to ceiling height (feet)</p>	<p>13</p>
<p>Glazing sill height (feet)</p>	<p>3.6 (top of the window is 8.1 ft high with 4.5 ft high glass)</p>

<p>Architecture</p>		
<p>Exterior walls</p>	<p>2006</p>	<p>2018</p>
<p>Construction</p>	<p>Steel-frame walls</p>	
<p>U-factor (Btu / h * ft<sup>2</sup> * °F) and/or R-value (h * ft<sup>2</sup> * °F / Btu)</p>	<p>Metal-frame wall Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084</p>	<p>Steel-frame wall U-Value = 0.047</p>

Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-Value = 0.023
Area (ft <sup>2</sup> )	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.32 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Gymnasium/Multipurpose Room (4 ft x 4 ft) x 9 skylights = 144 ft <sup>2</sup> total Skylight Area 3.75% of gym roof area	
Glass-Type and frame	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.43 SHGC = 0.35 VT = 0.5
U-factor (Btu / h * ft <sup>2</sup> * °F)		

SHGC				
Visible transmittance				
<b>Foundation</b>	<b>2006</b>		<b>2018</b>	
Foundation Type	Slab-on-grade floors (unheated)			
Construction	6" concrete slab poured directly on to the earth			
Thermal properties for ground level floor F-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-Factor = 0.54		F-Factor = 0.54	
Thermal properties for basement walls	NA			
Dimensions	Based on floor area and aspect ratio			
<b>Interior Partitions</b>	<b>2006</b>		<b>2018</b>	
Construction	2x4 steel-frame with gypsum board			
Dimensions	Based on floor plan and floor-to-floor height			
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)			
<b>Air Barrier System</b>	<b>2006</b>		<b>2018</b>	
Infiltration	1.04 cfm/ft2 @ 0.3 WC		0.17 cfm/ft2 @ 0.3 WC	
<b>HVAC</b>				
<b>System Type</b>	2006 A	2018 A	2006 B	2018 B

System Description	VAV Serving corridors and classrooms. Heating: HW boiler central Cooling: CHW with cooling tower, economizers (30% min damper)  Packaged Single Zone (PSZ) systems for all other spaces. Heating: Gas furnace Cooling: DX, economizers		DOAS with HRV - elec tempering Packaged Single Zone system Heating: Gas Cooling: DX + economizer  PSZs for all other spaces for heating and cooling. Ventilation from DOAS Heating: Gas furnace Cooling: DX	DOAS with HRV - elec tempering Packaged Single Zone system Heating: HP Cooling: DX + economizer  PSZs or all other spaces for heating and cooling. Ventilation from DOAS Heating: Gas furnace Cooling: DX
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1A 50 ton max per package PSZ		WSEC 2018, Table C403.3.2(1)A WSEC 2018, Table C403.3.2(7) Chillers (Path A) 1 system per classroom or 50 ton max per package PSZ	
Heating	WSEC 2006, Table 14-1E Furnaces WSEC 2006, Table 14-1B Heat Pumps		WSEC 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps	
<b>HVAC Control</b>	<b>2006</b>		<b>2018</b>	

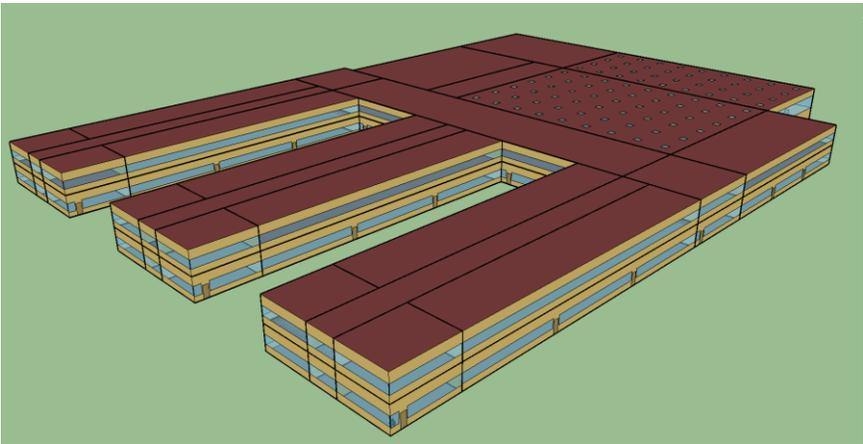
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F VAV Supply: Outdoor Air Reset, 55F @ 70F, 60F @ 60F	Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F
Chilled water supply temperatures	Design: 44F Outdoor Air Reset: 48F @ 60F, 140F @ 70F	NA
Hot water supply temperatures	Design: 180F Outdoor Air Reset: 180F @ 60F, 140F @ 70F	NA
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated	None, C403.5 Exception 10
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Classrooms	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)
Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered PSZ: 0.3 W/CFM
<b>Pump</b>	<b>2006</b>	<b>2018</b>
Pump Type	Variable speed	NA

Rated Pump Head	ChW: 75 ft HW: 60 ft CW: 60 ft	NA
Pump Power	Autosized	NA
<b>Cooling Tower</b>	<b>2006</b>	<b>2018</b>
Cooling Tower Setpoints	Climate 5B: 65°F Chiller Entering Water Temperature Climate 4C: 70°F Chiller Entering Water Temperature	NA
Cooling Tower Type	Open cooling tower with two-speed fans	NA
Cooling Tower Power	Autosized	NA
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	200	
Water temperature setpoint	140 F	
Water consumption (peak gpm)	See under <b>Schedules</b>	
<b>Lighting, Internal Loads &amp; Schedules - C405</b>		
<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	

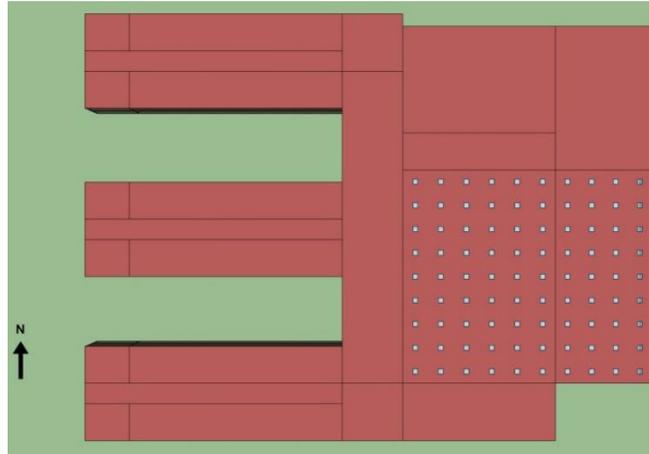
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
<b>Plug load</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Refrigeration</b>	<b>2006</b>	<b>2018</b>
Equipment	Walk-in freezer and display case both with air-cooled local condensers	Walk-in freezer and display case both with air-cooled local condensers. Heat recovery to domestic hot water if required per C403.9.2.3 Refrigeration condenser heat recovery
<b>Occupancy</b>	<b>2006</b>	<b>2018</b>
Average people	RTF Assumptions	
Schedule	RTF Schedules	
<b>Misc.</b>		
<b>Elevator</b>		
Peak Power	NA	
Schedule	NA	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

**Table 2.** Secondary School Modeling Input Summary

	Item	Descriptions	
<b>Program</b>			
	Vintage	<b>2006</b>	<b>2018</b>
	Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, electricity	
	Building Type (Principal Building Function)	<b>Education</b>	
	Building Prototype	<b>Secondary School</b>	
<b>Form</b>			
	Total Floor Area (sq feet)	210,900 (340 ft x 460 ft)	

<p>Building shape</p>	
<p>Aspect Ratio</p>	<p>1.4</p>
<p>Number of Floors</p>	<p>2</p>
<p>Window Fraction (Window-to-Wall Ratio)</p>	<p>25% Ribbon window across all facades on both floors</p>
<p>Window Locations</p>	<p>Continuous Band</p>
<p>Shading Geometry</p>	<p>None</p>
<p>Azimuth</p>	<p>Non-directional</p>

<p>Thermal Zoning</p>	<p>Classrooms zoned by exposure.                  Corner classrooms separated out from single exposure classrooms.</p> <p>Double loaded corridors zoned separately.</p> <p>Administrative areas zoned by exposure.</p> <p>Gymnasium, auxiliary gym, auditorium, kitchen, and cafeteria are single zones.</p> <p>See <b>Zone Summary</b>.</p>
<p>Floor to floor height (feet)</p>	<p>13</p>
<p>Floor to ceiling height (feet)</p>	<p>13</p>
<p>Glazing sill height (feet)</p>	<p>3.6                  (top of the window is 8.1 ft high with 4.5 ft high glass)</p>



**Architecture**

Exterior walls	2006	2018
Construction	Steel-frame walls	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.047
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-Value = 0.023
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.32 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>

Dimensions	Gymnasium	
	Auxiliary Gymnasium	
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.43 SHGC = 0.35 VT = 0.5
SHGC		
Visible transmittance		
<b>Foundation</b>		
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	
Thermal properties for ground level floor U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>	<b>2006</b>	<b>2018</b>
Construction	2x4 steel-frame with gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC	0.17 cfm/ft <sup>2</sup> @ 0.3 WC
<b>HVAC</b>		

<b>System Type</b>	2006 A	2018 A	2006 B	2018 B
System Description	<p>VAV serving corridors and classrooms.                      Heating: HW boiler central                      Cooling: CHW with cooling tower, economizers (30% min damper)</p> <p>Single-zone RTUs for all other spaces.                      Heating: Gas furnace                      Cooling: DX, economizers</p>		<p>DOAS with ERV - elec tempering                      Packaged Single Zone System                      Heating: Gas                      Cooling: DX</p> <p>Single-zone RTUs for all other spaces for heating and cooling.                      Ventilation from DOAS                      Heating: Gas furnace                      Cooling: DX</p>	<p>DOAS with ERV - elec tempering                      Packaged Single Zone System                      Heating: HP                      Cooling: DX</p> <p>Single-zone RTUs for all other spaces for heating and cooling.                      Ventilation from DOAS                      Heating: Gas furnace                      Cooling: DX</p>
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Auto-sized to design day			
Heating	Auto-sized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	

Air Conditioning	WSEC 2006, Table 14-1A WSEC 2006, Table 14-1C Chillers 50 ton max per package PSZ	WSEC 2018, Table C403.3.2(1)A WSEC 2018, Table C403.3.2(7) Chillers (Path A) 1 system per classroom or 50 ton max per package PSZ
Heating	WSEC 2006, Table 14-1E Furnaces	WSEC 2018, Table C403.3.2(7) Chillers (Path A) WSEC 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps
<b>HVAC Control</b>		
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F VAV Supply: Outdoor Air Reset, 55F @ 70F, 60F @ 60F	Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F
Chilled water supply temperatures	Design: 44F Outdoor Air Reset: 48F @ 60F, 140F @ 70F	NA
Hot water supply temperatures	Design: 180F Outdoor Air Reset: 180F @ 60F, 140F @ 70F	NA
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated	None, C403.5 Exception 10

Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Classrooms	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)
Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered PSZ: 0.3 W/CFM
<b>Pump</b>	<b>2006</b>	<b>2018</b>
Pump Type	Variable speed	NA
Rated Pump Head	ChW: 75 ft HW: 60 ft CW: 60 ft	NA
Pump Power	Autosized	NA
<b>Cooling Tower</b>	<b>2006</b>	<b>2018</b>
Cooling Tower Setpoints	Climate 5B: 65°F Chiller Entering Water Temperature Climate 4C: 70°F Chiller Entering Water Temperature	NA
Cooling Tower Type	Open cooling tower with two-speed fans	NA
Cooling Tower Power	Autosized	NA

<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage tank	
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	600	
Water temperature setpoint	140 F	
Water consumption	See under <b>Schedules</b>	

**Lighting, Internal Loads & Schedules - C405**

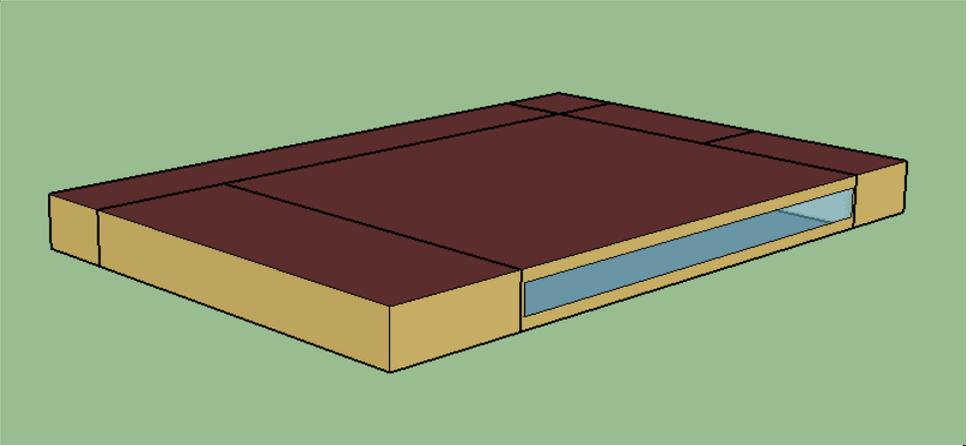
<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
<b>Plug load</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Electric load (cooking)</b>		
Average power density (W/ft <sup>2</sup> )	20.6 W/ft <sup>2</sup> - 30% Radiant fraction, 25% latent, 20% lost	
Schedule	See under <b>Schedules</b>	

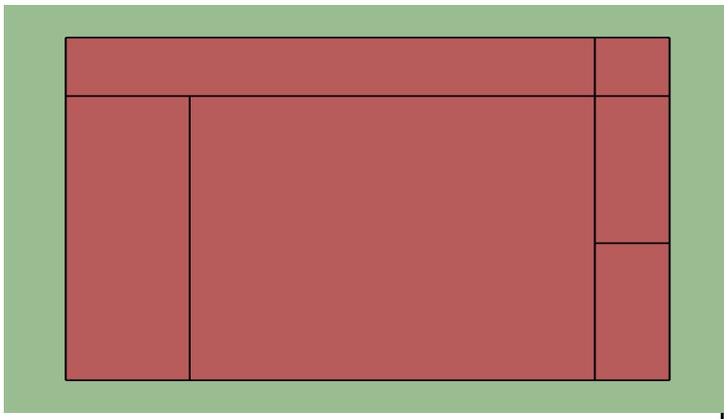
<b>Gas Equip Cooking</b>		
Average power density (W/ft <sup>2</sup> )	156 W/ft <sup>2</sup> - 20% Radiant fraction, 10% latent, 70% lost	
Schedule	See under <b>Schedules</b>	
<b>Refrigeration</b>		
Equipment	Walk-in freezer and display case both with air-cooled local condensers	Walk-in freezer and display case both with air-cooled local condensers. Heat recovery to domestic hot water if required per C403.9.2.3 Refrigeration condenser heat recovery
<b>Occupancy</b>	<b>2006</b>	<b>2018</b>
Average people	RTF Assumptions	
Schedule	RTF Schedules	
<b>Misc.</b>		
<b>Elevator</b>	<b>2006</b>	<b>2018</b>
Quantity	2	
Motor type	hydraulic	
Peak Motor Power Watts per elevator	16055	
Heat Gain to Building	Interior	
Peak Fan/lights Power Watts per elevator	161.9	
Motor and fan/lights Schedules	See under <b>Schedules</b>	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>

Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

**Table 3.** Supermarket Modeling Input Summary

	Item	Descriptions	
<b>Program</b>			
	Vintage	<b>2006</b>	<b>2018</b>
	Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, electricity	
	Building Type (Principal Building Function)	<b>Retail</b>	
	Building Prototype	<b>Supermarket</b>	

Form	
Total Floor Area (sq feet)	45,002 (260 ft x 173 ft)
Building shape	
Aspect Ratio	1.5
Number of Floors	1
Window Fraction (Window-to-Wall Ratio)	54% windows in Sales Space
Window Locations	Only for Sales Space
Shading Geometry	none
Azimuth	non-directional

Thermal Zoning	6 zones: Sales, produce, dry storage, deli, bakery, and Office.	
Floor to floor height (feet)	NA	
Floor to ceiling height (feet)	20	
Glazing sill height (feet)	4.5	

Architecture - C402		
<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Steel-frame walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Steel-frame wall U-Value = 0.047
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-Value = 0.023
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft <sup>2</sup> per skylight	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft <sup>2</sup> per skylight
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.425 SHGC = 0.35 VT = 0.5
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	

Construction	6" concrete slab poured directly on to the earth	
Thermal properties for ground level floor F-factor (Btu / h * ft * °F)	F-factor = 0.54	F-factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2x4 steel-frame with gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC	0.25 cfm/ft <sup>2</sup> @ 0.3 WC

<b>HVAC - C403</b>				
<b>System Tag</b>	<b>2006</b>		<b>2018</b>	
	2006 A	2006 B	2018 A	2018 B
System Description	Packaged Single Zone (PSZ) Heating: Gas Cooling: DX + economizer		DOAS with HRV - elec tempering Packaged Single Zone System Heating: Gas Cooling: DX	DOAS with HRV - elec tempering Packaged Single Zone System Heating: HP Cooling: DX
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			

<b>HVAC Efficiency</b>	<b>2006</b>	<b>2018</b>
Air Conditioning	WSEC 2006, Table 14-1A 50 ton max per package AHU	WSEC 2018, Table C403.3.2(1)A 50 ton max per package AHU
Heating	WSEC 2006, Table 14-1E Furnaces	WSEC 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F	Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated	None, C403.5 Exception 10
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	None	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Supply Fan</b>	<b>2006</b>	<b>2018</b>

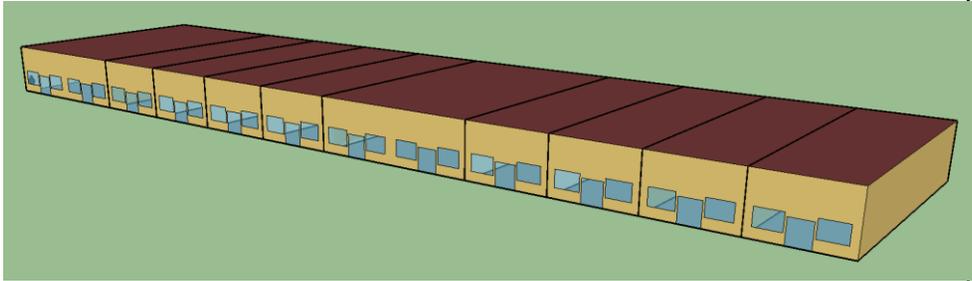
Fan schedules	RTF Schedules	
Supply Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)
Supply Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered PSZ: 0.3 W/CFM
<b>Pump</b>		
Pump Type	N/A	
Rated Pump Heat	N/A	
Pump Power	N/A	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Efficiency	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural Gas	Natural Gas, plus heat recovery through C403.9.2.3 Refrigeration condenser heat recovery.
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	70	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	

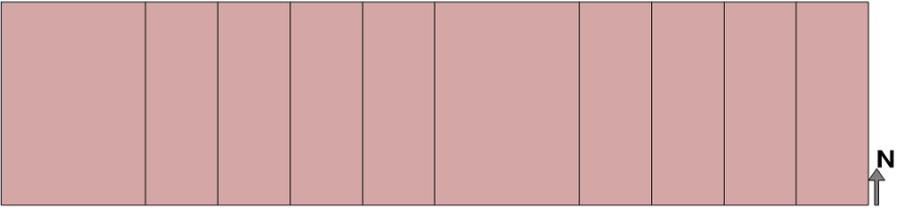
Lighting, Internal Loads & Schedules - C405		
Lighting	2006	2018
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
Plug load		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
Occupancy		
Average people	RTF Assumptions	
Schedule	RTF Schedules	
Misc.		
Elevator		
Peak Power	NA	
Schedule	NA	
Exterior Lighting	2006	2018
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

Schedule	
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**Table 4.** Strip mall Modeling Input Summary

	Item	Descriptions
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Program		
Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Retail</b>	
Building Prototype	<b>Strip mall</b>	
Form		
Total Floor Area (sq feet)	22,500 ft <sup>2</sup> (300 ft x 75 ft)	
Building shape		
Aspect Ratio	4 (0.33 for small store & 0.67 for large store)	
Number of Floors	1	

Window Fraction (Window-to-Wall Ratio)	10.5% (Window Dimensions: 24 windows, 7 ft x 5 ft each and 12 doors, 6 ft x 7 ft each, on the street facing façade with south WWR 26%)	
Window Locations	Windows only on the street facing façade	
Shading Geometry	None	
Azimuth	Non-directional	
Thermal Zoning	 <p>10 thermal zones (from left to right): LGStore1 (Type 1), SMStore1 (Type 1), SMStore2 (Type 2), SMStore3 (Type 3), SMStore4 (Type 2), LGStore2 (Type 3), SMStore5 (Type 3), SMStore6 (Type 3), SMStore7 (Type 3), and SMStore8 (Type 3). (See <b>Zone Summary</b> tab)</p>	
Floor to floor height (feet)	17	
Floor to ceiling height (feet)	17	
Glazing sill height (feet)	3.0 ft (top of the window is 8 ft high)	

<b>Architecture</b>		
<b>Exterior walls</b>		
Construction	Steel-frame walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.047

Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>		
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-Value = 0.023
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>		
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.32 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>		
Dimensions	Not modeled	
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	NA	

SHGC (all)			
Visible transmittance			
<b>Foundation</b>			
Foundation Type	Slab-on-grade floors (unheated)		
Construction	6" concrete slab poured directly on to the earth		
Thermal properties for ground level floor U-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-factor = 0.54	F-factor = 0.54	
Thermal properties for basement walls	NA		
Dimensions	Based on floor area and aspect ratio		
<b>Interior Partitions</b>			
Construction	2x4 steel-frame with gypsum board		
Dimensions	Based on floor plan and floor-to-floor height		
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft <sup>2</sup> )		
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>	
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC	

<b>HVAC - C403</b>				
<b>System Tag</b>	<b>2006</b>		<b>2018</b>	
	2006 A	2006 B	2018 A	2018 B

System Description	Packaged Single Zone System Heating: Gas Cooling: DX + economizer	Packaged Single Zone System Heating: HP Cooling: DX + economizer	DOAS with HRV - elec tempering (one system/zone) Packaged Single Zone System Heating: Gas Cooling: DX	DOAS with HRV - elec tempering (one system/zone) Packaged Single Zone System Heating: HP Cooling: DX
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1A 50 ton max per PSZ DX		WSEC 2018, Table C403.3.2(1)A 50 ton max per PSZ DX	
Heating	WSEC 2006, Table 14-1E Furnaces WSEC 2006, Table 14-1B Heat Pumps		WSEC 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps	
<b>HVAC Control</b>	<b>2006</b>		<b>2018</b>	
Thermostat Setpoint	See RTF Schedule Workbook		See RTF Schedule Workbook	
Thermostat Setback	See RTF Schedule Workbook		See RTF Schedule Workbook	
Supply air temperature	Maximum 95°F, Minimum 55°F		Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F	
Chilled water supply temperatures	NA			
Hot water supply temperatures	NA			
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Nonintegrated		None, C403.5 Exception 10	

Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	None, 1412.8 Exception 3 (<1200cfm OA)	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Supply Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Supply Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)
Supply Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered PSZ: 0.3 W/CFM
<b>Pump</b>		
Pump Type	NA	
Rated Pump Head	NA	
Pump Power	NA	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Power	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Electric	

Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	40	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	

**Lighting, Internal Loads & Schedules - C405**

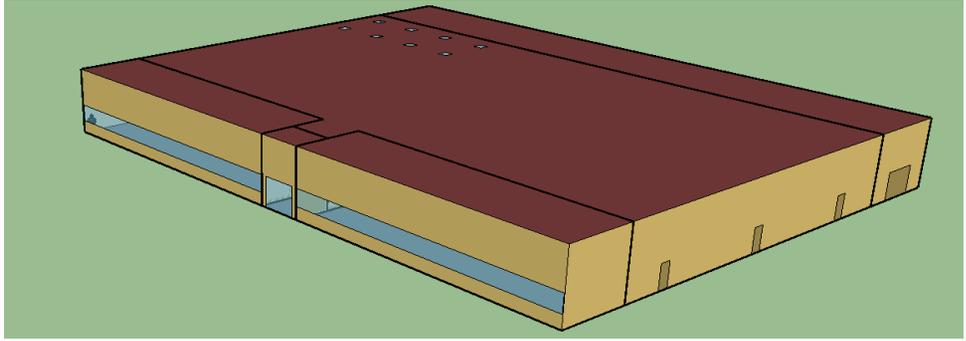
<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	
<b>Misc.</b>		
<b>Elevator</b>		

Peak Power	NA	
Schedule	NA	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

**Table 5.** Standalone Retail Modeling Input Summary

	Item	Descriptions	
<b>Program</b>			
	Vintage	<b>2006</b>	<b>2018</b>
	Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, electricity	
	Building Type (Principal Building Function)	<b>Retail</b>	
	Building Prototype	<b>Standalone Retail</b>	

Form

Total Floor Area (sq feet)	24695 (178 ft x 139 ft)
Building shape	
Aspect Ratio	1.28
Number of Floors	1
Window Fraction (Window-to-Wall Ratio)	7.1% (Window Dimensions: 82.136 ft x 5 ft, 9.843 ft x 8.563 ft and 82.136 ft x 5 on the street facing facade)
Window Locations	Windows only on the street facing façade (25.4% WWR)
Shading Geometry	None
Azimuth	Non-directional

Thermal Zoning	Five thermal zones (See <b>Zone Summary</b> tab)	
Floor to floor height (feet)	N/A	
Floor to ceiling height (feet)	20	
Glazing sill height (feet)	5 ft (top of the window is 8.73 ft high with 3.74 ft high glass)	

**Architecture - C402**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Steel-frame walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Steel-frame wall U-Value = 0.047
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	U-Value = 0.023
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	

<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft <sup>2</sup> per skylight	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft <sup>2</sup> per skylight
Glass-Type and frame	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.425 SHGC = 0.35 VT = 0.5
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	
Thermal properties for ground level floor F-factor (Btu / h * ft * °F)	F-factor = 0.54	F-factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2x4 steel-frame with gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC	0.25 cfm/ft <sup>2</sup> @ 0.3 WC

**HVAC - C403**

System Tag	2006		2018	
	2006 A	2006 B	2018 A	2018 B
System Description	Packaged Single Zone (PSZ) Heating: Gas Cooling: DX + economizer	Packaged Single zone Heating: HP Cooling: DX + economizer	DOAS with HRV - elec tempering Packaged RTU Single zone Heating: Gas Cooling: DX	DOAS with HRV - elec tempering Packaged Single Zone System Heating: HP Cooling: DX
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating				
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1A 50 ton max per package AHU		WSEC 2018, Table C403.3.2(1)A 50 on max per package AHU	
Heating	WSEC 2006, Table 14-1E Furnaces WSEC 2006, Table 14-1B Heat Pumps		WSEC 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps	
<b>HVAC Control</b>	<b>2006</b>		<b>2018</b>	
Thermostat Setpoint	See RTF Schedule Workbook		See RTF Schedule Workbook	
Thermostat Setback	See RTF Schedule Workbook		See RTF Schedule Workbook	
Supply air temperature	Maximum 95°F, Minimum 55°F		Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F	
Chilled water supply temperatures	NA			
Hot water supply temperatures	NA			
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated		None, C403.5 Exception 10	

Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	None	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)
Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered PSZ: 0.3 W/CFM
<b>Pump</b>		
Pump Type	N/A	
Rated Pump Heat	N/A	
Pump Power	N/A	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Efficiency	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural Gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	40	

Water temperature setpoint	140 F
Water consumption	RTF Schedules

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

**Misc.**

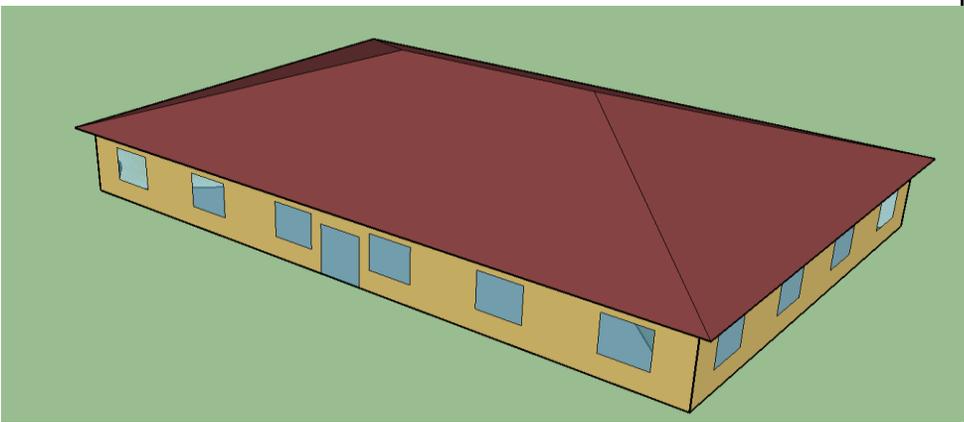
<b>Elevator</b>		
Peak Power	NA	
Schedule	NA	
<b>Exterior Lighting</b>		
	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

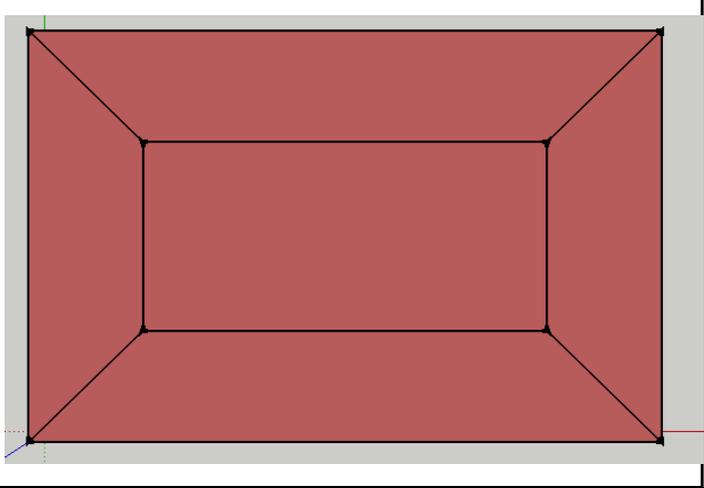
**Table 6.** Small Office Modeling Input Summary

	Item	Descriptions	
Program			
Vintage		2006	2018

Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)
Available fuel types	Gas, electricity
Building Type (Principal Building Function)	<b>Office</b>
Building Prototype	<b>Small Office</b>

**Form**

Total Floor Area (sq feet)	5500 (90.8 ft x 60.5ft)
Building shape	
Aspect Ratio	1.5
Number of Floors	1

Window Fraction (Window-to-Wall Ratio)	24.4% for South and 19.8% for the other three orientations (Window Dimensions: 6.0 ft x 5.0 ft punch windows for all façades)	
Window Locations	Evenly distributed along four façades	
Shading Geometry	None	
Azimuth	Non-directional	
Thermal Zoning	<p>Perimeter zone depth: 16.4 ft.</p> <p>Four perimeter zones, one core zone. Office spaces are broken out into open office, private office, conference, and break. The center zone are open office. The East and West zones are private office. The North zone are conference. The South zone are break.</p> <p>Percentages of floor area</p> <p>Percentages of floor area: perimeter 70%, core 30%</p>	
Floor to floor height (feet)	10	
Floor to ceiling height (feet)	10	
Glazing sill height (feet)	3 (top of the window is 8 ft high with 5 ft high glass)	Reduce glazing to 30% WWR.
<b>Architecture</b>		
<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Wood-Frame Walls	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Wood frame & other wall Zone 1: U-Value = 0.062 Zone 2: U-Value = 0.062	Wood frame & other wall U-Value = 0.054
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Attic roof	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Attic roof Zone 1: U-Value = 0.036 Zone 2: U-Value = 0.031	Attic and other roof U-Value = 0.021
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Hipped roof: 10.76 ft attic ridge height, 2 ft overhang-soffit	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area		
<b>Skylight</b>		
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>		
Foundation Type	Slab-on-grade floors (unheated)	

Construction	6" concrete slab poured directly on to the earth	
Thermal properties for basement floor F-factor (Btu / h * ft * °F) and/or R-value (h * ft2 * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	0.5 in gypsum board + 0.5 in gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>		
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.17 cfm/ft2 @ 0.3 WC

**HVAC - C403**

System Tag	2006		2018	
	2006 A	2006 B	2018 A	2018 B
System Description	Packaged Single Zone System Heating: Gas Cooling: DX + economizer	Packaged Single Zone System Heating: HP Cooling: DX + economizer	DOAS with HRV - elec tempering Packaged Single Zone System Heating: Gas Cooling: DX	DOAS with HRV - elec tempering Packaged Single Zone System Heating: HP Cooling: DX
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1A 5 ton max per PSZ DX		WSEC 2018, Table C403.3.2(1)A 2.5 ton max per PSZ DX	

Heating	WSEC 2006, Table 14-1E Furnaces WSEC 2006, Table 14-1B Heat Pumps	WSEC 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F Single Zone Equipment: No Reset	Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Nonintegrated	None, C403.5 Exception 10
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	None, 1412.8 Exception 3 (<1200cfm OA)	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Supply Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Supply Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)

Supply Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM		DOAS: 1.0 W/cfm of OA delivered PSZ: 0.3 W/CFM
<b>Pump</b>			
Pump Type	N/A		
Rated Pump Heat	N/A		
Pump Power	N/A		
<b>Cooling Tower</b>			
Cooling Tower Type	NA		
Cooling Tower Efficiency	NA		
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>	
SWH type	Storage tank		
Fuel type	Natural gas		
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8		WSEC 2018, Table C404.2
Tank Volume (gal)	40		
Water temperature setpoint	140 F		
Water consumption	See under <b>Schedules</b>		

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones

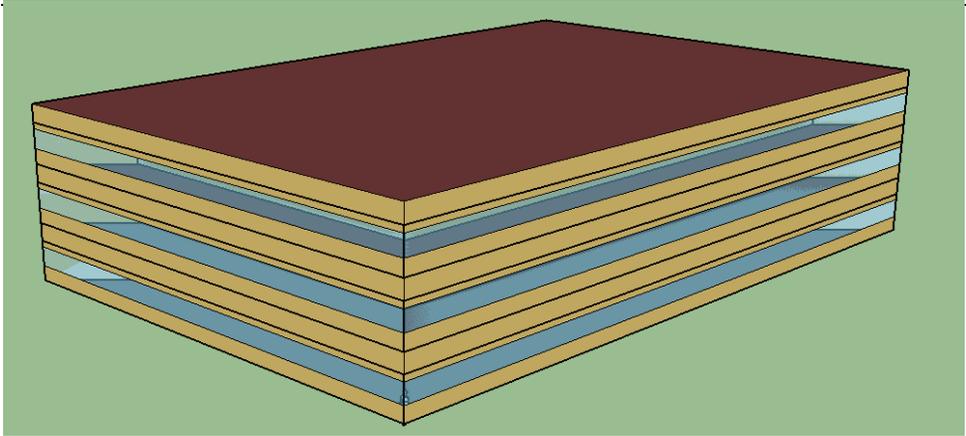
<b>Plug load</b>	
Average power density (W/ft <sup>2</sup> )	RTF Assumptions
Schedule	RTF Schedules
<b>Occupancy</b>	
Average people	RTF Assumptions
Schedule	RTF Schedules

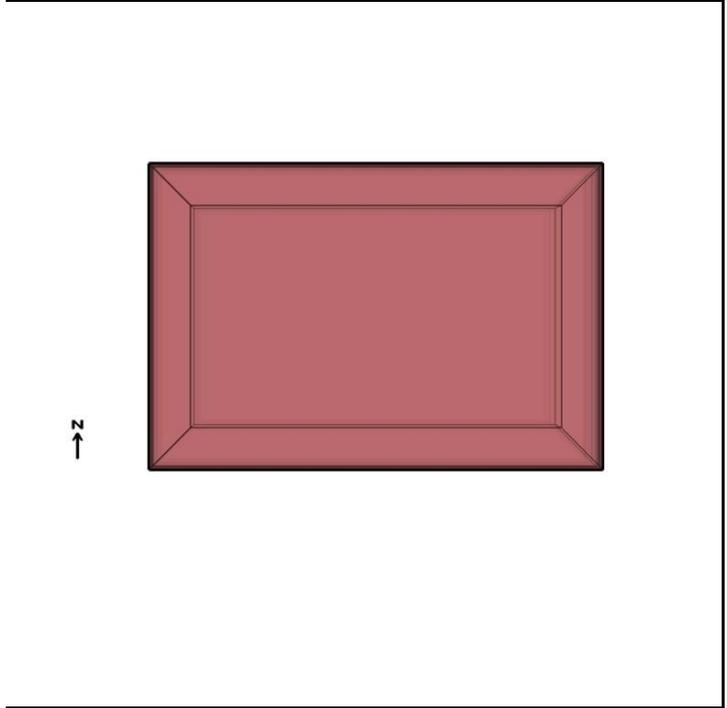
**Misc.**

<b>Elevator</b>										
Quantity	NA									
Motor type	NA									
Peak Motor Power (W/elevator)	NA									
Heat Gain to Building	NA									
Peak Fan/lights Power (W/elevator)	NA									
Motor and fan/lights Schedules	NA									
<b>Exterior Lighting</b>	<table border="1" style="width: 100%;"> <thead> <tr> <th></th> <th style="text-align: center;"><b>2006</b></th> <th style="text-align: center;"><b>2018</b></th> </tr> </thead> <tbody> <tr> <td>Peak Power</td> <td>RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards</td> <td>RTF inputs with power reductions based on 2018 code changes</td> </tr> <tr> <td>Schedule</td> <td>RTF Assumptions</td> <td>RTF Schedules</td> </tr> </tbody> </table>		<b>2006</b>	<b>2018</b>	Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes	Schedule	RTF Assumptions	RTF Schedules
	<b>2006</b>	<b>2018</b>								
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes								
Schedule	RTF Assumptions	RTF Schedules								

**Table 7.** Medium Office Modeling Input Summary

	Item	Descriptions	
<b>Program</b>			
Vintage	<b>2006</b>	<b>2018</b>	
Location	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)		
Available fuel types	Gas, electricity		
Building Type (Principal Building Function)	<b>Office</b>		
Building Prototype	<b>Medium Office</b>		
<b>Form</b>			
Total Floor Area (sq feet)	53,600 (163.8 ft x 109.2 ft)		

<p>Building shape</p>		
<p>Aspect Ratio</p>	<p>1.5</p>	
<p>Number of Floors</p>	<p>3</p>	
<p>Window Fraction (Window-to-Wall Ratio)</p>	<p>33% (Window Dimensions: 163.8 ft x 4.29 ft on the long side of façade 109.2 ft x 4.29 ft on the short side of the façade)</p>	<p>30% of above-grade gross walls</p>
<p>Window Locations</p>	<p>Evenly distributed along four façades</p>	
<p>Shading Geometry</p>	<p>None</p>	
<p>Azimuth</p>	<p>Non-directional</p>	

<p>Thermal Zoning</p>	<p>Perimeter zone depth: 15 ft.</p> <p>Each floor has four perimeter zones, one core zone. Office spaces are broken out into open office, private office, conference, and break. The center zone are open office. The East and West zones are private office. The North zone are conference. The South zone are break.</p> <p>Percentages of floor area</p> <p>Percentages of floor area: Perimeter 40%, Core 60%</p>	
<p>Floor to floor height (feet)</p>	<p>13</p>	
<p>Floor to ceiling height (feet)</p>	<p>9 (4 ft above-ceiling plenum)</p>	
<p>Glazing sill height (feet)</p>	<p>3.35 ft (top of the window is 7.64 ft high with 4.29 ft high glass)</p>	
<p><b>Architecture - C402</b></p>		
<p><b>Exterior walls</b></p>	<p><b>2006</b></p>	<p><b>2018</b></p>
<p>Construction</p>	<p>Steel-frame walls</p>	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Steel-frame wall U-factor = 0.055
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-factor = 0.027
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.4 SHGC = 0.4 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area		
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions		
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	

Construction	6" concrete slab poured directly on to the earth	
Thermal properties for ground level floor F-factor (Btu / h * ft * °F)	Zone 1: F-factor = 0.054 Zone 2: F-factor = 0.054	F-factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2x4 steel-frame with gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC	0.17 cfm/ft <sup>2</sup> @ 0.3 WC

**HVAC - C403**

System Tag	2006		2018	
	2006 A	2006 B	2018 A	2018 B
System Description	Central Packaged VAV (PVAV), one per floor Heating: elec central + elec VAV boxes Cooling: DX + economizer	NA	DOAS with HRV - elec tempering, one per floor VRF Heat Pump FCUs (no VRF heat recovery). One VRF outdoor system per floor.	NA
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1A 100 ton max per package AHU		WSEC 2018, Table C403.3.2(1)C 20 ton max per VRF outdoor unit	

Heating	N/A (electric)	WSEC 2018, Table C403.3.2(1)C
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F VAV Supply: Outdoor Air Reset, 55F @ 70F, 60F @ 60F	Maximum 95°F, Minimum 55°F DOAS Setpoint: 62°F
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated	None, C403.5 Exception 10
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Conference room only	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Supply Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Supply Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)
Supply Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered VRF: 0.3 W/CFM
<b>Pump</b>		
Pump Type	N/A	
Rated Pump Heat	N/A	

Pump Power	N/A	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Efficiency	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural Gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	100	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

<b>Misc.</b>		
<b>Elevator</b>		
Quantity	2	
Motor type	Hydraulic	
Peak Motor Power (W/elevator)	16,055	
Heat Gain to Building	Interior	
Peak Fan/lights Power (W/elevator)	161.9	
Motor and fan/lights Schedules	See under <b>Schedules</b>	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

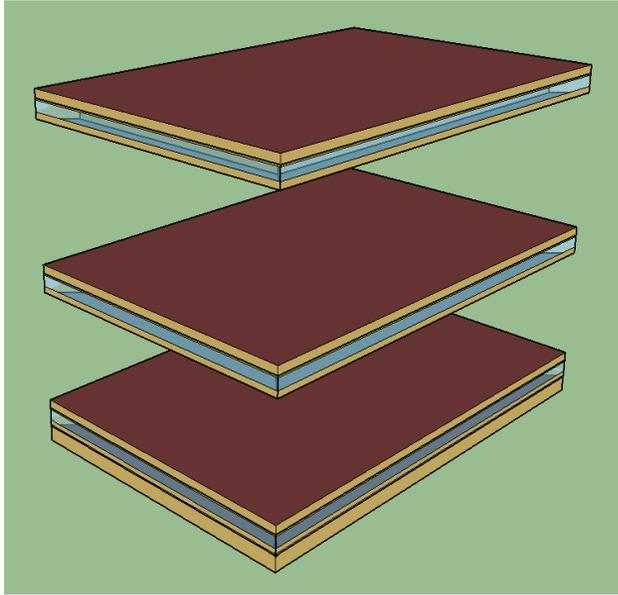
**Table 8.** Large Office Modeling Input Summary

	<b>Item</b>	<b>Descriptions</b>
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**Program**

Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Office</b>	
Building Prototype	<b>Large Office</b>	

**Form**

Total Floor Area (sq feet)	498,600 (240 ft x 160 ft)
Building shape	
Aspect Ratio	1.5

Number of Floors	12 (plus basement)	
Window Fraction (Window-to-Wall Ratio)	54.8% of above-grade gross walls	30% of above-grade gross walls
Window Locations	Even distribution among all four sides	
Shading Geometry	None	
Azimuth	Non-directional	
Thermal Zoning	<p>25 zones</p>  <p>Perimeter zone depth: 15 ft.                  Each floor has four perimeter zones, one core zone. Office spaces are broken out into open office, private office, conference, and break. The center zone is open office. The East and West zones are private office. The North zone are conference. The South zone are break.                  Percentages of floor area: Perimeter 30%, Core 70%.</p>	
Floor to floor height (feet)	13	
Floor to ceiling height (feet)	9	
Glazing sill height (feet)	3 ft	

**Architecture - C402**

Exterior walls	2006	2018
Construction	Steel-frame walls	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Steel-frame wall U-factor = 0.055
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-factor = 0.027
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.4 SHGC = 0.4 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area		
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Basement (conditioned)	

Construction	8" concrete wall; 6" concrete slab, 140 lbs heavy-weight aggregate	
Thermal properties for ground level floor F-factor (Btu / h * ft * °F)	F-factor = 0.054	F-factor = 0.54
Thermal properties for basement walls	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Mass Wall U-factor = 0.104
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2 x 4 uninsulated stud wall	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC	0.17 cfm/ft <sup>2</sup> @ 0.3 WC

**HVAC - C403**

System Tag	2006		2018	
	2006 A	2006 B	2018 A	2018 B
System Description	Central Packaged VAV (PVAV), one per floor Heating: elec central + elec VAV boxes Cooling: DX + economizer	NA	DOAS with HRV - elec tempering, one per floor VRF Heat Pump FCUs (no VRF heat recovery). One VRF outdoor system per floor.	NA
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			

<b>HVAC Efficiency</b>	<b>2006</b>	<b>2018</b>
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 100 ton max per package AHU	WSEC 2018, Table C403.3.2(1)C 20 ton max per VRF outdoor unit
Heating	N/A (electric)	WSEC 2018, Table C403.3.2(1)C
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F VAV Supply: Outdoor Air Reset, 55F @ 70F, 60F @ 60F	Maximum 95°F, Minimum 55°F ERV Setpoint: 62°F
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated	None, C403.5 Exception 10
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Conference room only	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
Energy Recovery	None	60% efficient sensible heat recovery with bypass
<b>Supply Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Supply Fan Mechanical Efficiency (%)	Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006 14-4	Fan efficiency: 0.6 if <5HP, otherwise 0.67 Motor Efficiency: Based on WSEC 2018 Table C405.8(1)

Supply Fan Pressure Drop	Calculated using fan and motor efficiency to match RTF fan W/CFM	DOAS: 1.0 W/cfm of OA delivered VRF: 0.3 W/CFM
<b>Pump</b>		
Pump Type	N/A	
Rated Pump Heat	N/A	
Pump Power	N/A	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Efficiency	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural Gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	840	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows

Occupancy Sensors	All applicable zones	All applicable zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

**Misc.**

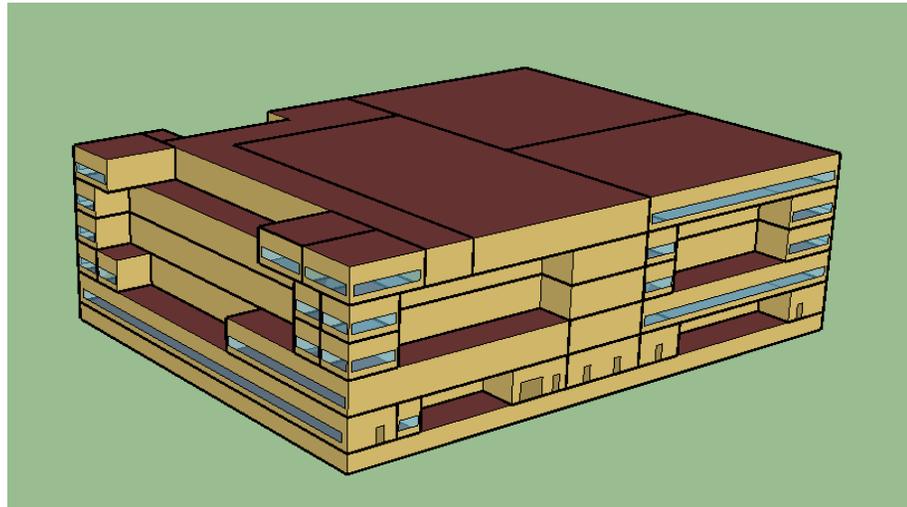
<b>Elevator</b>	<b>2006</b>	<b>2018</b>
Quantity	12	12
Motor type	Traction	Traction
Peak Motor Power Watts per elevator	20370	20370
Heat Gain to Building	Exterior	Exterior
Peak Fan/lights Power Watts per elevator	161.9	161.9
Motor and fan/lights Schedules	See under <b>Schedules</b>	See under Schedules
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules



**Table 9.** Hospital Modeling Input Summary

	Item	Descriptions	
<b>Program</b>			
	Vintage	<b>2006</b>	<b>2018</b>
	Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, electricity	
	Building Type (Principal Building Function)	<b>Health Care</b>	
	Building Prototype	<b>Hospital</b>	
<b>Form</b>			
	Total Floor Area (sq feet)	241,410 (including basement)	

Building shape



Aspect Ratio

1.31  
(230 ft x 175 ft for each floor)

Number of Floors

5  
(plus basement)

Window Fraction  
(Window-to-Wall Ratio)

North: 12%, East: 13%, South: 15%, West: 24%  
Average Total: 16%

Window Locations

See pictures

Shading Geometry

none

Azimuth

non-directional

Thermal Zoning	<p>55 zones, 162 zones with multipliers</p> <p>See <b>Zone Summary</b> and <b>HVAC Zoning</b> for thermal zoning layout, including Emergency Room, Office, Lobby, Nurse Station, Operating Room, Patient Room, Physical Therapy, Lab, Radiology, Dining, Kitchen, and Corridors.</p> <p>Percentages of floor area: Clinic 25%, Core/Public 35%, Perimeter (patient rooms and offices) 15%, Kitchen 5%, Lobby/Hallway 20%</p>
Floor to floor height (ft)	<p>14 ft above ground</p> <p>8 ft basement</p>
Floor to ceiling height (ft)	14 ft above ground and 8 ft basement (no drop-in ceiling plenum is modeled)
Glazing sill height (ft)	3 ft (4 ft high windows)

**Architecture**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Steel-frame walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	<p>Metal-frame wall</p> <p>Zone 1: U-Value = 0.109</p> <p>Zone 2: U-Value = 0.084</p>	<p>Steel-frame wall</p> <p>U-Value = 0.047</p>
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>		
Construction	Insulated above entire deck	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	<p>Zone 1: U-Value = 0.046</p> <p>Zone 2: U-Value = 0.039</p>	<p>U-Value = 0.023</p>
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	

U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>		
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Basement (conditioned)	
Construction	8" concrete wall; 6" concrete slab, 140 lbs heavy-weight aggregate	
Thermal properties for basement floor F-factor (Btu / h * ft * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: F-factor = 0.054 Zone 2: F-factor = 0.054	F-factor = 0.54
Thermal properties for basement walls F-factor (Btu / h * ft * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Mass Wall U-factor = 0.088
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2 x 4 uninsulated stud wall	
Dimensions	Based on floor plan and floor-to-floor height	

<b>Internal Mass</b>	6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC	0.25 cfm/ft <sup>2</sup> @ 0.3 WC

**HVAC**

<b>System Type</b>	2006 A	2018 A	2006 B	2018 B
Heating type	Both constant air volume (CAV) and VAV systems depending on the zone. All system use ChW/HW with hydronic reheat.		Both constant air volume (CAV) and VAV systems depending on the zone. All system use ChW/HW with hydronic reheat. HRC post processing calculation per C403.9.2.4  To model a HRC post process we will need hourly HW and CHW loads from the model. Please put HW and CHW on district sources	
Distribution and terminal units	Zoning per RTF Model			
<b>HVAC Sizing</b>				
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	

Cooling	WSEC 2006, Table 14-1 (A-G) Chiller size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	WSEC 2018, Table C403.3.2 Chiller size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme
Heating	WSEC 2006, Table 14-1 (A-G) Boiler size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	WSEC 2018, Table C403.3.2 Boiler size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme
<b>HVAC Control</b>		
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)	Maximum 95°F, Minimum 55°F AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)
Chilled water supply temperatures	44 °F Outdoor Air Reset: 48°F (@55°F, 70°F)	44 °F Outdoor Air Reset: 48°F (@55°F, 70°F)
Hot water supply temperatures	180 °F Outdoor Air Reset: 140°F (@70°F, 60°F)	130 °F Outdoor Air Reset: 120°F (@70°F,60°F)
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75°F	Airside Economizer with high limit shut-off per WSEC 2018 table C403.5.3.3 Control: Differential Dry-Bulb
Ventilation	ASHRAE 170 / Department of Health guidelines. Sourced from RTF model	
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system

Energy Recovery	None	False cooling coils in exhaust. Modeled through post processing calculation
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Fan efficiency: 60% Motor Efficiency: Based on table WSEC table C405.8
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>		
Pump Type	Chilled water (CHW) pumps variable speed; service hot water (SWH): constant speed; hot water (HW) pump: variable speed	
Rated Pump Head	Pump power assumptions as specified in ASHRAE 90.1 Appendix G	
Pump Power	Autosized	
<b>Cooling Tower</b>		
Cooling Tower Setpoints	Climate 5B: 65°F Chiller Entering Water Temperature Climate 4C: 70°F Chiller Entering Water Temperature	
Cooling Tower Type	Open cooling tower with two-speed fans	
Cooling Tower Power	Autosized	
<b>Service Water Heating</b>		
SWH type	Main and central gas water heater with storage tank	
Fuel type	Natural Gas (main and laundry)	
Thermal efficiency (%)	WSEC 2006, Table 14-1F	WSEC 2018, Table C404.2

Tank Volume (gal)	350
Water temperature setpoint	140 F
Water consumption	See under <b>Schedules</b>

**Internal Loads & Schedules**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	ASHRAE 90.12007, Table 7.8	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	all perimeter zone
Occupancy Sensors	None	all zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

**Misc.**

<b>Elevator</b>	
Quantity	8
Motor type	Traction
Peak Motor Power (watts/elevator)	20370
Heat Gain to Building	Exterior
Peak Fan/lights Power (watts/elevator)	161.9

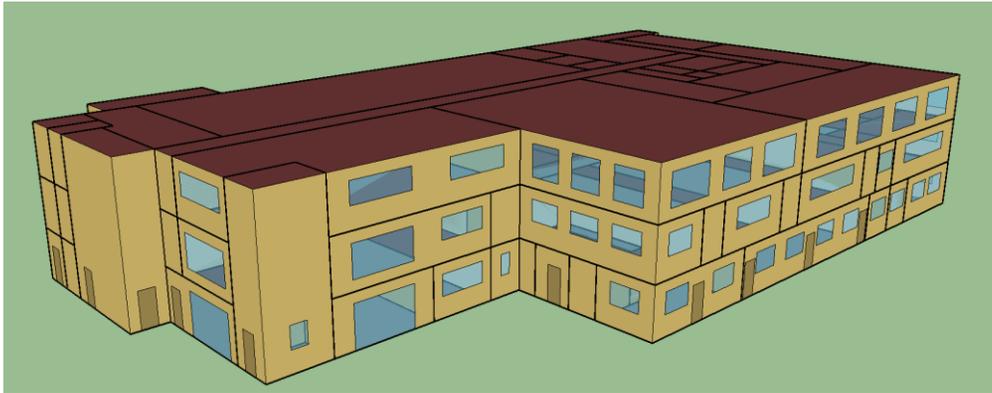
Motor and fan/lights Schedules	See under <b>Schedules</b>	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

**Table 10.** Outpatient Healthcare Modeling Input Summary

	<b>Item</b>	<b>Descriptions</b>	
<b>Program</b>			
	Vintage	<b>2006</b>	<b>2018</b>

Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)
Available fuel types	Gas, electricity
Building Type (Principal Building Function)	<b>Health Care</b>
Building Prototype	<b>Outpatient Healthcare</b>

**Form**

Total Floor Area (sq feet)	40,950
Building shape	
Aspect Ratio	NA
Number of Floors	3
Window Fraction (Window-to-Wall Ratio)	North: 20.5%, East:19.1%, South: 24.1%, West: 12.9% Average Total: 20%
Window Locations	See pictures

Shading Geometry	Nne
Azimuth	Non-directional
Thermal Zoning	118 zones; See <b>Zone Summary</b> and <b>HVAC Zoning</b>
Floor to floor height (feet)	10 ft
Floor to ceiling height (feet)	10 ft
Glazing sill height (feet)	3 ft (4 ft high windows)

**Architecture**

<b>Exterior walls</b>			
Construction	Steel-Frame Walls		
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	<table border="1"> <tr> <td>Metal framing walls Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084</td> <td>Steel-frame wall U-Value = 0.047</td> </tr> </table>	Metal framing walls Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.047
Metal framing walls Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.047		
Dimensions	Based on floor area and aspect ratio		
Tilts and orientations	Vertical		
<b>Roof</b>			
Construction	Insulated above entire deck		
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	<table border="1"> <tr> <td>Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039</td> <td>U-Value = 0.023</td> </tr> </table>	Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	U-Value = 0.023
Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	U-Value = 0.023		
Dimensions	Based on floor area and aspect ratio		
Tilts and orientations	Horizontal		
<b>Window</b>			
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio		
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC		
U-factor (Btu / h * ft <sup>2</sup> * °F)	<table border="1"> <tr> <td>U-Factor = 0.55 SHGC = 0.45 VT = 0.5</td> <td>Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38</td> </tr> </table>	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
U-Factor = 0.55 SHGC = 0.45 VT = 0.5		Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38	
SHGC (all)			
Visible transmittance			

Operable area	12%			
<b>Skylight</b>				
Dimensions	Not modeled			
Glass-Type and frame	NA			
U-factor (Btu / h * ft <sup>2</sup> * °F)				
SHGC (all)				
Visible transmittance				
<b>Foundation</b>				
Foundation Type	Slab-on-grade floors (unheated)			
Construction	6" concrete slab poured directly on to the earth			
Thermal properties for ground level floor U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	F-Factor = 0.54		F-Factor = 0.54	
Thermal properties for basement walls	NA			
Dimensions	Based on floor area and aspect ratio			
<b>Interior Partitions</b>				
Construction	2x4 steel-frame with gypsum board			
Dimensions	Based on floor plan and floor-to-floor height			
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft <sup>2</sup> )			
<b>Air Barrier System</b>				
Infiltration	1.04 cfm/ft <sup>2</sup> @ 0.3 WC		0.25 cfm/ft <sup>2</sup> @ 0.3 WC	
<b>HVAC</b>				
<b>System Type</b>	2006 A	2018 A	2006 B	2018 B

System Description	Central VAV - Hydronic heating and cooling. Heating: Hydronic reheat		Central VAV - Hydronic heating and cooling. Heating: Hydronic reheat	
Distribution and terminal units	VAV terminal box with damper and hot water reheating coil			
<b>HVAC Sizing</b>				
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1 (A-G)		WSEC 2018, Table C403.3.2	
Heating	WSEC 2006, Table 14-1 (A-G)		WSEC 2018, Table C403.3.2	
<b>HVAC Control</b>				
Thermostat Setpoint	See RTF Schedule Workbook		See RTF Schedule Workbook	
Thermostat Setback	See RTF Schedule Workbook		See RTF Schedule Workbook	
Supply air temperature	Maximum 95°F, Minimum 55°F AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)		Maximum 95°F, Minimum 55°F AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)	
Chilled water supply temperatures	44 °F Outdoor Air Reset: 48°F (@55°F, 70°F)		44 °F Outdoor Air Reset: 48°F (@55°F, 70°F)	
Hot water supply temperatures	180 °F Outdoor Air Reset: 140°F (@70°F, 60°F)		130 °F Outdoor Air Reset: 120°F (@70°F,60°F)	

Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75°F	Airside Economizer with high limit shut-off per WSEC 2018 table C403.5.3.3 Control: Differential Dry-Bulb
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None	False cooling coils in exhaust. Modeled through post processing calculation
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Fan efficiency: 67% Motor Efficiency: Based on table WSEC table C405.8
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>	<b>2006</b>	<b>2018</b>
Pump Type	Pump serving the hot water system, constant speed	
Rated Pump Head	Requirements in codes or standards	
Pump Power	Autosized	
<b>Cooling Tower</b>	<b>2006</b>	<b>2018</b>
Cooling Tower Type	NA	
Cooling Tower Power	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural Gas	
SWH Design Capacity (kBtu/h)	85	

Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	120	
Water temperature setpoint	140 F	
Water consumption	See under <b>Schedules</b>	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	All exterior zones with windows
Occupancy Sensors	None	Office and Storage Zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

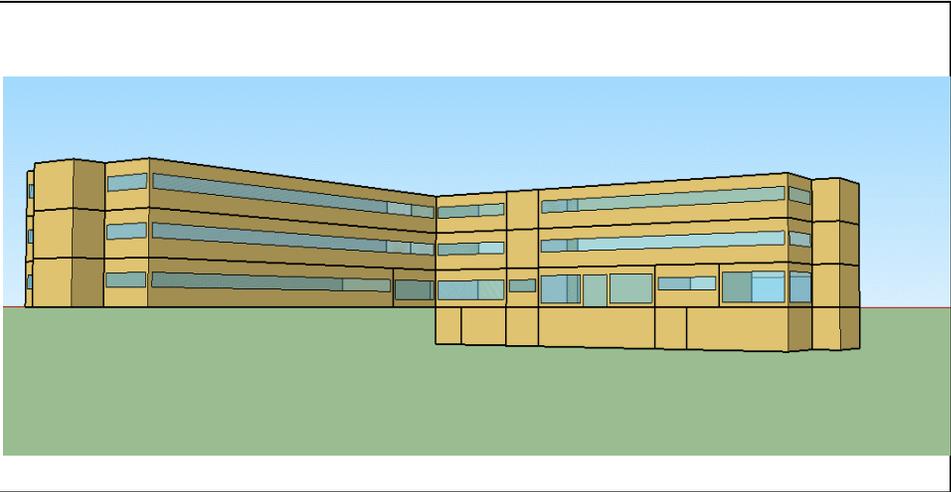
**Misc.**

<b>Elevator</b>	
Quantity	3
Motor type	hydraulic
Peak Motor Power (W/elevator)	16,055
Heat Gain to Building	Interior

Peak Fan/lights Power (W/elevator)	161.9	
Motor and fan/lights Schedules	See under <b>Schedules</b>	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

**Table 11.** Residential Care Modeling Input Summary

Item	Descriptions
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<b>Program</b>		
Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Health Care</b>	
Building Prototype	<b>Residential Care</b>	
<b>Form</b>		
Total Floor Area (sq feet)	47,401 (including basement)	
Building shape		
Aspect Ratio	NA	

Number of Floors	3
Window Fraction (Window-to-Wall Ratio)	Average Total: 29%
Window Locations	See pictures
Shading Geometry	none
Azimuth	non-directional
Thermal Zoning	63 Zones; See Zone Summary
Floor to floor height (feet)	28
Floor to ceiling height (feet)	10
Glazing sill height (feet)	4

**Architecture**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Wood-framed wall	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Wood frame & other wall Zone 1: U-Value = 0.062 Zone 2: U-Value = 0.044	Steel-frame wall U-Value = 0.047
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations		
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulated above entire deck	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-Value = 0.023
Dimensions	Based on floor area and aspect ratio	

Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.4 SHGC = 0.4 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	
Construction	Concrete slab	
Thermal properties for ground level floor U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	NA	

<b>Interior Partitions</b>	<b>2006</b>	<b>2018</b>
Construction	Not modeled	
Dimensions	NA	
<b>Internal Mass</b>		
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC

**HVAC**

<b>System Type</b>	2006 A	2018 A	2006 B	2018 B
System Description	Zone Exhaust PTAC Heat: Elec Resist Cooling: DX Common area: VAV w/ elec resistance reheat		Zone Exhaust PTAC Heat: Elec Resist Cooling: DX Common area: VAV w/ elec resistance reheat	
<b>HVAC Sizing</b>	<b>2006</b>	<b>2018</b>		
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>	<b>2018</b>		
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 50 ton max per package RTU 1 ton max per PTAC	WSEC 2018, Table C403.3.2 50 ton max per package RTU 1 ton max per PTAC		
Heating	WSEC 2006, Table 14-1 (A-G)	WSEC 2018, Table C403.3.2		
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>		
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook		

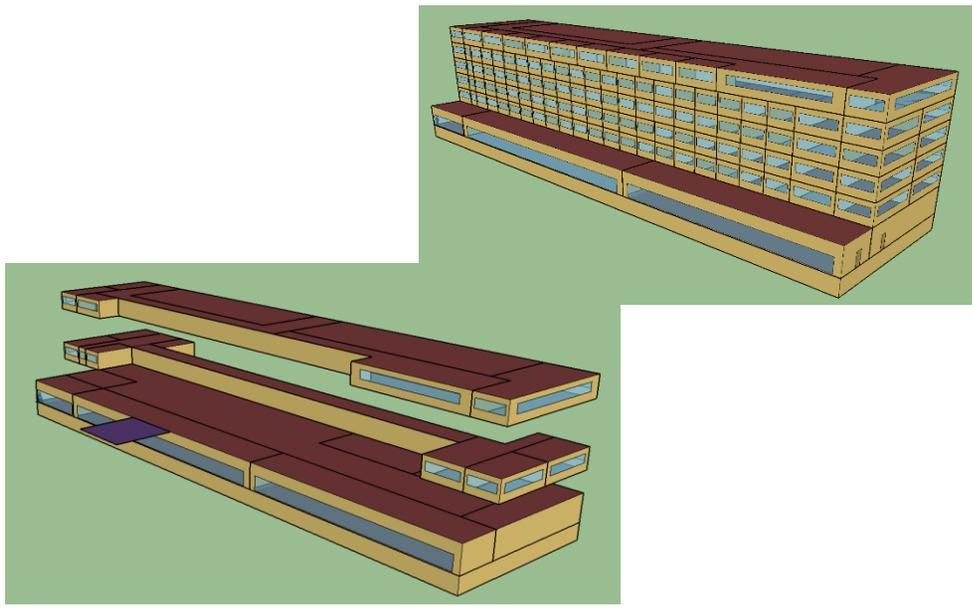
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F VAV supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)	Maximum 95°F, Minimum 55°F VAV supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)
Chilled water supply temperatures	44 °F Outdoor Air Reset: 48°F (@55°F, 70°F)	44 °F Outdoor Air Reset: 48°F (@55°F, 70°F)
Hot water supply temperatures	180 °F Outdoor Air Reset: 140°F (@70°F, 60°F)	130 °F Outdoor Air Reset: 120°F (@70°F,60°F)
Economizers	Airside Economizer in common area only Control: Fixed Dry-Bulb, 75°F	Airside Economizer in common area only Control: Differential Dry Bulb C403.5 Exception 5
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None	None
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Supply Fan Eff. 60% Motor Efficiency: Based on table WSEC table C405.8 C403.8.4 Group R occupancy exhaust fan efficacy (3.8 cfm / watt)
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.

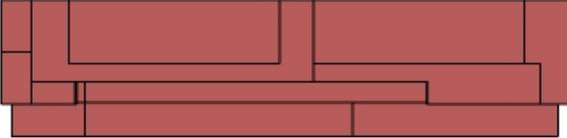
<b>Pump</b>		
Pump Type	Chilled water (CHW) pumps variable speed; service hot water (SWH): constant speed; hot water (HW) pump: variable speed	
Rated Pump Heat	Pump power assumptions as specified in ASHRAE 90.1 Appendix G	
Pump Power	Autosized	
<b>Cooling Tower</b>		
	Climate 5B: 65°F Chiller Entering Water Temperature Climate 4C: 70°F Chiller Entering Water Temperature	
Cooling Tower Type	Open cooling tower with two-speed fans	
Cooling Tower Efficiency	Autosized	
<b>Service Water Heating</b>		
	<b>2006</b>	<b>2018</b>
SWH type	Storage Tank	
Fuel type	Natural Gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	40	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	
<b>Lighting, Internal Loads &amp; Schedules - C405</b>		
<b>Lighting</b>		
	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	

Daylighting Controls	None	Exterior Zones with Windows
Occupancy Sensors	None	Storage, Office, and Bread Zones
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	
<b>Misc.</b>		
<b>Elevator</b>		
Peak Power	NA	
Schedule	NA	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

Table 12. Large Hotel Modeling Inputs

Item	Descriptions
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<b>Program</b>		
Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Lodging</b>	
Building Prototype	<b>Large Hotel</b>	
<b>Form</b>		
Total Floor Area (sq feet)	122,132	
Building shape		

Aspect Ratio	Ground floor: 3.79 (284 ft x 75 ft) All other floors: 5.07 (284 ft x 56 ft)
Number of Floors	6 above-ground floors plus one basement (284 ft x 75 ft)
Window Fraction (Window-to-Wall Ratio)	South: 36.7%, East: 24.5%, North: 26.0%, West: 24.5% Total: 30.2%
Window Locations	For standard guest room, one per guest room (9.9' x 4')
Shading Geometry	None
Azimuth	Non-directional
Thermal Zoning	 <p>22 zones; 195 zones with multipliers                  Basement: conditioned single zone;                  Ground Floor: 7 zones including retails, lobby, cafe, laundry, storage and mechanical rooms;                  2nd to 5th Floor (guest-floor): 7 zones per floor, including guest rooms and corridor. Each floor has 42 guest rooms;                  6th Floor: 7 zones including guest rooms, banquet room, dining, kitchen and corridor.</p> <p>Total 179 guest rooms, accounting for 41% of total floor area.</p>
Floor to floor height (feet)	Basement: 8 ft Ground floor: 13 ft 2nd - 6th floors: 10 ft
Floor to ceiling height (feet)	Same as above
Glazing sill height (feet)	6 in. in ground floor, 3.6 ft. in upper floors

**Architecture - C402**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Steel-frame walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.055
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-factor = 0.027
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	22%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		

<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Basement (conditioned)	
Construction	8" heavy-weight Concrete with carpet for all walls and slabs in the model	
Thermal properties for basement floor F-factor (Btu / h * ft * °F) and/or R-value (h * ft2 * °F / Btu)	Zone 1: F-factor = 0.054 Zone 2: F-factor = 0.054	F-factor = 0.54
Thermal properties for basement walls	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084	Mass Wall U-factor = 0.104
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	1 in. gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
Internal Mass	6 inches standard wood (16.6 lb/ft <sup>2</sup> )	
<b>Air Barrier System</b>		
Infiltration	2006 1.04 cfm/ft2 @ 0.3 WC	2018 0.25 cfm/ft2 @ 0.3 WC

<b>HVAC</b>				
<b>System Type</b>	2006 A	2018 A	2006 B	2018 B
System Description	Guestrooms: FPFCs with DOAS, electric tempering Common areas: Single-duct VAV systems, HW Reheat Heating: Gas Boiler Cooling: Chiller and Cooling		Guestrooms: FPFCs with DOAS Common areas: Single-duct VAV systems, HW Reheat Heating: Gas Boiler Cooling: Chiller and Cooling Tower, economizer	

	Tower, economizer		
<b>HVAC Sizing</b>			
Air Conditioning	Autosized to design day		
Heating	Autosized to design day		
<b>HVAC Efficiency</b>	<b>2006</b>	<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1 (A-G) Chiller size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	WSEC 2018, Table C403.3.2 & C406.2 Chiller size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	
Heating	WSEC 2006, Table 14-1 (A-G) Boiler size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	WSEC 2018, Table C403.3.2 & C406.2 Boiler size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>	
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook	
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook	
Supply air temperature	Maximum 95°F, Minimum 55°F DOAS: Temper to 55°F, no cooling AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)	Maximum 95°F, Minimum 55°F DOAS: Temper to 55°F, no cooling AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)	

Chilled water supply temperatures	44 °F Outdoor Air Reset: 48°F (@55°F)	44 °F Outdoor Air Reset: 48°F (@55°F)
Hot water supply temperatures	180 °F Outdoor Air Reset: 175°F (@70°F)	130 °F Outdoor Air Reset: 120°F (@70°F)
Economizers	Airside Economizer	Airside Economizer with high limit shut-off per WSEC 2018 table C403.5.3.3
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	50% Efficient Sensible ERV, ERV bypass control to 62°F	60% Efficient Sensible ERV, ERV bypass control to 62°F
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Supply Fan Eff. 60% Motor Efficiency: Based on table WSEC table C405.8 C403.8.4 Group R occupancy exhaust fan efficacy (3.8 cfm / watt)
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>		
Pump Type	Chilled water (CHW) pumps variable speed; service hot water (SWH): constant speed; hot water (HW) pump: variable speed	
Rated Pump Head	Pump power assumptions as specified in ASHRAE 90.1 Appendix G	
Pump Power	Autosized	

<b>Cooling Tower</b>		
Cooling Tower Setpoints	Climate 5B: 65°F Chiller Entering Water Temperature Climate 4C: 70°F Chiller Entering Water Temperature	
Cooling Tower Type	Open cooling tower with two-speed fans	
Cooling Tower Power	Autosized	
<b>Service Water Heating</b>		
SWH type	Main and central gas water heater with storage tank	
Fuel type	Natural Gas (main and laundry)	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	1600	
Water temperature setpoint	140 F (main)	
Water consumption	See under <b>Schedules</b>	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	All exterior zones which include glazing.
Occupancy Sensors	None	None
<b>Plug load</b>		

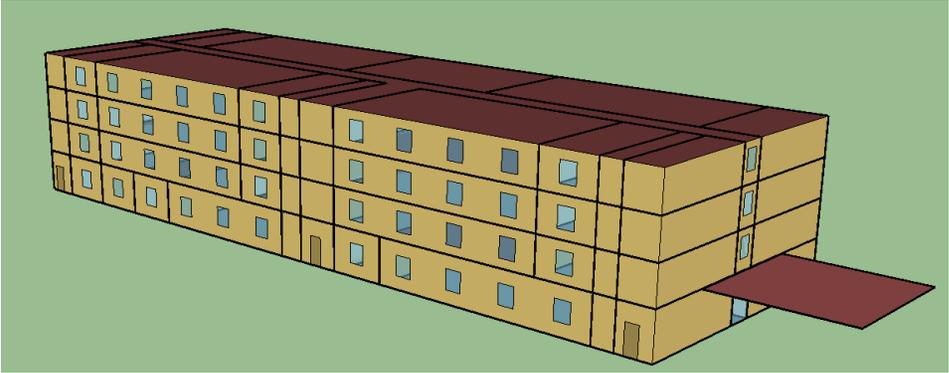
Average power density (W/ft <sup>2</sup> )	RTF Assumptions
Schedule	RTF Schedules
<b>Occupancy</b>	
Average people	RTF Assumptions
Schedule	RTF Schedules

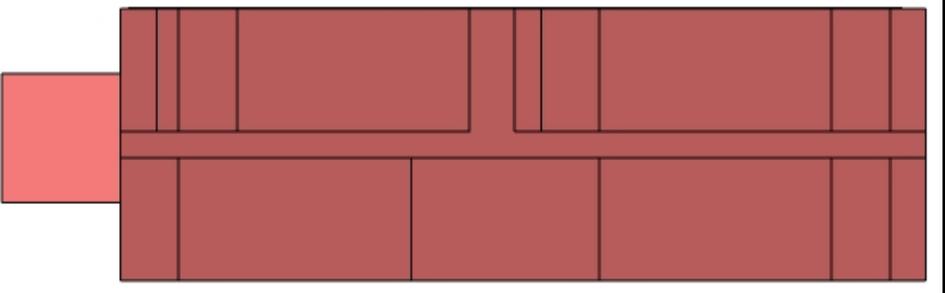
**Misc.**

<b>Elevator</b>		
Quantity	6	
Motor type	Traction	
Peak Motor Power Watts per elevator	20370	
Heat Gain to Building	Exterior	
Peak Fan/lights Power Watts per elevator	161.9	
Motor and fan/lights Schedules	See under Schedules	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

**Table 13.** Small Hotel Modeling Inputs

	Item	Descriptions	
<b>Program</b>			
	Vintage	<b>2006</b>	<b>2018</b>
	Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, electricity	
	Building Type (Principal Building Function)	<b>Lodging</b>	

Building Prototype	<b>Small Hotel</b>
<b>Form</b>	
Total Floor Area (sq feet)	43200 (180 ft x 60 ft)
Building shape	
Aspect Ratio	3
Number of Floors	4
Window Fraction (Window-to-Wall Ratio)	South: 3.1%, East: 11.4%, North: 4.0%, West: 15.2% Average Total: 10.9%
Window Locations	One per guest room (4' x 5')
Shading Geometry	None
Azimuth	Non-directional

<p>Thermal Zoning</p>	
<p><i>Ground Floor:</i> 19 zones including guest rooms, lobby, office space, meeting room, laundry room, employee lounge, restrooms, exercise room, mechanical room, corridor, stairs, storage;  <i>2nd-4th Floor:</i> 16 zones per floor, including guest rooms, corridor, stairs and storage;                  Guest rooms accounts for 63% of total floor area.</p>	
Floor to floor height (feet)	Ground floor: 11 ft Upper floors: 9 ft
Floor to ceiling height (feet)	Same as above
Glazing sill height (feet)	3 ft in ground floor, 2 ft. in upper floors

<b>Architecture - C402</b>		
<b>Exterior walls</b>		
Construction	Wood-Frame Walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Wood frame & other wall Zone 1: U-Value = 0.062 Zone 2: U-Value = 0.062	wood frame & other wall U-Value = 0.054
Dimensions	Based on floor area and aspect ratio	

Tilts and orientations	Vertical	
<b>Roof</b>		
Construction	Insulated above entire deck	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	U-Value = 0.027
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	

Thermal properties for slab-on-grade floor F-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2 x 4 uninsulated stud wall	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	6 inches standard wood (16.6 lb/ft²)	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC

**HVAC - C403**

System Type	2006 A	2018 A	2006 B	2018 B
System Description	Guestrooms: PTHPs w/ electric backup heat Common areas: Split AC/furnace bathfan @ const volume		Guestrooms: PTHPs w/ electric backup heat Common areas: Split AC/furnace bathfan @ const volume	
<b>HVAC Sizing</b>				
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	

Air Conditioning	WSEC 2006, Table 14-1 (A-G) 1 ton max PTHP	WSEC 2018, Table C403.3.2 w/ C406.2 1 ton max PTHP
Heating	WSEC 2006, Table 14-1 (A-G)	WSEC 2018, Table C403.3.2
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F	Maximum 95°F, Minimum 55°F
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	No economizer	No economizer
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 spft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 spft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	NA	NA
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Fan efficiency: 60% Motor Efficiency: Based on table WSEC table C405.8
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>		

Pump Type	Constant speed (recirculating pump for main water heater)	
Rated Pump Head	10 ft	
Pump Power	Autosized	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Power	NA	
<b>Service Water Heating</b>		
SWH type	Main water heater	
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	600	
Water temperature setpoint	140 F for guest rooms and 180 F for laundry	
Water consumption	See under <b>Schedules</b>	

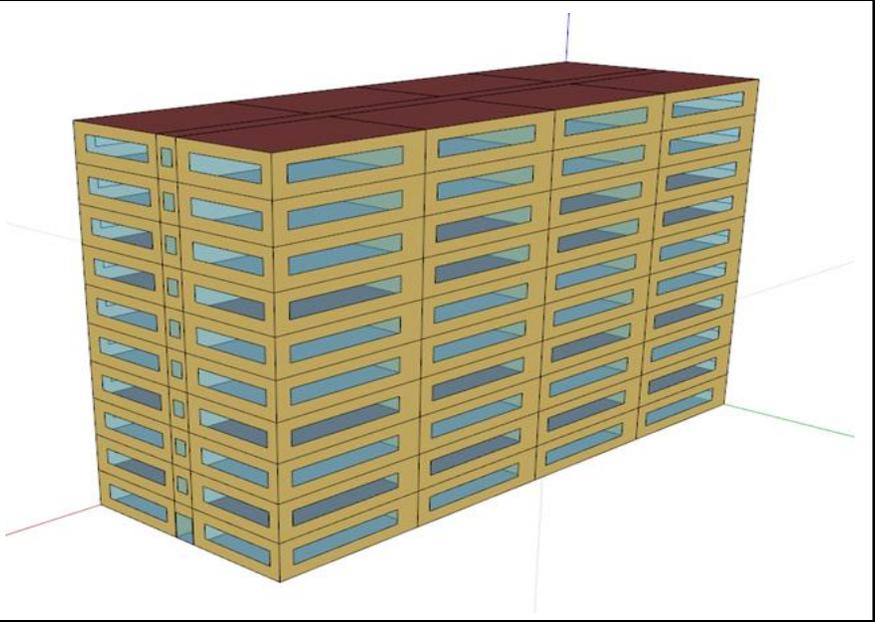
**Lighting, Internal Loads & Schedules - C405**

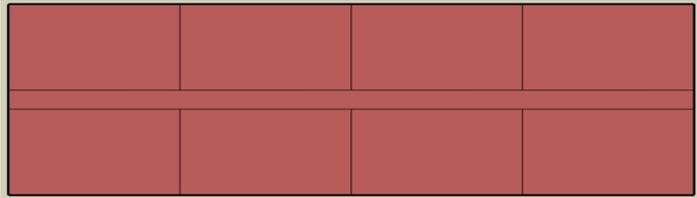
<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	All exterior zones which include glazing.
Occupancy Sensors	None	None
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	

<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	
<b>Misc.</b>		
<b>Elevator</b>		
Motor type	2	
Peak Motor Power Watts per elevator	hydraulic	
Heat Gain to Building	16055	
Peak Fan/lights Power Watts per elevator	Interior	
Motor and fan/lights Schedules	161.9	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

Table 14. High-rise Apartment Modeling Inputs

	Item	Descriptions	
<b>Program</b>			
Vintage		<b>2006</b>	<b>2018</b>

Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)
Available fuel types	Gas, electricity
Building Type (Principal Building Function)	<b>Multifamily</b>
Building Prototype	<b>High-Rise Apartment</b>
<b>Form</b>	
Total Floor Area (sq feet)	84,360 (152 ft x 55.5 ft)
Building shape	
Aspect Ratio	2.75
Number of Floors	10

Window Fraction (Window-to-Wall Ratio)	South: 30%, east: 30%, north: 30%, west: 30% average total: 30%
Window Locations	See image
Shading Geometry	None
Azimuth	Non-directional
Thermal Zoning	<p>90 zones                      Each floor has 8 apartments except ground floor (7 apartments and 1 office with equivalent apartment area)                      Total 8 apartments per floor with corridor in center.                      Zone depth is 25 ft for each apartment from side walls and each apt is 25' x 38' (950 ft<sup>2</sup>).</p> 
Floor to floor height (ft)	10
Floor to ceiling height (ft)	10 (No drop-in ceiling plenum is modeled)
Glazing sill height (ft)	3 ft (4 ft high windows)

**Architecture**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Steel-Frame Walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.057 Zone 2: U-Value = 0.044	Steel-frame walls U-Value = 0.055
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	

<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Insulated above entire deck	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-Value = 0.027
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	100%	
<b>Skylight</b>		
Dimensions	Not Modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>		
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	
Slab on grade floor insulation Level (F-factor)	F-Factor = 0.54	F-Factor = 0.54
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2 x 4 uninsulated stud wall	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	8 lbs/ft <sup>2</sup> of floor area	

<b>Air Barrier System</b>		
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.17 cfm/ft2 @ 0.3 WC

**HVAC - C403**

System Tag	2006		2018	
	2006 A	2006 B	2018 A	2018 B
System Description	Zone Exhaust WSHPs on condensor loop (Cali HP loop) Heat: Gas Boiler, zonal HPs Cooling: Cooling tower, zonal HPs		Balanced Zonal Ventilation, ERV 60% sensible WSHPs on condensor loop (Cali HP loop) Heat: Gas Boiler, zonal HPs Cooling: Cooling tower, zonal HPs	
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 2.5 ton max zone HP Chiller size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme		WSEC 2018, Table C403.3.2 2.5 ton max zone HP Chiller size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	
Heating	WSEC 2006, Table 14-1 (A-G) Boiler size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme		WSEC 2018, Table C403.3.2 Boiler size based on Autosized capacity divided by 2. Assume a 2 +1 redundancy scheme	
<b>HVAC Control</b>	<b>2006</b>		<b>2018</b>	

Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F	Maximum 95°F, Minimum 55°F ERV Setpoint: 62°F
Economizers	None	None, C403.5 Exception 1
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	Balanced ventilation, International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None. Required for fan systems with greater than 5,000 CFM and which have a min OA of 70% or greater.	60% Efficient Sensible ERV, ERV bypass control to 62°F
<b>Fans</b>	Whole house fan	Whole house supply and exhaust fan with ERV
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Supply Fan Eff. 60% Motor Efficiency: Based on table WSEC table C405.8 C403.8.4 Group R occupancy exhaust fan efficacy (3.8 cfm / watt)
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>		
Pump Type	Condensing water (CW) pumps variable speed	

Rated Pump Head	Pump power assumptions as specified in ASHRAE 90.1 Appendix G	
Pump Power	Autosized	
<b>Condensing Water</b>		
Condensing Water Setpoints: Outlet from cooling tower or boiler	Climate 5B: 65°F Climate 4C: 70°F	
Cooling Tower Type	Open cooling tower with two-speed fans	
Cooling Tower Power	Autosized	
<b>Service Water Heating</b>		
SWH type	Central water heater with storage tank	
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	900	
Water temperature setpoint	140 F	
Water consumption	See under <b>Schedules</b>	

**Internal Loads & Schedules**

<b>Lighting</b>		
Average power density (W/ft <sup>2</sup> )	Apartment units: Estimate based on % high efficiency lamps. 1.36 W/sf	Apartment units: Estimate based on % high efficiency lamps. 0.42 W/sf
Schedule	See under <b>Schedules</b>	
Daylighting Controls		
Occupancy Sensors		

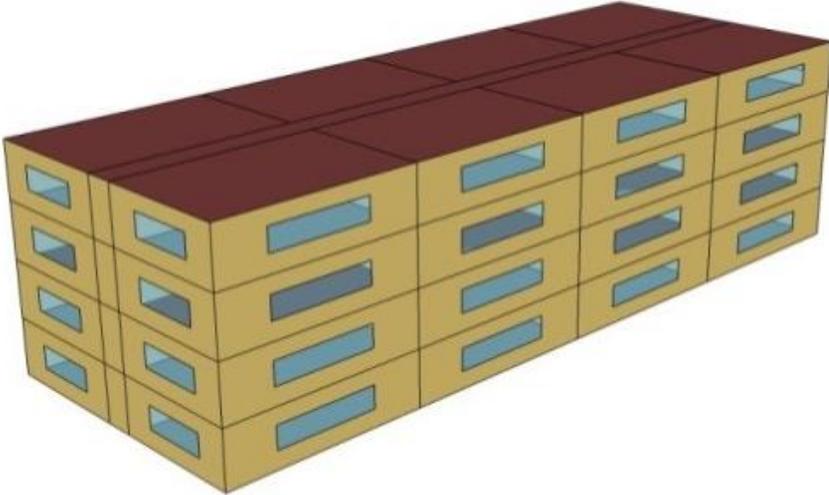
<b>Plug load</b>	
Average power density (W/ft <sup>2</sup> )	0.62 W/ft <sup>2</sup> daily peak per apartment, including all the home appliances See under <b>Plug Load</b> for the detailed calculations
Schedule	See under <b>Schedules</b>
<b>Occupancy</b>	
Average people	See under <b>Zone Summary</b>
Schedule	See under <b>Schedules</b>

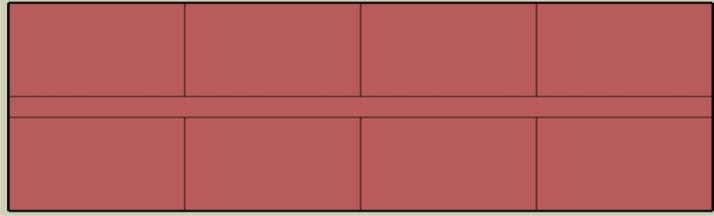
**Misc.**

<b>Elevator</b>	
Quantity	1
Motor type	Traction
Peak Motor Power (watts/elevator)	20370
Heat Gain to Building	Interior
Peak Fan/lights Power (watts/elevator)	161.9
Motor and fan/lights Schedules	See under <b>Schedules</b>
<b>Exterior Lighting</b>	
Peak Power (W)	Based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards
Schedule	See under <b>Schedules</b> and control requirements in codes or standards

**Table 15.** Mid-rise Apartment Modeling Inputs

Item	Descriptions
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Program		
Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Multifamily</b>	
Building Prototype	<b>Mid-Rise Apartment</b>	
Form		
Total Floor Area (sq feet)	33,700 (152 ft x 55.5 ft)	
Building shape		

Aspect Ratio	2.74
Number of Floors	4
Window Fraction (Window-to-Wall Ratio)	South: 20.0%, East: 20.0%, North: 20.0%, West: 20.0% Average Total: 20.0%
Window Locations	See image
Shading Geometry	None
Azimuth	Non-directional
Thermal Zoning	<p>27 zones                      Each floor has 8 apartments except ground floor (7 apartments and 1 office with equivalent apartment area)                      Total 8 apartments per floor with corridor in center.                      Zone depth is 25 ft for each apartment from side walls and each apt is 25' x 38' (950 ft²).</p> 
Floor to floor height (ft)	10
Floor to ceiling height (ft)	10 (No drop-in ceiling plenum is modeled)
Glazing sill height (ft)	3 ft (4 ft high windows)

**Architecture**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Steel-Frame Walls	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.057 Zone 2: U-Value = 0.044	Steel-frame walls U-Value = 0.055
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>

Construction	Insulated above entire deck	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-Value = 0.027
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.4 SHGC = 0.4 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	100%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Not Modeled	
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	NA	
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	
Slab on grade floor insulation level (F-factor)	F-Factor = 0.54	F-Factor = 0.54
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>	<b>2006</b>	<b>2018</b>
Construction	2 x 4 uninsulated stud wall	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	8 lbs/ft <sup>2</sup> of floor area	
<b>Air Barrier System</b>		

Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.17 cfm/ft2 @ 0.3 WC		
<b>HVAC - C403</b>				
<b>System Tag</b>	<b>2006</b>		<b>2018</b>	
	2006 A	2006 B	2018 A	2018 B
System Description	Zone Exhaust Heating: Zonal Electric Cooling: PTAC		Balanced Zone Ventilation, ERV 60% sensible Heating: Zonal Electric Cooling: PTAC	
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 1 ton max PTAC		WSEC 2018, Table C403.3.2 1 ton max PTAC	
Heating	WSEC 2006, Table 14-1 (A-G)		WSEC 2018, Table C403.3.2	
<b>HVAC Control</b>	<b>2006</b>		<b>2018</b>	
Thermostat Setpoint	See RTF Schedule Workbook		See RTF Schedule Workbook	
Thermostat Setback	See RTF Schedule Workbook		See RTF Schedule Workbook	
Supply air temperature	Maximum 95°F, Minimum 55°F		Maximum 95°F, Minimum 55°F ERV Setpoint: 62°F	
Economizers	None		None, C403.5 Exception 1	
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006		Balanced ventilation, International Mechanical Code, 2018	

Demand Control Ventilation	Spaces larger than 500 spft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 spft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None. Required for fan systems with greater than 5,000 CFM and which have a min OA of 70% or greater.	60% Efficient Sensible ERV, ERV bypass control to 62°F
<b>Fans</b>	Whole house fan	Whole house supply and exhaust fan with ERV
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Supply Fan Eff. 60% Motor Efficiency: Based on table WSEC table C405.8 C403.8.4 Group R occupancy exhaust fan efficacy (3.8 cfm / watt)
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	Central water heater with storage tank	
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	360	
Water temperature setpoint	140 F	
Water consumption	See under <b>Schedules</b>	
<b>Internal Loads &amp; Schedules</b>		
<b>Lighting</b>		

Average power density (W/ft <sup>2</sup> )	Apartment units: Estimate based on % high efficiency lamps. 1.36 W/sf	Apartment units: Estimate based on % high efficiency lamps. 0.42 W/sf
Schedule	See under <b>Schedules</b>	
Daylighting Controls		
Occupancy Sensors		
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	0.62 W/ft <sup>2</sup> daily peak per apartment, including all the home appliances See under <b>Plug Load</b> for the detailed calculations	
Schedule	See under <b>Schedules</b>	
<b>Occupancy</b>		
Average people	See under <b>Zone Summary</b>	
Schedule	See under <b>Schedules</b>	

**Misc.**

<b>Elevator</b>	
Quantity	1
Motor type	hydraulic
Peak Motor Power (watts/elevator)	16055
Heat Gain to Building	Interior
Peak Fan/lights Power (watts/elevator)	161.9
Motor and fan/lights Schedules	See under <b>Schedules</b>
<b>Exterior Lighting</b>	
Peak Power (W)	Based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards
Schedule	See under <b>Schedules</b> and control requirements in codes or standards

**Table 16.** Warehouse Modeling Inputs

	<b>Item</b>	<b>Descriptions</b>
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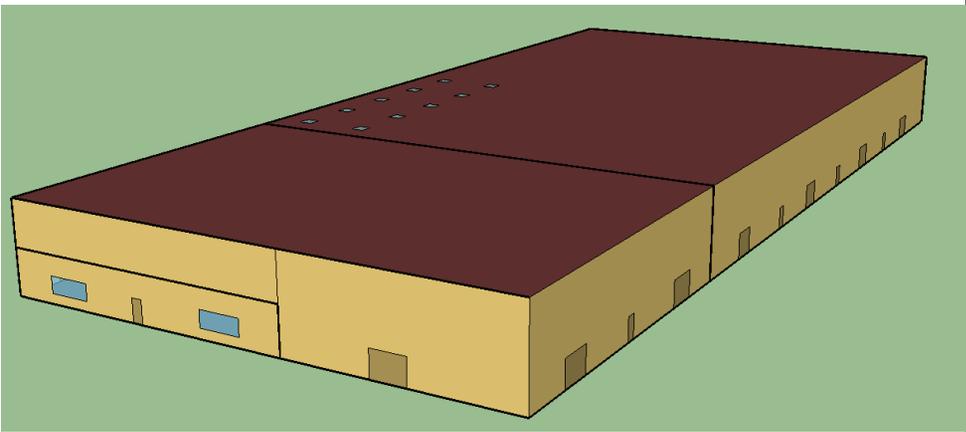
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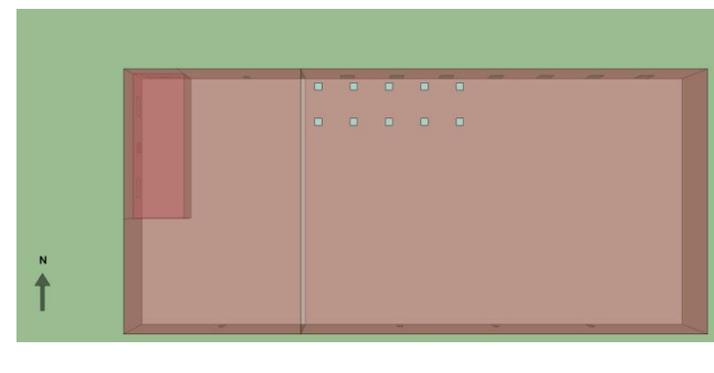
**Program**

Vintage	2006	2018
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Non-refrigerated warehouse</b>	
Building Prototype	<b>Warehouse</b>	

**Form**

Total Floor Area (sq feet)	49,495 (330 ft x 150 ft)
----------------------------	-----------------------------

<p>Building shape</p>		
<p>Aspect Ratio</p>	<p>2.2</p>	
<p>Number of Floors</p>	<p>1</p>	
<p>Window Fraction (Window-to-Wall Ratio)</p>	<p>0.71% Punched windows in Office Space</p>	
<p>Window Locations</p>	<p>Only for Office Space</p>	
<p>Shading Geometry</p>	<p>none</p>	
<p>Azimuth</p>	<p>non-directional</p>	
<p>Thermal Zoning</p>	<p>Three zones: Bulk Storage, Fine Storage, and Office.</p> <p>The Office zone is enclosed on two sides and at the top by the Fine Storage zone.</p>	

	
Floor to floor height (feet)	28
Floor to ceiling height (feet)	14 (Office)
Glazing sill height (feet)	3 (top of the window is 8 ft high with 5 ft high glass)

**Architecture**

	2006	2018
<b>Exterior walls</b>	<b>2006</b>	
Construction	Metal Building Wall	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal framing walls Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Metal building walls U-Value = 0.044
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	
Construction	Metal Building Roof	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Other roof Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	Metal building roof U-Value = 0.026

Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Horizontal	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Bulk Storage, Fine Storage Rectangular skylights (4 ft x 4 ft) = 16 ft <sup>2</sup> per skylight Number of skylights and total skylight area vary according to requirements in codes or standards	
Glass-Type and frame	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.425 SHGC = 0.35 VT = 0.5
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	

Thermal properties for ground level floor U-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	2x4 steel-frame with gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC

**HVAC**

System Type	2006 A	2018 A	2006 B	2018 B
Heating type	Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan)		Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan)	
Distribution and terminal units	Office/fine storage: Direct, uncontrolled air Bulk storage: non-ducted			
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			

<b>HVAC Efficiency</b>	<b>2006</b>	<b>2018</b>
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 5 ton max packaged RTU	WSEC 2018, Table C403.3.2 5 ton max packaged RTU
Heating	WSEC 2006, Table 14-1 (A-G)	WSEC 2018, Table C403.3.2
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	See RTF Schedule Workbook	See RTF Schedule Workbook
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Maximum 95°F, Minimum 55°F AHU supply: Outdoor Air Reset, min. 55°F (@ 70°F), max. 60°F (@ 60°F)	Maximum 95°F, Minimum 55°F AHU Supply: Warmest Zone Reset, min. 55°F, max. 60°F
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None	None
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Fan efficiency: 60% Motor Efficiency: Based on table WSEC table C405.8

Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>	<b>2006</b>	<b>2018</b>
Pump Type	NA	
Rated Pump Head	NA	
Pump Power	NA	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Power	NA	
<b>Service Water Heating</b>	<b>2006</b>	<b>2018</b>
SWH type	NA	
Fuel type	NA	
Thermal efficiency (%)	NA	NA
Tank Volume (gal)	NA	
Water temperature setpoint	NA	
Water consumption	See under <b>Schedules</b>	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	Office
Occupancy Sensors	None	FineStorage, BulkStorage
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	
Schedule	RTF Schedules	

<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

**Misc.**

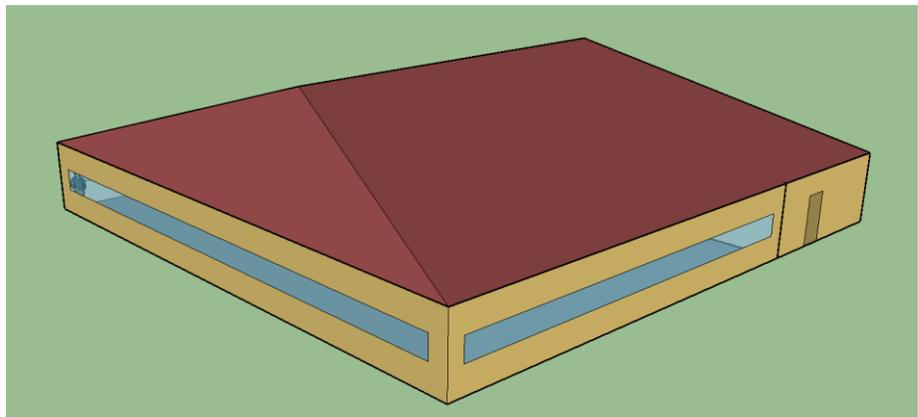
<b>Elevator</b>	<b>2006</b>	<b>2018</b>
Peak Power	Not modeled	
Schedule	Not modeled	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

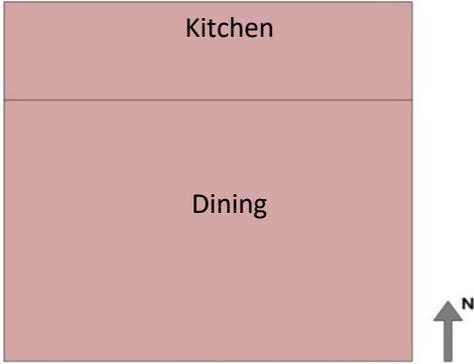
**Table 17.** Full-service Restaurant Modeling Inputs

	<b>Item</b>	<b>Descriptions</b>
<b>Program</b>		
Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	

Available fuel types	Gas, electricity
Building Type (Principal Building Function)	<b>Food service</b>
Building Prototype	<b>Sit Down Restaurant</b>

**Form**

Total Floor Area (sq feet)	5,502 (74.2 ft x 74.2 ft)
Building shape	
Aspect Ratio	1
Number of Floors	Single floor plus attic
Window Fraction (Window-to-Wall Ratio)	South: 28% East: 20.22% North: 0% West: 20.22% Total: 17.11%
Window Locations	All on dining-zone facade, none in kitchen. See above
Shading Geometry	None

Azimuth	Non-directional	
Thermal Zoning	<p style="text-align: center;">Kitchen, Dining, and Unconditioned Attic</p> 	
Floor to floor height (feet)	N/A	
Floor to ceiling height (feet)	10	
Glazing sill height (feet)	3.5 ft (top of the window is 6.5 ft with 3 ft high glass)	

**Architecture**

<b>Exterior walls</b>		
Construction	Steel-frame walls	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Metal-frame wall Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.047
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>		
Construction	Attic roof	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Attic roof Zone 1: U-Value = 0.036 Zone 2: U-Value = 0.031	Attic and other roof U-Value = 0.018
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Insulated ceiling - horizontal Attic roof North & south - 45 deg. East & west - 18.44 deg.	
<b>Window</b>		
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>		
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC		
Visible transmittance		
<b>Foundation</b>		
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	

Thermal properties for ground level floor U-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	0.5 in gypsum board + 0.5 in gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	6 inches standard wood (16.6 lb/ft²)	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC

**HVAC**

System Type	2006 A	2018 A	2006 B	2018 B
System Description	Packaged RTU Single zone Heat: Gas Cooling: DX + economizer		Packaged RTU Single zone Heat: Gas Cooling: DX + economizer	
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	Autosized to design day			
Heating	Autosized to design day			
<b>HVAC Efficiency</b>	<b>2006</b>		<b>2018</b>	
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 50 ton max per package RTU		WSEC 2018, Table C403.3.2 50 ton max per package RTU	

Heating	WSEC 2006, Table 14-1 (A-G)	WSEC 2018, Table C403.3.2
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F Single Zone Equipment: No Reset	Maximum 95°F, Minimum 55°F Single Zone Equipment: No Reset
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75°F	Airside Economizer Control: Differential Dry Bulb
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None	None
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	
Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Fan efficiency: 60% Motor Efficiency: Based on table WSEC table C405.8
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>		

Pump Type	Service hot water	
Rated Pump Head	No	
Pump Power	RTF Assumption: 100% eff motor. Negligible power consumption	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Power	NA	
<b>Service Water Heating</b>		
SWH type	Storage tank	
Fuel type	Natural gas (main)	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	270	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	Dinning
Occupancy Sensors	None	None
<b>Plug load</b>		
Average power density (W/ft <sup>2</sup> )	RTF Assumptions	

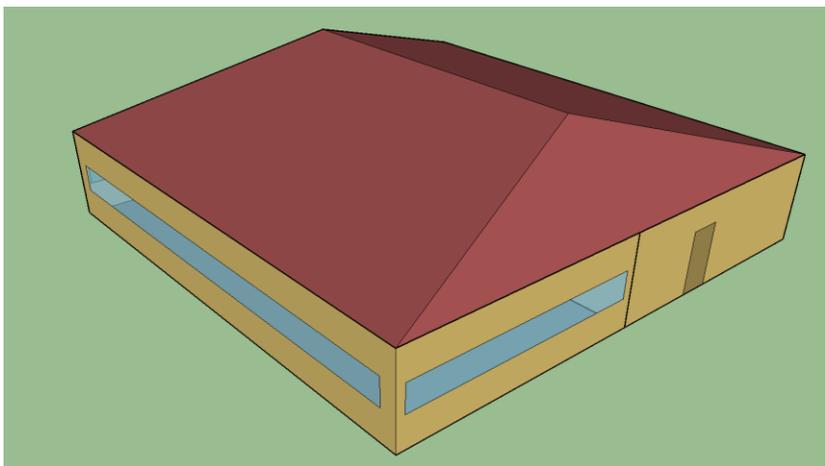
Schedule	RTF Schedules	
<b>Occupancy</b>		
Average people	RTF Assumptions	
Schedule	RTF Schedules	
<b>Misc.</b>		
<b>Elevator</b>		
Peak Power	NA	
Schedule	NA	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules

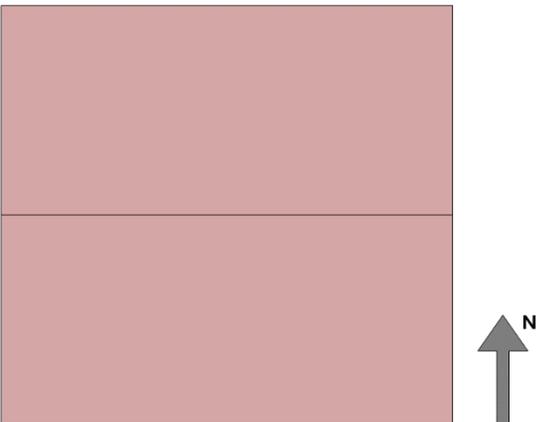
**Table 18.** Fast Food Restaurant Modeling Inputs

	Item	Descriptions
	Program	

Vintage	<b>2006</b>	<b>2018</b>
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	<b>Food service</b>	
Building Prototype	<b>Fast Food</b>	

**Form**

Total Floor Area (sq feet)	2500 (50 ft x 50 ft)
Building shape	
Aspect Ratio	1
Number of Floors	1

Window Fraction (Window-to-Wall Ratio)	South: 28% East: 14% North: 0% West: 14% Total: 14%
Window Locations	East (23.3 ft x 3 ft), south (46.7 ft x 3 ft), and west (23.3 ft x 3 ft) sides of dining zone façade
Shading Geometry	none
Azimuth	non-directional
Thermal Zoning	Kitchen, Dining, and Unconditioned Attic (See <b>ZoneSummary</b> tab) 
Floor to floor height (feet)	NA
Floor to ceiling height (feet)	10
Glazing sill height (feet)	3.5 (top of the window is 6.5 ft high with 3 ft high glass)

**Architecture**

<b>Exterior walls</b>	<b>2006</b>	<b>2018</b>
Construction	Wood-Frame Walls	

U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Wood frame & other wall Zone 1: U-Value = 0.062 Zone 2: U-Value = 0.062	wood frame & other wall U-Value = 0.046
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
<b>Roof</b>	<b>2006</b>	<b>2018</b>
Construction	Attic roof	
U-factor (Btu / h * ft <sup>2</sup> * °F) and/or R-value (h * ft <sup>2</sup> * °F / Btu)	Attic roof Zone 1: U-Value = 0.036 Zone 2: U-Value = 0.031	Attic and other roof U-Value = 0.018
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Insulated ceiling - horizontal Attic roof North & south - 45 deg. East & west - 18.44 deg.	
<b>Window</b>	<b>2006</b>	<b>2018</b>
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
SHGC (all)		
Visible transmittance		
Operable area	0%	
<b>Skylight</b>	<b>2006</b>	<b>2018</b>
Dimensions	Not modeled	
Glass-Type and frame	NA	
U-factor (Btu / h * ft <sup>2</sup> * °F)	NA	

SHGC		
Visible transmittance		
<b>Foundation</b>	<b>2006</b>	<b>2018</b>
Foundation Type	Slab-on-grade floors (unheated)	
Construction	6" concrete slab poured directly on to the earth	
Thermal properties for ground level floor U-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-Factor = 0.54	F-Factor = 0.54
Thermal properties for basement walls	NA	
Dimensions	Based on floor area and aspect ratio	
<b>Interior Partitions</b>		
Construction	0.5 in gypsum board + 0.5 in gypsum board	
Dimensions	Based on floor plan and floor-to-floor height	
<b>Internal Mass</b>	6 inches standard wood (16.6 lb/ft²)	
<b>Air Barrier System</b>	<b>2006</b>	<b>2018</b>
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC

**HVAC**

<b>System Type</b>	2006 A	2018 A	2006 B	2018 B
System Description	Packaged RTU Single zone Heat: Gas Cooling: DX + economizer		Packaged RTU Single zone Heat: Gas Cooling: DX + economizer	
<b>HVAC Sizing</b>	<b>2006</b>		<b>2018</b>	

Air Conditioning	Autosized to design day	
Heating	Autosized to design day	
<b>HVAC Efficiency</b>	<b>2006</b>	<b>2018</b>
Air Conditioning	WSEC 2006, Table 14-1 (A-G) 50 ton max per package RTU	WSEC 2018, Table C403.3.2 50 ton max per package RTU
Heating	WSEC 2006, Table 14-1 (A-G)	WSEC 2018, Table C403.3.2
<b>HVAC Control</b>	<b>2006</b>	<b>2018</b>
Thermostat Setpoint	See RTF Schedule Workbook	See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workbook	See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F Single Zone Equipment: No Reset	Maximum 95°F, Minimum 55°F Single Zone Equipment: No Reset
Chilled water supply temperatures	NA	
Hot water supply temperatures	NA	
Economizers	Airside Economizer Control: Fixed Dry-Bulb, 75°F	Airside Economizer Control: Differential Dry Bulb
Ventilation	Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Demand Control Ventilation	Spaces larger than 500 sqft with occupant density greater than 40 ppl / 1,000sqft	Spaces larger than 500 sqft with occupant density greater than 25 ppl / 1,000sqft, served by specified mechanical system
Energy Recovery	None	None
<b>Fan</b>	<b>2006</b>	<b>2018</b>
Fan schedules	RTF Schedules	

Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input	Fan efficiency: 60% Motor Efficiency: Based on table WSEC table C405.8
Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
<b>Pump</b>		
Pump Type	N/A	
Rated Pump Head	No	
Pump Power	N/A	
<b>Cooling Tower</b>		
Cooling Tower Type	NA	
Cooling Tower Power	NA	
<b>Service Water Heating</b>		
SWH type	Storage tank	
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	180	
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	

**Lighting, Internal Loads & Schedules - C405**

<b>Lighting</b>	<b>2006</b>	<b>2018</b>
Average power density (W/ft <sup>2</sup> )	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assumptions	
Daylighting Controls	None	Dinning
Occupancy Sensors	None	None
<b>Plug load</b>		

Average power density (W/ft <sup>2</sup> )	RTF Assumptions
Schedule	RTF Schedules
<b>Occupancy</b>	
Average people	RTF Assumptions
Schedule	RTF Schedules

**Misc.**

<b>Elevator</b>		
Peak Power	NA	
Schedule	NA	
<b>Exterior Lighting</b>	<b>2006</b>	<b>2018</b>
Peak Power	RTF Assumptions based on design assumptions for façade, parking lot, entrance, etc. and requirements in codes or standards	RTF inputs with power reductions based on 2018 code changes
Schedule	RTF Assumptions	RTF Schedules