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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February 20, 2020

# **Table of Contents**

#### **TABLE OF TABLES**

Table 18. Primary School Modeling Input Summary	
Table 19. Secondary School Modeling Input Summary	10
Table 20. Supermarket Modeling Input Summary	20
Table 21. Strip mall Modeling Input Summary	28
Table 22. Standalone Retail Modeling Input Summary	37
Table 23. Small Office Modeling Input Summary	44
Table 24. Medium Office Modeling Input Summary	51
Table 25. Large Office Modeling Input Summary	60
Table 26. Hospital Modeling Input Summary	69
Table 27. Outpatient Healthcare Modeling Input Summary	77
Table 28. Residential Care Modeling Input Summary	84
Table 29. Large Hotel Modeling Inputs	91
Table 30. Small Hotel Modeling Inputs	100
Table 31. High-rise Apartment Modeing Inputs	107
Table 32. Mid-rise Apartment Modeling Inputs	114
Table 33. Warehouse Modeling Inputs	121
Table 34. Full-service Restaurant Modeling Inputs	
Table 35. Fast Food Restaurant Modeling Inputs	136

#### **APPENDIX E – COMMERCIAL BUILDING MODELING INPUTS**

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

	ltem	Descriptions	
Pr	ogram		
	Vintage	2006	2018
	Locations		e, WA (mixed, marine) kane, WA (cool, dry)
	Available fuel types	Gas, electricity	
	Building Type (Principal Building Function)	Education	
	Building Prototype	Primary School	
Fc	orm		
	Total Floor Area (sq feet)		960 x 270 ft)

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

T The s	was at Zarain a				
ine	ermal Zoning				
		Classrooms zoned by exposure. Corner classrooms separated out from single exposure classrooms.  Double loaded corridors zoned separately.			
		Administrative area, Gymnasium, mechanical, media center, lobby, kitchen, and cafeteria are single zones. See <b>Zone Summary</b> .	↑ I		
Floo	or to floor height (feet)				
			1	3	
Floo (fee	or to ceiling height et)		1	3	
Glaz	zing sill height (feet)	(top of th	3. ne window is 8.1 ft	6 high with 4.5 ft high glass)	
Archi	itecture				
	erior walls	2006 2018			
	Construction	Steel-frame walls			
°F) a	J-factor (Btu / h * ft² * and/or R-value (h * ft² * °F / )	Metal-frame Zone 1: U-Value Zone 2: U-Value	e = 0.109	Steel-frame wal U-Value = 0.047	

Dimensions	Based on floor are	ea and aspect ratio	
Tilts and orientations	Vertical		
Roof	2006 2018		
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)		
U-factor (Btu / h * ft² *  °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-Value = 0.023	
Area (ft2)	Based on floor are	ea and aspect ratio	
Tilts and orientations	Horiz	zontal	
Window	2006	2018	
Glass-Type and frame		ing sill height, floor area and aspect ratio	
U-factor (Btu / h * ft² *  °F)  SHGC (all)  Visible transmittance	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.32 Operable: U-Factor = 0.34 SHGC = 0.38	
Operable area	0%		
Skylight	2006	2018	
Dimensions	Gymnasium/Multipurpose Room (4 ft x 4 ft) x 9 skylights = 144 ft² total Skylight Area 3.75% of gym roof area		
Glass-Type and frame U-factor (Btu / h * ft² * °F)	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.43 SHGC = 0.35 VT = 0.5	

SHGC				
Visible transmittance				
Foundation	20	06	2018	
Foundation Type		Slab-on-grade	floors (unheated)	
Construction	6	" concrete slab poure	d 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-Facto	r = 0.54	F-Factor = 0.5	54
Thermal properties for basement walls	NA			
Dimensions	Based on floor area and aspect ratio			
Interior Partitions	2006 20		2018	
Construction	2x4 steel-frame with gypsum board			
Dimensions	Based on floor plan and floor-to-floor height			
Internal Mass	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)			
Air Barrier System	2006 2018			
Infiltration	1.04 cfm/ft2 @ 0.3 WC		0.17 cfm/ft2 @ 0.	3 WC
VAC			•	
System Type	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 - electempering Packaged Single Zonesystem 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
HVAC Sizing	2006		2018	Cooling: DX
Air Conditioning	Autosized to design day			
Heating		Autosized to design day		
HVAC Efficiency	2006		2018	
Air Conditioning	WSEC 2006, Table 14-1A WSEC 201		WSEC 2018, Table C40 WSEC 2018, Table C403.3 (Path A) 1 system per classroom o per package PS	3.2(7) Chillers r 50 ton max
Heating	WSEC 2006, Table 14-1E Furnaces WSEC 2006, Table 14-1B Heat Pumps		WSEC 2018, Table C4 Furnaces WSEC 2018, Table C403 Pumps	,
HVAC Control	2006	2006		

See RTF Schedule Workbook	See RTF Schedule Workbook
See RTF Schedule Workbook	See RTF Schedule Workbook
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
Design: 44F Outdoor Air Reset: 48F @ 60F, 140F @ 70F	NA
Design: 180F NA Outdoor Air Reset: 180F @ 60F, 140F @ 70F	
Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated	None, C403.5 Exception 10
Washington State Ventilation and Indoor Air Quality Code, 2006	International Mechanical Code, 2018
Classrooms	None, C403.7.1 Exception 1 (DOAS w/ energy recovery)
None	60% efficient sensible heat recovery with bypass
2006	2018
RTF Sc	hedules
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, oth 0.67 Motor Efficiency: Based on WSE Table C405.8(1)	
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
2006	2018
	See RTF Schedule Workbook  Maximum 95°F, Minimum 55°F VAV Supply: Outdoor Air Reset, 55F @ 70F, 60F @ 60F  Design: 44F Outdoor Air Reset: 48F @ 60F, 140F @ 70F  Design: 180F Outdoor Air Reset: 180F @ 60F, 140F @ 70F  Airside Economizer Control: Fixed Dry-Bulb, 75F Lockout, Integrated  Washington State Ventilation and Indoor Air Quality Code, 2006  Classrooms  None  2006  RTF Sc Fan efficiency: 0.5 if <2000cfm, 0.6 if <10000cfm, otherwise 0.62 Motor Efficiency: Based on WSEC 2006  14-4 Calculated using fan and motor

Rated Pump Head	ChW: 75 ft HW: 60 ft CW: 60 ft	NA	
Pump Power	Autosized	NA	
Cooling Tower	2006	2018	
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	
Service Water Heating	2006	2018	
SWH type	Storage Tank		
Fuel type	Natural gas		
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2	
Tank Volume (gal)	20	00	
Water temperature setpoint	140 F		
Water consumption (peak gpm)	See under <b>Schedules</b>		
ighting, Internal Load	ds & Schedules - C405		
Lighting	2006	2018	
Average power density (W/ft²)	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	2006	2018
Average power density (W/ft²)	RTF Ass	sumptions
Schedule	RTF Sc	chedules
Refrigeration	2006	2018
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
Occupancy	2006	2018
Average people	RTF Assumptions	
Schedule	RTF Schedules	
sc.		
Elevator		
Peak Power	N	IA .
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

 Table 2. Secondary School Modeling Input Summary

	ltem	Descriptions	
Progra	am		
	Vintage	2006	2018
	Locations	(1) Zone 4C: Seattle, WA (2) Zone 5B2 Spokane,	
	Available fuel types	Gas, electri	icity
	Building Type (Principal Building Function)	Educatio	n
	Building Prototype	Secondary S	School
Form			
	Total Floor Area (sq feet)	210,900 (340 ft x 46	

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

Thermal Zoning	Classrooms zoned by exposure. Corner classrooms separated out from single exposure classrooms.	
	Double loaded corridors zoned separately.	
	Administrative areas zoned by exposure.	
	Gymnasium, auxiliary gym, auditorium, kitchen, and	
	cafeteria are single zones. See <b>Zone</b>	
	Summary.	
Floor to floor height (feet)	13	
Floor to ceiling height (feet)	13	
Glazing sill height (feet)	3.6 (top of the window is 8.1 ft high	with 4.5 ft high glass)
Architecture		
Exterior walls	2006	2018
Construction	Steel-frame w	/alls

U-factor (Btu / h * ft² * °F) and/or	Metal-frame wall Zone 1: U-Value = 0.109	Steel-frame wall U-Value = 0.047
R-value (h * ft <sup>2</sup> * °F / Btu)	Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	U-Value = 0.047
Dimensions	Based on floor area and aspect ratio	
Tilts and orientations	Vertical	
Roof	2006	2018
Construction	Insulation entirely a (Single-ply roof membrane, steel	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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	
Window	2006	2018
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 * ft² * °F)		
SHGC (all)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.32 Operable: U-Factor = 0.34 SHGC = 0.38
Visible transmittance	1 = 0.0	3.133 = 0.00
Operable area	0%	
Operable area	0%	

Dimensions	Gymnasium	
	Auxiliary Gymnasium	
Glass-Type and frame		
U-factor (Btu / h * ft² * °F)		
SHGC	U-Factor = 0.7 SHGC = 0.45 VT = 0.5	U-Factor = 0.43 SHGC = 0.35 VT = 0.5
Visible transmittance		
Foundation	2006	2018
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 ar	nd aspect ratio
Interior Partitions	2006	2018
Construction	2x4 steel-frame with g	ypsum board
Dimensions	Based on floor plan and floor-to-floor height	
Internal Mass	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)	
Air Barrier System	2006	2018
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.17 cfm/ft2 @ 0.3 WC

HVAC

System Type	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)  Single-zone RTUs for all other spaces. Heating: Gas furnace Cooling: DX, economizers		DOAS with ERV - elec tempering Packaged Single Zone System Heating: Gas Cooling: DX  Single-zone RTUs for all other spaces for heating and cooling. Ventilation from DOAS Heating: Gas furnace Cooling: DX	DOAS with ERV - elec tempering Packaged Single Zone System Heating: HP Cooling: DX  Single- zone RTUs for all other spaces for heating and cooling. Ventilation from DOAS Heating: Gas furnace Cooling: DX
HVAC Sizing	200	6	2018	ı
Air Conditioning		Auto-sized to design day		
Heating		Auto-sized to design day		
HVAC Efficiency	200	6	2018	

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
HVAC Control		
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
Fan	2006	2018
Fan schedules	RTF Schedu	ıles
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
Pump	2006	2018
Pump Type	Variable speed	NA
Rated Pump Head	ChW: 75 ft HW: 60 ft CW: 60 ft	NA
Pump Power	Autosized	NA
Cooling Tower	2006	2018
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

Service Water Heating	2006	2018
SWH type	Storage ta	nk
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

Lighting	2006	2018
Average power density (W/ft²)	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assump	tions
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows
Occupancy Sensors	All applicable zones	All applicable zones
Plug load	2006	2018
Average power density (W/ft²)	RTF Assumptions	
Schedule	RTF Schedules	
Electric load (cooking)		
Average power density (W/ft²)	20.6 W/ft <sup>2</sup> - 30% Radiant fraction, 25% latent, 20% lost	
Schedule	See under <b>Schedules</b>	

Gas Equip Cooking			
Average power density (W/ft²)	156 W/ft² - 20% Radiant fractio	n, 10% latent, 70% lost	
Schedule	See under <b>Schedules</b>		
Refrigeration			
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	
Occupancy	2006	2018	
Average people	RTF Assumptions		
Schedule	RTF Schedules		
Elevator	2006	2018	
Quantity	2		
Motor type	hydraulio	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			

2006

See under Schedules

2018

**Exterior Lighting** 

Misc.

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		
Pro	ogram			
	Vintage	2006	2018	
	Locations	(1) Zone 4C: Seattle (2) Zone 5B2 Spok	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, el	ectricity	
	Building Type (Principal Building Function)	Re	Retail	
	Building Prototype	Super	market	

orm	
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	
hitecture - C402			
Exterior walls	20	06	2018
Construction		Steel-fram	e walls
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-fa	ame wall actor = 0.109 actor = 0.084	Steel-frame wall U-Value = 0.047
Dimensions		Based on floor area	and aspect ratio
Tilts and orientations		Vertic	·
Roof	20	006	2018
Construction	(Single-	Insulation entirely ply roof membrane, ste	y above Deck el deck with rigid insulation)

U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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	Horiz	zontal		
Window	2006	2018		
Dimensions	Based on window fraction, location, glaz	ing sill height, floor area and aspect ratio		
Glass-Type and frame	Hypothetical window with a	weighted U-factor and SHGC		
U-factor (Btu / h * ft² * °F)				
SHGC (all)	U-Factor = 0.55 SHGC = 0.45	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34		
Visible transmittance	VT = 0.5	SHGC = 0.38		
Operable area	0%			
Skylight	2006	2018		
Dimensions	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft² per skylight	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft² per skylight		
Glass-Type and frame				
U-factor (Btu / h * ft <sup>2</sup> * °F)	U-Factor = 0.7	U-Factor = 0.425		
SHGC (all)	SHGC = 0.45 VT = 0.5	SHGC = 0.35 VT = 0.5		
Visible transmittance				
Foundation	2006	2018		
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-facto	r = 0.54	
Thermal properties for basement walls		N	IA		
Dimensions		Based on floor are	ea and aspect ratio		
Interior Partitions					
Construction		2x4 steel-frame w	rith gypsum board		
Dimensions	Bsed on floor plan and floor-to-floor height				
Internal Mass	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)				
Air Barrier System	2006		20	018	
Infiltration	1.04 cfm/ft2	@ 0.3 WC	0.25 cfm/ft2	2 @ 0.3 WC	
VAC - C403					
System Tag	20	06	20	18	
	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	
HVAC Sizing	2006 2018		18		
Air Conditioning		Autosized to	design day		
Heating		Autosized to	design day	_	

HVAC Efficiency	2006	2018
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 2018, Table C403.3.2(4) Furnaces WSEC 2018, Table C403.3.2(2) Heat Pumps
HVAC Control	2006	2018
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	N	IA
Hot water supply temperatures	N	IA
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 (Denergy recovery)	
Energy Recovery	None	60% efficient sensible heat recovery with bypass
Supply Fan	2006	2018

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Fan schedules	RTF Sc	hedules
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, otheriwse 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
Pump		
Pump Type	N	/A
Rated Pump Heat	N	/A
Pump Power	N	/A
Cooling Tower		
Cooling Tower Type	N	IA
Cooling Tower Efficiency	NA	
Service Water Heating	2006	2018
SWH type	Storag	e 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 Sc	hedules

hting, Internal Loads & So	chedules - C405	
Lighting	2006 2018	
Average power density (W/ft²)	WSEC 2006, Table 15-1 10% better than WSEC C405.4.2	
Schedule	RTF Ass	umptions
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/ft²)	RTF Ass	umptions
Schedule	RTF Sc	hedules
Occupancy		
Average people	RTF Ass	umptions
Schedule	RTF Sc	hedules
SC.		
Elevator		
Peak Power	N	A
Schedule	N	A
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	

Table 4. Strip mall Modeling Input Summary

Item	Descriptions

rogram		
Vintage	2006	2018
Locations	(1) Zone 4C: Sea (2) Zone 5B2 Sp	ttle, WA (mixed, marine) pokane, WA (cool, dry)
Available fuel types		s, electricity
Building Type (Principal Building Function)		Retail
Building Prototype	St	rip mall
orm		
Total Floor Area (sq feet)	22,500 ft	t² (300 ft x 75 ft)
Building shape		
Aspect Ratio	(0.33 for small sto	4 ore & 0.67 for large store)
Number of Floors		1

Window Fraction (Window-to-Wall Ratio)	(Window 24 windows, 7 ft x 5 ft each and 12 c	10.5%  Dimensions: doors, 6 ft x 7 ft each, on the street facing south WWR 26%)
Window Locations	Windows only on t	he street facing façade
Shading Geometry		None
Azimuth	Non-c	directional
Thermal Zoning	-	
	LGStore1 (Type 1), SMStore1 (Type 1 SMStore4 (Type 2), LGStore2 (Type 3 SMStore7 (Type 3),	es (from left to right): ), SMStore2 (Type 2), SMStore3 (Type 3), S), SMStore5 (Type 3), SMStore6 (Type 3), and SMStore8 (Type 3).
Floor to floor height (feet)	(See Zone	Summary tab) 17
		17
Floor to ceiling height (feet)		17
Glazing sill height (feet)	3.0 ft (top of the	e window is 8 ft high)
Architecture	1	
Exterior walls		
Construction	Steel-f	frame walls
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 a	area and aspect ratio
Tilts and orientations	Vertical	
Roof		
Construction		tirely above Deck , steel deck with rigid insulation)
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-factor = 0.036 Zone 2: U-factor = 0.031	U-Value = 0.023
Dimensions	Based on floor a	area and aspect ratio
Tilts and orientations	Horizontal	
Window		
Dimensions	Based on window fraction, location, gla	azing sill height, floor area and aspect ratio
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft² * °F)		
SHGC (all)	U-Factor = 0.55 SHGC = 0.45	Fix: U-Factor = 0.32 Operable: U-Factor = 0.34
Visible transmittance	VT = 0.5	SHGC = 0.38
Operable area	0%	
Skylight		
Dimensions	Not	modeled
Glass-Type and frame U-factor (Btu / h * ft² * °F)		NA

SHGC (all)				
Visible transmittance  Foundation				
Foundation Type		Slah-on-gra	de floors (unheated)	
Construction		Slab-on-grade floors (unheated) 6" concrete slab poured directly on to the earth		earth
Thermal properties for ground level floor U-factor (Btu / h * ft2 * °F) and/or R-value (h * ft2 * °F / Btu)	F-fact	or = 0.54	F-facto	or = 0.54
Thermal properties for basement walls			NA	
Dimensions		Based on floo	r area and aspect ratio	
Interior Partitions				
Construction		2x4 steel-fran	ne with gypsum board	
Dimensions		Based on floor pla	an and floor-to-floor hei	ght
Internal Mass	Inte	rior furnishings: 6 in	ches standard wood (1	6.6 lb/ft²)
Air Barrier System	2	2006	2	018
Infiltration	1.04 cfm/i	t2 @ 0.3 WC	0.25 cfm/ft	2 @ 0.3 WC
AC - C403			l	
System Tag	2006 2018		018	
	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	
HVAC Sizing	-	2006		2018	
Air Conditioning		Autosized to design day			
Heating		Autosized to design day			
HVAC Efficiency	2006		2018		
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		
HVAC Control		2006		2018	
Thermostat Setpoint	See RTF Sch	See RTF Schedule Workbook		See RTF Schedule Workbook	
Thermostat Setback	See RTF Sch	See RTF Schedule Workbook		See RTF Schedule Workbook	
Supply air temperature	Maximum 95°	°F, Minimum 55°F		F, Minimum 55°F etpoint: 62°F	
Chilled water supply temperatures		NA			
Hot water supply temperatures		NA			
Economizers	Control: Fixe	Economizer ed Dry-Bulb, 75F Nonintegrated	None, C403	.5 Exception 10	

		T	
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	
Supply Fan	2006	2018	
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, otheriwse 0.6 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	
Pump			
Pump Type	NA		
Rated Pump Head	NA		
Pump Power	NA		
Cooling Tower			
Cooling Tower Type	NA		
Cooling Tower Power	NA		
Service Water Heating	2006	2018	
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 & S	chedules - C405		
Lighting	2006	2018	
Average power density (W/ft²)	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2	
Schedule	RTF A	ssumptions	
Daylighting Controls	All perimeter zones with windows	All perimeter zones with windows	
Occupancy Sensors	All applicable zones	All applicable zones	
Plug load		L	
Average power density (W/ft²)	RTF A	ssumptions	
Schedule	RTF	Schedules	
Occupancy			
Average people	RTF A	ssumptions	
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

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

Dra	Item	Descriptions		
PIC	ogram			
	Vintage	2006	2018	
	Locations		e, WA (mixed, marine) kane, WA (cool, dry)	
	Available fuel types	Gas, e	lectricity	
	Building Type (Principal Building Function)	Re	Retail	
	Building Prototype	Standalo	Standalone Retail	

rm	
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</b> <b>Summary</b> tab)		
Floor to floor height (feet)		N/	'A
Floor to ceiling height (feet)		2	0
Glazing sill height (feet)	5 ft (top	of the window is 8.73	ft high with 3.74 ft high glass)
Architecture - C402	•		
Exterior walls	20	06	2018
Construction		Steel-fra	me walls
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-fa	ame wall actor = 0.109 actor = 0.084	Steel-frame wall U-Value = 0.047
Dimensions		Based on floor are	a and aspect ratio
Tilts and orientations		Vert	•
Roof	20	06	2018
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)		
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-V Zone 2: U-V	alue = 0.046 alue = 0.039	U-Value = 0.023
Dimensions		Based on floor are	a and aspect ratio
Tilts and orientations		Horiz	ontal

Window	2006	2018	
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 * ft² * °F)	U-Factor = 0.55	Fix: U-Factor = 0.323	
SHGC (all)	SHGC = 0.45	Operable: U-Factor = 0.34	
Visible transmittance	VT = 0.5	SHGC = 0.38	
Operable area	0'	%	
Skylight	2006	2018	
Dimensions	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft² per skylight	Core Retail, 8 Rectangular skylights 4 ft x 4 ft = 16 ft² per skylight	
Glass-Type and frame			
U-factor (Btu / h * ft² * °F)	U-Factor = 0.7	U-Factor = 0.425	
SHGC (all)	SHGC = 0.45 VT = 0.5	SHGC = 0.35 VT = 0.5	
Visible transmittance	V 1 = 0.0	V1 = 0.0	
Foundation	2006	2018	
Foundation Type	Slab-on-grade fl	oors (unheated)	
Construction	6" concrete slab poured	d 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	N	A	
Dimensions	Based on floor are	ea and aspect ratio	
Interior Partitions			
Construction	2x4 steel-frame w	rith gypsum board	
Dimensions	Based on floor plan and floor-to-floor height		
Internal Mass	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)		
Air Barrier System	2006	2018	
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.25 cfm/ft2 @ 0.3 WC	

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System Tag	20	006	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
HVAC Sizing	20	006	2	018
Air Conditioning		Autosized to	design day	
Heating				
HVAC Efficiency	20	006	2	018
Air Conditioning		, Table 14-1A r package AHU		able C403.3.2(1)A r 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	
HVAC Control	20	006	2018	
Thermostat Setpoint	See RTF Sche	edule Workbook	See RTF Schedule Workbook	
Thermostat Setback	See RTF Sche	edule Workbook	See RTF Scho	edule Workbook
Supply air temperature	Maximum 95°F, Minimum 55°F			F, Minimum 55°F tpoint: 62°F
Chilled water supply temperatures			İA	
Hot water supply temperatures		N	IA	
Economizers	Control: Fixed Dry	conomizer -Bulb, 75F Lockout, grated	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
Fan	2006	2018
Fan schedules	RTF Sc	hedules
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, otheriwse 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
Pump		
Pump Type	N	/A
Rated Pump Heat	N	/A
Pump Power	N	/A
Cooling Tower		
Cooling Tower Type	N	IA
Cooling Tower Efficiency	N	IA
Service Water Heating	2006	2018
SWH type	Storag	e Tank
Fuel type	Natural Gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8 WSEC 2018, Table C404.2	
Tank Volume (gal)	4	0

Water temperature setpoint	140 F		
Water consumption	RTF Schedules		
ighting, Internal Loads & Sc	hedules - C405		
Lighting	2006	2018	
Average power density (W/ft²)	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2	
Schedule	RTF Ass	umptions	
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/ft²)	RTF Ass	umptions	
Schedule	RTF Sc	hedules	
Occupancy			
Average people	RTF Ass	umptions	
Schedule	RTF Sc	hedules	
lisc.			
Elevator			
Peak Power	N	IA	
Schedule	N	IA	
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	

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

	ltem	Descriptions	
Pro	ogram		
	Vintage	2006	2018

Locations	<ul><li>(1) Zone 4C: Seattle, WA (mixed, marine)</li><li>(2) Zone 5B2 Spokane, WA (cool, dry)</li></ul>
Available fuel types	Gas, electricity
Building Type (Principal Building Function)	Office
Building Prototype	Small Office
orm	
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)		(Window Di	r the other three orientations mensions: idows for all façades)
Window Locations		Evenly distributed a	llong four façades
Shading Geometry		Nor	
Azimuth		Non-dire	ctional
Thermal Zoning	Perimeter zone depth: 16.4 ft.  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.  Percentages of floor area  Percentages of floor area: perimeter 70%, core 30%		
Floor to floor height (feet)		10	
Floor to ceiling height (feet)		10	
Glazing sill height (feet)	3 (top of the window is high gl		Reduce glazing to 30% WWR.
rchitecture			
Exterior walls	2006 2018		2018
Construction		Wood-Frar	me Walls

U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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		
Roof	2006	2018	
Construction	Attic	roof	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 are	a and aspect ratio	
Tilts and orientations	Hipped roof: 10.76 ft attic ridg		
Window	2006	2018	
Dimensions	Based on window fraction, location, glazi	ng sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a w	veighted U-factor and SHGC	
U-factor (Btu / h * ft² * °F)	U-Factor = 0.55	Fix: U-Factor = 0.38	
SHGC (all)	SHGC = 0.45 VT = 0.5	Operable: U-Factor = 0.4 SHGC = 0.38	
Visible transmittance			
Operable area	09	6	
Skylight			
Dimensions	Not mo	odeled	
Glass-Type and frame			
U-factor (Btu / h * ft² * °F)		Λ.	
SHGC (all)	N/	4	
Visible transmittance			
Foundation			

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-Fact	or = 0.54			
Thermal properties for basement walls		N	NA .		
Dimensions		Based on floor are	ea and aspect ratio		
Interior Partitions					
Construction		0.5 in gypsum board	+ 0.5 in gypsum board	b	
Dimensions		Based on floor plan a	nd floor-to-floor heigh	t	
Internal Mass		6 inches standard	d wood (16.6 lb/ft²)		
Air Barrier System					
Infiltration	1.04 cfm/ft	1.04 cfm/ft2 @ 0.3 WC		0.17 cfm/ft2 @ 0.3 WC	
AC - C403	<u>'</u>				
System Tag	2	006	20	18	
	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	
HVAC Sizing	2	006	20	)18	
Air Conditioning		Autosized t	o design day		
Heating		Autosized to design day			
HVAC Efficiency	2	006	20	118	
Air Conditioning	WSEC 2006, Table 14-1A WSEC 2006 WSEC DX		WSEC 2018, Table C403.3.2(1)A 2.5 ton max per PSZ DX		

49

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	
HVAC Control	2006	2018	
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	N	A	
Hot water supply temperatures	N	A	
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	
Supply Fan	2006	2018	
Fan schedules	RTF Scl		
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	
Pump			
Pump Type	N/A		
Rated Pump Heat	N/	'A	
Pump Power	N/	'A	
Cooling Tower			
Cooling Tower Type	N.	A	
Cooling Tower Efficiency	N.	A	
Service Water Heating	2006	2018	
SWH type	Storag	e tank	
Fuel type	Natura	al gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2	
Tank Volume (gal)	41	0	
Water temperature setpoint	140	) F	
Water consumption	See under \$	Schedules	
hting, Internal Loads & So	chedules - C405		
Lighting	2006	2018	
Average power density (W/ft²)	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/ft²)	RTF Assu	umptions	
Schedule	RTF Sci	nedules	
Occupancy			
Average people	RTF Assu	umptions	
Schedule	RTF Sci	nedules	
SC.			
Elevator			
Quantity	N.	A	
Motor type	NA		
Peak Motor Power (W/elevator)	NA		
Heat Gain to Building	N.	A	
Peak Fan/lights Power (W/elevator)	NA		
Motor and fan/lights Schedules	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	

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

D	Item	Descriptions	
Pro	ogram	2000	2040
	Vintage	2006	2018
	Location	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, el	lectricity
	Building Type (Principal Building Function)	Office	
	Building Prototype	Medium Office	
Fo	rm		
	Total Floor Area (sq feet)	·	600 x 109.2 ft)

Building shape				
Aspect Ratio	1.	.5		
Number of Floors	3	3		
Window Fraction (Window-to-Wall Ratio)	33% (Window Dimensions: 163.8 ft x 4.29 ft on the long side of facade 109.2 ft x 4.29 ft on the short side of the façade)	30% of above-grade gross walls		
Window Locations	Evenly distributed	Evenly distributed along four façades		
Shading Geometry	None			
Azimuth	Non-directional			

Thermal Zoning	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 are 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 40%, Core 60%	<b>2</b> ↑	
Floor to floor height (feet)	Core 00 /6		13
Floor to ceiling height (feet)		(4 ft above	9 e-ceiling plenum)
Glazing sill height (feet)	3.35 ft (top of the window is 7.64 ft high with 4.29 ft high glass)		
rchitecture - C402	1		
Exterior walls	2006	3	2018
Construction		Steel-	-frame walls

U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 are	ea and aspect ratio
Tilts and orientations	Ver	tical
Roof	2006	2018
Construction		ely above Deck teel deck with rigid insulation)
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-factor = 0.027
Dimensions	Based on floor are	ea and aspect ratio
Tilts and orientations	Horiz	zontal
Window	2006	2018
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspe	
Glass-Type and frame	Hypothetical window with a	weighted U-factor and SHGC
U-factor (Btu / h * ft² * °F)	U-Factor = 0.4	Fix: U-Factor = 0.38
SHGC (all)	SHGC = 0.4 VT = 0.5	Operable: U-Factor = 0.4 SHGC = 0.38
Visible transmittance		
Operable area	0	%
Skylight	2006	2018
Dimensions		
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	7	
SHGC (all)		
Visible transmittance		
Foundation	2006	2018
Foundation Type	Slab-on-grade f	loors (unheated)

System Tag	2006	2018	
AC - C403			
Infiltration	1.04 cfm/ft2 @ 0.3 WC	0.17 cfm/ft2 @ 0.3 WC	
Air Barrier System	2006	2018	
Internal Mass	Interior furnishings: 6 inche	s standard wood (16.6 lb/ft²)	
Dimensions	Based on floor plan and floor-to-floor height		
Construction	2x4 steel-frame with gypsum board		
Interior Partitions		·	
Dimensions	Based on floor are	ea and aspect ratio	
Thermal properties for basement walls	N	NA .	
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		
Construction	6" concrete slab poured directly on to the earth		

## HV

System Tag	20	2006		118
	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
HVAC Sizing	20	06	20	18
Air Conditioning		Autosized t	o design day	
Heating		Autosized t	o design day	
HVAC Efficiency	20	2006 2018		
Air Conditioning		WSEC 2006, Table 14-1A 100 ton max per package AHU		ble C403.3.2(1)C VRF outdoor unit

Heating	N/A (electric)	WSEC 2018, Table C403.3.2(1)C
HVAC Control	2006	2018
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	N	IA
Hot water supply temperatures	N	IA
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
Supply Fan	2006	2018
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
Pump		
Pump Type	N/A	
Rated Pump Heat	N/A	

Pump Power	N/A	
Cooling Tower		
Cooling Tower Type	NA NA	4
Cooling Tower Efficiency	NA	
Service Water Heating	2006 2018	
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	
nting, Internal Loads & So	chedules - C405	
Lighting	2006	2018

## Lig

Lighting	2006	2018
Average power density (W/ft²)	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Ass	umptions
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/ft²)	RTF Assumptions	
Schedule	RTF Schedules	
Occupancy		
Average people	RTF Assumptions	
Schedule	RTF Schedules	

## Misc.

50.		
Elevator		
Quantity	2	
Motor type	Hydr	aulic
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>	
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

Table 8. Large Office Modeling Input Summary

ltem	Descriptions

ogram	0000	0040
Vintage	2006	2018
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types	Gas, e	electricity
Building Type (Principal Building Function)	Office	
Building Prototype	Large	e Office
m		
Total Floor Area (sq feet)		98,600 t 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 a	mong all four sides	
Shading Geometry	No	ne	
Azimuth	Non-dire	ectional	
Thermal Zoning		25 zones	
	Perimeter zone depth: 15 ft.  Each floor has four perimeter zones, one core zone. Office spaces are broken of into open office, private office, conference, and break. The center zone is oper 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%.		
Floor to floor height (feet)	13		
Floor to ceiling height (feet)	9		
Glazing sill height (feet)	3 ft		
chitecture - C402	•		
Exterior walls	2006	2018	
Construction	Steel-frame walls		

Glass-Type and frame U-factor (Btu / h * ft² * °F) SHGC (all) Visible transmittance  Foundation Foundation Type	2006  Basement (co	2018	
U-factor (Btu / h * ft² * °F) SHGC (all) Visible transmittance	NA NA		
U-factor (Btu / h * ft² * °F)	NA NA		
Glass-Type and frame			
2	Not moc		
Dimensions	Not mod		
Skylight	2006	2018	
Operable area	0%		
Visible transmittance	VT = 0.5	SHGC = 0.38	
SHGC (all)	SHGC = 0.4	Operable: U-Factor = 0.4	
U-factor (Btu / h * ft² * °F)	U-Factor = 0.4	Fix: U-Factor = 0.38	
Glass-Type and frame	Hypothetical window with a we	Hypothetical window with a weighted U-factor and SHGC	
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect ratio		
Window	2006	2018	
Tilts and orientations	Horizo	ntal	
Dimensions	Based on floor area	·	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-factor = 0.027	
Construction	Insulation entirely (Single-ply roof membrane, ste		
Roof	2006 2018		
Tilts and orientations	Vertic		
Dimensions	Based on floor area and aspect ratio		
and/or R-value (h * ft² * °F / Btu)	Zone 2: U-factor = 0.084	3 Tablet = 0.000	
	Zone 1: U-factor = 0.109	Steel-frame wall U-factor = 0.055	

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-facto	r = 0.54
Thermal properties for basement walls	Zone 1: U-fa	ame wall actor = 0.109 actor = 0.084		s Wall = 0.104
Dimensions		Based on floor a	rea and aspect ratio	
Interior Partitions				
Construction		2 x 4 uninsu	ılated stud wall	
Dimensions		Based on floor plan	and floor-to-floor heigh	t
Internal Mass	6 inches standard wood (16.6 lb/ft²)			
Air Barrier System	20	006	20	18
Infiltration	1.04 cfm/ft2 @ 0.3 WC		0.17 cfm/ft2 @ 0.3 WC	
AC - C403	<u>. I</u>			
System Tag	2006 2018		18	
	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 NA
System Description  HVAC Sizing	VAV (PVAV), one per floor Heating: elec central + elec VAV boxes Cooling: DX + economizer	NA 006	DOAS with HRV - elec tempering, one per floor VRF Heat Pump FCUs (no VRF heat recovery). One VRF outdoor system per floor.	
	VAV (PVAV), one per floor Heating: elec central + elec VAV boxes Cooling: DX + economizer	006	DOAS with HRV - elec tempering, one per floor VRF Heat Pump FCUs (no VRF heat recovery). One VRF outdoor system per floor.	NA

HVAC Efficiency	2006	2018
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
HVAC Control	2006	2018
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	N	A
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
Supply Fan	2006	2018
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
Pump		
Pump Type	N/A	
Rated Pump Heat	N.	/A
Pump Power	N.	/A
Cooling Tower		
Cooling Tower Type	N	IA
Cooling Tower Efficiency	N	IA
Service Water Heating	2006	2018
SWH type	Storage Tank	
Fuel type	Natural Gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	84	40
Water temperature setpoint	140 F	
Water consumption	RTF Schedules	
ghting, Internal Loads & Sc	hedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Ass	umptions
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/ft²)	RTF Ass	umptions	
Schedule	RTF Sc	hedules	
Occupancy			
Average people	RTF Ass	umptions	
Schedule		hedules	
SC.			
Elevator	2006	2018	
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	
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	

Table 9. Hospital Modeling Input Summary

	ltem	Descriptions		
Pro	ogram			
	Vintage	2006	2018	
	Locations	(1) Zone 4C: Seattle, WA (2) Zone 5B2 Spokane,	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
	Available fuel types	Gas, electricity		
	Building Type (Principal Building Function)	Health Car	re	
	Building Prototype	Hospita	Hospital	
Fo	rm			
	Total Floor Area (sq feet)	241,410 (including base	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	55 zones, 162 zones with multipliers 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.		
	Percentages of floor area: Clinic 25%, Core/Public 35%, Perimeter (patient rooms offices) 15%, Kitchen 5%, Lobby/Hallway 20%			
	Floor to floor height (ft)	14 ft above g 8 ft basem		
	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 w		
Arc	chitecture			
	Exterior walls	2006	2018	
	Construction	Steel-frame walls		
	U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 a	nd aspect ratio	
	Tilts and orientations	Vertical		
	Roof			
	Construction	Insulated above e	entire deck	
	U-factor (Btu / h * ft² *  °F) and/or  R-value (h * ft² * °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		
	Window	2006 2018		
	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 * ft² *  °F)  SHGC (all)  Visible transmittance	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38	
Operable area	0%		
Skylight			
Dimensions	Not mod	deled	
Glass-Type and frame U-factor (Btu / h * ft² *  °F) SHGC (all) Visible transmittance	NA		
Foundation	2006	2018	
Foundation Type	Basement (co	nditioned)	
Construction	8" concrete wall; 6" concrete slab,	,	
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 F-factor (Btu / h * ft * °F) and/or R-value (h * ft2 * °F / Btu) Dimensions	Metal-frame wall Zone 1: U-factor = 0.109 Zone 2: U-factor = 0.084  Based on floor area	Mass Wall U-factor = 0.088	
Interior Partitions	Dadda dir illoh dida		
Construction	2 x 4 uninsulated stud wall		
Dimensions	Based on floor plan and floor-to-floor height		

Internal Mass

mioriai maoo	6	inches standard	wood (16.6 lb/ft²)		
Air Barrier System	2006		2018		
Infiltration	1.04 cfm/ft2 @ 0.	3 WC	0.25 cfm/ft2 @	0.3 WC	
'AC					
System Type	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		Zoning per			
terminal units					
HVAC Sizing		A.staalaa III.	desian des		
Air Conditioning		Autosized to			
Heating HVAC Efficiency	2006	Autosized to	a design day 2018		
TIVAC Efficiency	2000		2018		

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
HVAC Control		
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 44 °F emperatures 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	
Fan	2006	2018	
Fan schedules	RTF Scheo	dules	
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.	
Pump			
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		
Cooling Tower			
Cooling Tower Setpoints	coling 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	Autosize	ed	
Service Water Heating			
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)	35	50
Water temperature setpoint	140 F	
Water consumption	See under	Schedules
nternal Loads &		
chedules		
Lighting	2006	2018
Average power density (W/ft²)	ASHRAE 90.12007, Table 7.8	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Ass	umptions
Daylighting Controls	None	all perimeter zone
Occupancy Sensors	None	all zones
Plug load		
Average power density (W/ft²)	RTF Assumptions	
Schedule	RTF Schedules	
Occupancy		
Average people	RTF Ass	umptions
Schedule	RTF Schedules	
isc.		
Elevator		
Quantity	8	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>Scl</b>	nedules
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

 Table 10. Outpatient Healthcare Modeling Input Summary

	ltem	Descriptions			
Pro	Program				
	Vintage	2006	2018		

Locations	<ul><li>(1) Zone 4C: Seattle, WA (mixed, marine)</li><li>(2) Zone 5B2 Spokane, WA (cool, dry)</li></ul>
Available fuel types	Gas, electricity
Building Type (Principal Building Function)	Health Care
Building Prototype	Outpatient Healthcare
rm	
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-direction	onal
Thermal Zoning	118 zones; See <b>Zone Summa</b>	ary and HVAC Zoning
Floor to floor height (feet)	10 ft	
Floor to ceiling height (feet)	10 ft	
Glazing sill height (feet)	3 ft (4 ft high wi	ndows)
Architecture		
Exterior walls		
Construction	Steel-Frame	Walls
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Metal framing walls Zone 1: U-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.047
Ďimensions	Based on floor area ar	nd aspect ratio
Tilts and orientations	Vertical	
Roof		
Construction	Insulated above entire deck	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	U-Value = 0.023
Dimensions	Based on floor area ar	nd aspect ratio
Tilts and orientations	Horizonta	al
Window		
Dimensions	Based on window fraction, location, glazing s	sill height, floor area and aspect ratio
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft² * °F) SHGC (all)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
Visible transmittance		

Operable area	12%				
Skylight					
Dimensions	Not modeled				
Glass-Type and frame					
U-factor (Btu / h * ft² * °F)		NA			
SHGC (all)					
Visible transmittance					
Foundation					
Foundation Type		Slab-on-grade floors	s (unheated)		
Construction	6"	concrete slab poured dire	ectly 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-Facto	or = 0.54	F-Factor = 0.	.54	
Thermal properties for basement walls	NA				
Dimensions		Based on floor area ar	nd aspect ratio		
Interior Partitions			•		
Construction		2x4 steel-frame with	gypsum board		
Dimensions	E	Based on floor plan and fl			
Internal Mass	Interior furnishings: 6 inches standard wood (16.6 lb/ft²)				
Air Barrier System					
Infiltration	1.04 cfm/ft2 @ 0.3 WC 0.25 cfr		0.25 cfm/ft2 @ 0	n/ft2 @ 0.3 WC	
AC					
System Type	2006 A	2018 A	2006 B	2018	

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 w	ith damper and hot water reheating coil
HVAC Sizing		
Air Conditioning	Αι	itosized to design day
Heating	Αι	itosized to design day
HVAC Efficiency	2006	2018
Air Conditioning	WSEC 2006, Table 14-1 (A	A-G) WSEC 2018, Table C403.3.2
Heating	WSEC 2006, Table 14-1 (	A-G) WSEC 2018, Table C403.3.2
HVAC Control		
Thermostat Setpoint	See RTF Schedule Workb	oook See RTF Schedule Workbook
Thermostat Setback	See RTF Schedule Workb	oook See RTF Schedule Workbook
Supply air temperature	Maximum 95°F, Minimum AHU supply: Outdoor Air Reset, m 70°F), max. 60°F (@ 60°	nin. 55°F (@ AHU supply: Outdoor Air Reset, min.
Chilled water supply temperatures	44 °F Outdoor Air Reset: 48°F (@55	70°F)
Hot water supply temperatures	180 °F Outdoor Air Reset: 140°F (@70	130 °F O°F, 60°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: Differencial 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
Fan	2006	2018
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.
Pump	2006	2018
Pump Type	Pump serving the hot water sy	ystem, constant speed
Rated Pump Head	Requirements in code	s or standards
Pump Power	Autosize	d
Cooling Tower	2006	2018
Cooling Tower Type	NA	
Cooling Tower Power	NA	
Service Water Heating	2006	2018
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>Sch</b>	nedules
ighting, Internal Loads &	Schedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	WSEC 2006, Table 15-1	10% better than WSEC 2018, Table C405.4.2
Schedule	RTF Assump	otions
Daylighting Controls	None	All exterior zones with windows
Occupancy Sensors	None	Office and Storage Zones
Plug load		
Average power density (W/ft²)	RTF Assump	otions
Schedule	RTF Sched	ules
Occupancy		
Average people	RTF Assump	otions
Schedule	RTF Sched	ules
⁄lisc.		
Elevator		
Quantity	3	
Motor type	hydraulie	С
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>	
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

 Table 11. Residential Care Modeling Input Summary

Item	Descriptions

Program		
Vintage	2006	2018
Locations		
	(1) Zone 4C: Seattle (2) Zone 5B2 Spok	e, WA (mixed, marine) kane, WA (cool, dry)
Available fuel types	Gas, e	lectricity
Building Type (Principal Building Function)		h Care
Building Prototype	Resider	ntial Care
Form		
Total Floor Area (sq feet)		,401 basement)
Building shape		
Aspect Ratio		NA

Number of Floors	3	3
Window Fraction (Window-to-Wall Ratio)	Average T	otal: 29%
Window Locations	See pi	ctures
Shading Geometry	no	
Azimuth	non-dire	ectional
Thermal Zoning	63 Zones; See 2	Zone Summary
Floor to floor height (feet)	2	8
Floor to ceiling height (feet)	10	
Glazing sill height (feet)	4	
Architecture		
Exterior walls	2006	2018
Construction	Wood-fra	med wall
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 are	a and aspect ratio
Tilts and orientations		
Roof	2006	2018
Construction	Insulated abov	ve entire deck
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-Value = 0.023
Dimensions	Based on floor are	a and aspect ratio

Tilts and orientations	Horizontal	
Window	2006	2018
Dimensions	Based on window fraction, location, glazi	ing sill height, floor area and aspect ratio
Glass-Type and frame	Hypothetical window with a w	veighted U-factor and SHGC
U-factor (Btu / h * ft² * °F)	U-Factor = 0.4	Fix: U-Factor = 0.323
SHGC (all)	SHGC = 0.4 VT = 0.5	Operable: U-Factor = 0.34 SHGC = 0.38
Visible transmittance	1	
Operable area	09	%
Skylight	2006	2018
Dimensions	Not modeled	
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	NA	
SHGC (all)		
Visible transmittance		
Foundation	2006	2018
Foundation Type	Slab-on-grade fl	oors (unheated)
Construction	Concrete slab	
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 NA	
Dimensions	NA	

Interior Partitions	200	06	201	18
Construction		Not n	nodeled	
Dimensions			NA	
Internal Mass				
Air Barrier System	200	06	201	18
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	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	
HVAC Sizing	200	)6	201	18
Air Conditioning		Autosized	to design day	
Heating		Autosized	to design day	
HVAC Efficiency	200	)6	201	18
Air Conditioning	WSEC 2006, Ta 50 ton max per 1 ton max p	package RTU	WSEC 2018, T 50 ton max per 1 ton max	package RTU
Heating	WSEC 2006, Ta	able 14-1 (A-G)	WSEC 2018, T	able C403.3.2
HVAC Control	200	06	20	18
Thermostat Setpoint	See RTF Scheo	dule Workbook	See RTF Scheo	dule 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 5 VAV supply: Outdoor Air Reset 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 130 °F Outdoor Air Reset: 140°F (@70°F, 60°F) 0utdoor Air Reset: 120°I (@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 sqcupant density greater than 1,000sqft, served by spaces larger than 500 sqcupant density greater than 5	
Energy Recovery	None	None
Fan	2006	2018
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.

Pump		
Pump Type		peed; service hot water (SWH): constant /) pump: variable speed
Rated Pump Heat	Pump power assumptions as spe	cified in ASHRAE 90.1 Appendix G
Pump Power	Auto	osized
Cooling Tower		Entering Water Temperature Entering Water Temperature
Cooling Tower Type	Open cooling tower	r with two-speed fans
Cooling Tower Efficiency	Autosized	
Service Water Heating	2006	2018
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	
ghting, Internal Loads & So	chedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	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
Plug load		
Average power density (W/ft²)	RTF Ass	sumptions
Schedule	RTF Sc	chedules
Occupancy		
Average people	RTF Assumptions	
Schedule	RTF Schedules	
Misc.		
Elevator		
Peak Power	N	IA
Schedule	N	IA
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

Table 12. Large Hotel Modeling Inputs

Item	Descriptions

Program		
Vintage	2006	2018
Locations	(1) Zone 4C: Seattle, WA (mixed, marine) (2) Zone 5B2 Spokane, WA (cool, dry)	
Available fuel types		Sas, electricity
Building Type (Principal Building Function)	Lodging	
Building Prototype	L	arge Hotel
orm		
Total Floor Area (sq feet)		122,132

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	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.  Total 170 guest rooms, accounting for 41% of total floor area.	
Floor to floor height (feet)	Total 179 guest rooms, accounting for 41% of total floor area.  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	

chitecture - 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-Value = 0.109 Zone 2: U-Value = 0.084	Steel-frame wall U-Value = 0.055
Dimensions	Based on floor are:	a and aspect ratio
Tilts and orientations	Vert	ical
Roof	2006	2018
Construction	Insulation entirely above Deck (Single-ply roof membrane, steel deck with rigid insulation)	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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	Horizo	ontal
Window	2006	2018
Dimensions	Based on window fraction, location, glazi	ng sill height, floor area and aspect ra
Glass-Type and frame	Hypothetical window with a w	eighted U-factor and SHGC
U-factor (Btu / h * ft² * °F)	II Fastan O.F.	Fig. 11 Factor 0.00
SHGC (all)	U-Factor = 0.55 SHGC = 0.45	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4
Visible transmittance	VT = 0.5	SHGC = 0.38
Operable area	22'	%
Skylight	2006	2018
Dimensions	Not mo	odeled
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	NA NA	
SHGC (all)		
Visible transmittance		

Foundation	20	06	20	18
Foundation Type	Basement (conditioned)			
Construction	8" heavy-weight Concrete with carpet for all walls and slabs in the model		os 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-fa Zone 2: F-fa		F-factor	· = 0.54
Thermal properties for basement walls	Metal-fra Zone 1: U-fa Zone 2: U-fa	ctor = 0.109	Mass U-factor	
Dimensions		Based on floor are	a and aspect ratio	
Interior Partitions				
Construction		1 in. gyps	um board	
Dimensions	E	Based on floor plan a	nd floor-to-floor height	t
Internal Mass		6 inches standard	l wood (16.6 lb/ft²)	
Air Barrier System	20	06	20	18
Infiltration	1.04 cfm/ft2	@ 0.3 WC	0.25 cfm/ft2	@ 0.3 WC
IVAC				
System Type	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		
HVAC Sizing			
Air Conditioning		o design day	
Heating	Autosized to	design day	
HVAC Efficiency	2006	2018	
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	
HVAC Control	2006	2018	
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	44 °F	44 °F
temperatures	Outdoor Air Reset: 48°F (@55°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
Fan	2006	2018
Fan Fan schedules		2018 hedules
Fan schedules	RTF Sc	Supply Fan Eff. 60%  Motor Efficiency: Based on table WSEC table C405.8  C403.8.4 Group R occupancy exhaust
Fan schedules Fan Mechanical Efficiency (%)	Fan efficiency: RTF input Motor Efficiency: RTF Input  RTF Input, dependent on the fan supply	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)  Pressure drop calculated from
Fan schedules  Fan Mechanical Efficiency (%)  Fan Pressure Drop	Fan efficiency: RTF input Motor Efficiency: RTF Input  RTF Input, dependent on the fan supply air cfm.  Chilled water (CHW) pumps variable sp	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)  Pressure drop calculated from
Fan schedules  Fan Mechanical Efficiency (%)  Fan Pressure Drop  Pump	Fan efficiency: RTF input Motor Efficiency: RTF Input  RTF Input, dependent on the fan supply air cfm.  Chilled water (CHW) pumps variable sp speed; hot water (HW)	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)  Pressure drop calculated from allowable fan motor horsepower.

Cooling Tower		
Cooling Tower Setpoints		ntering Water Temperature ntering Water Temperature
Cooling Tower Type	Open cooling tower	with two-speed fans
Cooling Tower Power	Auto	sized
Service Water Heating		
SWH type	Main and central gas wate	er heater with storage tank
Fuel type	Natural Gas (m	ain and laundry
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	16	000
Water temperature setpoint	140 F	(main)
Water consumption		Schedules
ighting, Internal Loads & Sc	hedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	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
Plug load		1

Average power density (W/ft²)	RTF Assumptions		
Schedule	RTF Schedules		
Occupancy			
Average people	RTF Ass	umptions	
Schedule	RTF Sc	hedules	
Misc.			
Elevator			
Quantity	(	6	
Motor type	Trac	ction	
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		
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	

Table 13. Small Hotel Modeling Inputs

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

Building Prototype	Small Hotel	
orm		
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	

Thermal Zoning		
	Ground Floor: 19 zones including guest rooms, lobby, office space, meeting room, lau employee lounge, restrooms, exercise room, mechanical room, corridor, stairs, st 2nd-4th Floor: 16 zones per floor, including guest rooms, corridor, stairs and sto Guest rooms accounts for 63% of total floor area.	
Floor to floor height (feet)		floor: 11 ft loors: 9 ft
Floor to ceiling height (feet)	Same as above	
Glazing sill height (feet)	3 ft in ground floor	, 2 ft. in upper floors
rchitecture - C402		
Exterior walls		
Construction	Wood-Frame Walls	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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	
Roof		
Construction	Insulated above entire deck	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.046 Zone 2: U-Value = 0.039	U-Value = 0.027
Dimensions	Based on floor area	a and aspect ratio
Tilts and orientations	Horizo	ontal
Window	2006	2018
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 * ft² * °F)	U-Factor = 0.55	Fix: U-Factor = 0.38
SHGC (all)	SHGC = 0.45	Operable: U-Factor = 0.4
Visible transmittance	VT = 0.5	SHGC = 0.38
Operable area	0%	
Skylight	2006	2018
Dimensions	Not modeled	
Glass-Type and frame		
U-factor (Btu / h * ft <sup>2</sup> * °F)	NA	
SHGC (all)		
Visible transmittance		
Foundation	2006	2018
Foundation Type	Slab-on-grade flo	oors (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-Facto	r = 0.54	F-Facto	r = 0.54	
Thermal properties for basement walls	NA				
Dimensions	Based on floor area and aspect ratio				
Interior Partitions					
Construction	2 x 4 uninsulated stud wall				
Dimensions	Based on floor plan and floor-to-floor height				
Internal Mass	6 inches standard wood (16.6 lb/ft²)				
Air Barrier System	2006		2018		
Infiltration	1.04 cfm/ft2 @ 0.3 WC		0.25 cfm/ft2 @ 0.3 WC		
VAC - 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		
HVAC Sizing					
Air Conditioning	Autosized to design day				
Heating	Autosized to design day				
HVAC Efficiency	2006		2018		

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	
HVAC Control	2006	2018	
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	
Fan	2006	2018	
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.	
Pump			
·			

Pump Type

Pump Type	Constant speed (recirculating pump for main water heater)		
Rated Pump Head		10 ft	
Pump Power	Autosized		
Cooling Tower			
Cooling Tower Type	NA		
Cooling Tower Power	NA		
Service Water Heating			
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>		
hting, Internal Loads & Sch	edules - C405		
Lighting	2006	2018	
Average power density (W/ft²)	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 glazin	
Occupancy Sensors	None	None	
Plug load		<u> </u>	
Average power density (W/ft²)	RTF Assumptions		
Schedule	RTF Schedules		

Occupancy		
Average people	RTF Assumptions	
Schedule	RTF Sc	hedules
sc.		
Elevator		
Motor type	2	2
Peak Motor Power Watts per elevator	hydr	aulic
Heat Gain to Building	16055	
Peak Fan/lights Power Watts per elevator	Interior	
Motor and fan/lights Schedules	161.9	
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

**Table 14.** High-rise Apartment Modeing Inputs

	ltem	Descri	ptions
Pro	ogram		
	Vintage	2006	2018

Locations	<ul><li>(1) Zone 4C: Seattle, WA (mixed, marine)</li><li>(2) Zone 5B2 Spokane, WA (cool, dry)</li></ul>	
Available fuel types	Gas, electricity	
Building Type (Principal Building Function)	Multifamily	
Building Prototype	High-Rise Apartment	
rm		
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%  See image	
Window Locations		
Shading Geometry	No	one
Azimuth	Non-di	rectional
Thermal Zoning	90 zones Each floor has 8 apartments except grou equivalent apartment area) Total 8 apartments per floor with corridor Zone depth is 25 ft for each apartment fro (950 ft²).	r in center.
Floor to floor height (ft)	1	10
Floor to ceiling height (ft)	1	10
	(No drop-in ceiling	plenum is modeled)
Glazing sill height (ft)	3 ft (4 ft hig	gh windows)
Architecture		
Exterior walls	2006	2018
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 are	ea and aspect ratio
Tilts and orientations	Vertical	

Roof	2006	2018
Construction	Insulated above entire deck	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-Value = 0.027
Dimensions	Based on floor are	a and aspect ratio
Tilts and orientations	Horiz	ontal
Window	2006	2018
Dimensions	Based on window fraction, location, glazi	ng sill height, floor area and aspect ratio
Glass-Type and frame	Hypothetical window with a w	veighted U-factor and SHGC
U-factor (Btu / h * ft² * °F)	U-Factor = 0.55	Fix: U-Factor = 0.38
SHGC (all)	SHGC = 0.45	Operable: U-Factor = 0.4
Visible transmittance	VT = 0.5	SHGC = 0.38
Operable area	100	0%
Skylight		
Dimensions	Not Modeled	
Glass-Type and frame		
U-factor (Btu / h * ft² * °F)	N.	Λ
SHGC (all)	IV.	A
Visible transmittance		
Foundation		
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	
Interior Partitions		
Construction	2 x 4 uninsulated stud wall	
Dimensions	Based on floor plan and floor-to-floor height	
Internal Mass	8 lbs/ft <sup>2</sup> of floor area	

Air Barrier System				
Infiltration	1.04 cfm/ft2	2 @ 0.3 WC	0.17 cfm/ft2	@ 0.3 WC
/AC - C403				
System Tag	20	06	201	18
	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	
HVAC Sizing	20	06	201	18
Air Conditioning		Autosized to design day		
Heating		Autosized to	design day	
HVAC Efficiency	20	2006 2018		18
Air Conditioning	WSEC 2006, Ta 2.5 ton ma Chiller size base capacity divided by redundance	x zone HP ed on Autosized v 2. Assume a 2 +1	WSEC 2018, T 2.5 ton max Chiller size base capacity divided by redundanc	x zone HP ed on Autosized 2. Assume a 2 +1
Heating	WSEC 2006, To Boiler size based or divided by 2. A redundance	able 14-1 (A-G) Autosized capacity Assume a 2 +1	WSEC 2018, T Boiler size based on divided by 2. A redundanc	able C403.3.2 Autosized capacity ssume a 2 +1
HVAC Control	20	•	201	•

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
Fans	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.
Pump		
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	
Condensing Water		
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	Auto	sized
Service Water Heating		
SWH type	Central water heat	er with storage tank
Fuel type	Natural gas	
Thermal efficiency (%)	ASHRAE 90.12007, Table 7.8	WSEC 2018, Table C404.2
Tank Volume (gal)	9	00
Water temperature setpoint	14	0 F
Water consumption	See under <b>Schedules</b>	
ernal Loads & Schedules		
Lighting		
Average power density (W/ft²)	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	Schedules
Daylighting Controls		
Occupancy Sensors		

Plug load	<del></del> -	
Average power density (W/ft²)	0.62 W/ft² 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>	
Occupancy		
Average people	See under <b>Zone Summary</b>	
Schedule	See under <b>Schedules</b>	
isc.		
Elevator		
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>	
Exterior Lighting		
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
--	------	--------------

rogram		
Vintage	2006	2018
Locations		e, WA (mixed, marine) kane, WA (cool, dry)
Available fuel types	Gas, e	electricity
Building Type (Principal Building Function)		ifamily
Building Prototype	Mid-Rise	Apartment
orm		-
Total Floor Area (sq feet)		3,700 x 55.5 ft)

Aspect Ratio	2.7	74
Number of Floors	4	1
Window Fraction (Window-to-Wall Ratio)	South: 20.0%, East: 20.0%, Average To	
Window Locations	See ir	mage
Shading Geometry	No	ne
Azimuth	Non-dire	ectional
Thermal Zoning	27 zones Each floor has 8 apartments except groun equivalent apartment area) Total 8 apartments per floor with corridor i Zone depth is 25 ft for each apartment fro (950 ft²).	in center.
Floor to floor height (ft)	10	0
Floor to ceiling height (ft)	10 (No drop-in ceiling plenum is modeled)	
Glazing sill height (ft)	3 ft (4 ft high	h windows)
rchitecture	-	
Exterior walls	2006	2018
Construction	Steel-Fran	me 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	
	1	

Air Barrier System		
Internal Mass	8 lbs/ft <sup>2</sup> of floor area	
Dimensions	Based on floor plan a	nd floor-to-floor height
Construction	2 x 4 uninsulated stud wall	
Interior Partitions	2006	2018
Dimensions	Based on floor area and aspect ratio	
Slab on grade floor insulation level (F-factor)	F-Factor = 0.54	F-Factor = 0.54
Construction	6" concrete slab poured	directly on to the earth
Foundation Type	Slab-on-grade fl	oors (unheated)
Foundation	2006	2018
Visible transmittance		
SHGC (all)	N	А
U-factor (Btu / h * ft² * °F)	]	•
Glass-Type and frame		
Dimensions	Not Modeled	
Skylight	2006	2018
Operable area	100	0%
Visible transmittance	V I = 0.5	30GC = 0.30
SHGC (all)	U-Factor = 0.4 SHGC = 0.4 VT = 0.5	Fix: U-Factor = 0.38 Operable: U-Factor = 0.4 SHGC = 0.38
U-factor (Btu / h * ft <sup>2</sup> * °F)	71	
Glass-Type and frame		veighted U-factor and SHGC
Dimensions	Based on window fraction, location, glaz	ing sill height, floor area and aspect ratio
Window	2006 2018	
Tilts and orientations		contal
Dimensions	Based on floor are	ea and aspect ratio
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °F / Btu)	Zone 1: U-Value = 0.034 Zone 2: U-Value = 0.034	U-Value = 0.027
Construction	Insulated abo	ve entire deck

Infiltration	1.04 cfm/ft2	@ 0.3 WC	0.17 cfm/ft2	0.17 cfm/ft2 @ 0.3 WC	
AC - C403					
System Tag	200	)6	2018		
	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		
HVAC Sizing	200	06	201	8	
Air Conditioning		Autosized	to design day		
Heating		Autosized to			
HVAC Efficiency	200	)6	201	8	
Air Conditioning	WSEC 2006, Ta 1 ton ma		WSEC 2018, Ta 1 ton max		
Heating	WSEC 2006, Ta	able 14-1 (A-G)	WSEC 2018, Ta	able C403.3.2	
HVAC Control	200	2006		8	
Thermostat Setpoint	See RTF Sched	See RTF Schedule Workbook		ule Workbook	
Thermostat Setback	See RTF Schedule Workbook		See RTF Sched	ule Workbook	
Supply air temperature	Maximum 95°F,	Maximum 95°F, Minimum 55°F		Minimum 55°F int: 62°F	
Economizers	No	None		Exception 1	
Ventilation	Washington State Indoor Air Qual		Balanced ventilation		

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
Fans	Whole house fan	Whole house supply and exhaust fan with ERV
Fan schedules	RTF Sc	hedules
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.
Service Water Heating	2006	2018
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>	
ernal Loads & Schedules		
Lighting		

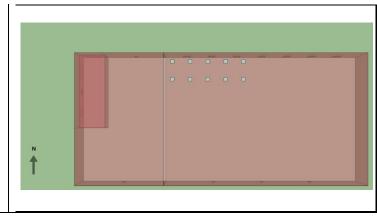
Average power density (W/ft²)	Apartment units: Estimate based on % high efficiency lamps. 1.36 W/sf	Apartment units: Estimate based on % high efficiency lamps. 0.42 W/sf
Schedule	See under	Schedules
Daylighting Controls		
Occupancy Sensors		
Plug load		
Average power density (W/ft²)		t, including all the home appliances r the detailed calculations
Schedule	See under	Schedules
Occupancy		
Average people	See under <b>Zo</b>	ne Summary
Schedule	See under <b>Schedules</b>	
SC.		
Elevator		
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>	
Exterior Lighting		
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

Item Descriptions
-------------------

Program		
Vintage	2006	2018
Locations		
		cle, WA (mixed, marine) okane, WA (cool, dry)
Available fuel types	Gas,	electricity
Building Type (Principal Building Function)	Non-refrigerated warehouse	
Building Prototype	Warehouse	
Form		
Total Floor Area (sq feet)		
		9,495
	(330	ft x 150 ft)

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



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

Exterior walls	2006	2018
Construction	Metal Bui	lding Wall
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 are	ea and aspect ratio
Tilts and orientations	Vertical	
Roof	2006	2018
Construction	Metal Building Roof	
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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	
Window	2006 2018	
Dimensions	Based on window fraction, location, glazing sill height, floor area and aspect rati	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC	
U-factor (Btu / h * ft <sup>2</sup> * °F)		
SHGC (all)	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38
Visible transmittance	V 1 = 0.5	Si 190 = 0.36
Operable area	0	<u> </u> %
Skylight	2006	2018
Dimensions	Bulk Storage, Fine Storage Rectangular skylights (4 ft x 4 ft) = 16 ft2 per skylight Number of skylights and total skylight area vary according to requirements in codes or standards	
Glass-Type and frame		
U-factor (Btu / h * ft² * °F)	U-Factor = 0.7 SHGC = 0.45	U-Factor = 0.425 SHGC = 0.35
SHGC (all)	VT = 0.5	VT = 0.5
Visible transmittance		
Visible transmittance Foundation	2006	2018
		2018 loors (unheated)

				·	
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 NA				
Dimensions		Based on floor are	ea and aspect ratio		
Interior Partitions					
Construction		2x4 steel-frame v	vith gypsum board		
Dimensions	Based on floor plan and floor-to-floor height				
Internal Mass	Interior	furnishings: 6 inche	s standard wood (16.6 l	b/ft²)	
A: D : 0 :	2006 2018		3		
Air Barrier System	200	,0		0.25 cfm/ft2 @ 0.3 WC	
Infiltration	1.04 cfm/ft2		0.25 cfm/ft2 (	@ 0.3 WC	
•	-		0.25 cfm/ft2 (	@ 0.3 WC	
Infiltration AC System Type	1.04 cfm/ft2 2006 A		2006 B	2018 B	
Infiltration	2006 A  Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan)	@ 0.3 WC  2018 A  Office/fine storage: D	2006 B Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan) Direct, uncontrolled air		
Infiltration  AC  System Type  Heating type  Distribution and terminal units	2006 A Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan)	@ 0.3 WC  2018 A  Office/fine storage: D  Bulk storage	2006 B  Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan)  Direct, uncontrolled air e: non-ducted	2018 B	
Infiltration  AC  System Type  Heating type	2006 A  Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan)	@ 0.3 WC  2018 A  Office/fine storage: D  Bulk storage	2006 B Office/fine material storage: Packaged RTU Single zone Heat: Gas Cooling: DX + economizer Bulk storage: Gas unit heater (CV fan) Direct, uncontrolled air	2018 B	

HVAC Efficiency	2006	2018
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
HVAC Control	2006	2018
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	N	ÎA
Hot water supply temperatures	N	IA
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
Fan	2006	2018
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

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Fan Pressure Drop	RTF Input, dependent on the fan supply air cfm.	Pressure drop calculated from allowable fan motor horsepower.
Pump	2006	2018
Pump Type	NA	
Rated Pump Head	N.A.	4
Pump Power	NA NA	4
Cooling Tower		
Cooling Tower Type	NA NA	4
Cooling Tower Power	NA NA	A
Service Water Heating	2006	2018
SWH type	NA NA	A
Fuel type	NA	
Thermal efficiency (%)	NA	NA
Tank Volume (gal)	NA	4
Water temperature setpoint	NA NA	A
Water consumption	See under <b>Schedules</b>	
hting, Internal Loads & So	chedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	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
Plug load		
Average power density (W/ft²)	RTF Assumptions	
Schedule	RTF Schedules	

Occupancy				
Average people	RTF Ass	RTF Assumptions		
Schedule	RTF Sc	RTF Schedules		
C.	•			
Elevator	2006	2018		
Peak Power	Not mo	odeled		
Schedule	Not mo	odeled		
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		

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

	ltem	Descriptions	
Pro	ogram		
-	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)	Food service	
Building Prototype	Sit Down Restaurant	
orm		
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	Kitchen, Dining, and U	Inconditioned Attic
	Kitch	en
	Diniı	ng ^N
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)	
chitecture		
Exterior walls		
Construction	Steel-fram	e walls
$ \begin{array}{lll} & \text{U-factor (Btu / h * ft^2 * °F)} & \text{Metal-frame wall} \\ & \text{and/or} & \text{Zone 1: U-Value} = 0.109 \\ & \text{R-value (h * ft^2 * °F / Btu)} & \text{Zone 2: U-Value} = 0.084 \\ \end{array} $	Zone 1: U-Value = 0.109	Steel-frame wall U-Value = 0.047
Dimensions	Based on floor area and aspect ratio  Vertical	
Tilts and orientations		
Roof		
Construction	Attic roof	

U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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 are	ea and aspect ratio	
Tilts and orientations	Insulated ceiling - horizontal Attic roof North & south - 45 deg. East & west - 18.44 deg.		
Window			
Dimensions	Based on window fraction, location, glaz	ing sill height, floor area and aspect ratio	
Glass-Type and frame	Hypothetical window with a weighted U-factor and SHGC		
U-factor (Btu / h * ft² * °F)	U-Factor = 0.55	Fix: U-Factor = 0.323	
SHGC (all)	SHGC = 0.45 VT = 0.5	Operable: U-Factor = 0.34 SHGC = 0.38	
Visible transmittance	71 - 0.0	31100 = 0.00	
Operable area	0%		
Skylight			
Dimensions	Not modeled		
Glass-Type and frame			
U-factor (Btu / h * ft² * °F)	NA		
SHGC			
Visible transmittance			
Foundation			
Foundation Type	Slab-on-grade fl	oors (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	r = 0.54	F-Facto	r = 0.54
Thermal properties for basement walls		NA NA		
Dimensions		Based on floor a	rea and aspect ratio	
Interior Partitions				
Construction	0	.5 in gypsum board	d + 0.5 in gypsum board	
Dimensions	E	Based on floor plan	and floor-to-floor height	t
Internal Mass		6 inches standa	rd wood (16.6 lb/ft²)	
Air Barrier System	200	06	20	18
Infiltration	1.04 cfm/ft2	@ 0.3 WC	0.25 cfm/ft2	@ 0.3 WC
/AC	.1			
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	
HVAC Sizing	200	06	20	18
Air Conditioning		Autosized	to design day	
Heating	Autosized to design day			
HVAC Efficiency	200	2006		18
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
HVAC Control	2006	2018
	2000	2010
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	N	IA .
Hot water supply temperatures	N	IA
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
Fan	2006	2018
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.
Pump		<u> </u>
<b>-</b>		

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Pump Type	Service hot water	
Rated Pump Head	No	
Pump Power	RTF Assumption: 100% eff motor. Negligible power consumption	
Cooling Tower		
Cooling Tower Type		NA
Cooling Tower Power		NA
Service Water Heating		
SWH type	Stora	age 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	
nting, Internal Loads & Sc	hedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	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
Plug load		
Average power density (W/ft²)	RTF Assumptions	

Schedule	RTF Sc	RTF Schedules		
Occupancy				
Average people	RTF Ass	umptions		
Schedule	RTF Sc	RTF Schedules		
Misc.	·			
Elevator				
Peak Power	N	IA		
Schedule	N	IA		
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		

 Table 18. Fast Food Restaurant Modeling Inputs

	ltem	Descriptions
Pro	ogram	

Vintage	2006	2018
Locations	(1) Zone 4C: Seattle (2) Zone 5B2 Spok	, WA (mixed, marine) cane, WA (cool, dry)
Available fuel types	Gas, el	lectricity
Building Type (Principal Building Function)	Food s	service
Building Prototype	Fast	Food
rm		
Total Floor Area (sq feet)	2500 (50	ft x 50 ft)
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		ft), and west (23.3 ft x 3 ft) sides of dining e façade
Shading Geometry	!	none
Azimuth Thermal Zoning	non-c	directional
	K i	oned 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)	
chitecture		
Exterior walls	2006	2018
Construction	Wood-Frame Walls	

U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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		
Roof	2006 2018		
Construction	Attic roof		
U-factor (Btu / h * ft² * °F) and/or R-value (h * ft² * °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.		
Window	2006	2018	
D: :	Based on window fraction, location, glazing sill height, floor area and aspect ratio		
Dimensions	Based on window fraction, location, glazing	g sill height, floor area and aspect ratio	
Glass-Type and frame	Based on window fraction, location, glazin  Hypothetical window with a we		
	Hypothetical window with a we	eighted U-factor and SHGC	
Glass-Type and frame	U-Factor = 0.55 SHGC = 0.45	eighted U-factor and SHGC  Fix: U-Factor = 0.323  Operable: U-Factor = 0.34	
Glass-Type and frame  U-factor (Btu / h * ft² * °F)	Hypothetical window with a well  U-Factor = 0.55	eighted U-factor and SHGC  Fix: U-Factor = 0.323	
Glass-Type and frame  U-factor (Btu / h * ft² * °F)  SHGC (all)	U-Factor = 0.55 SHGC = 0.45	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38	
Glass-Type and frame  U-factor (Btu / h * ft² * °F)  SHGC (all)  Visible transmittance	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38	
Glass-Type and frame  U-factor (Btu / h * ft² * °F)  SHGC (all)  Visible transmittance  Operable area	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38	
Glass-Type and frame  U-factor (Btu / h * ft² * °F)  SHGC (all)  Visible transmittance  Operable area  Skylight	U-Factor = 0.55 SHGC = 0.45 VT = 0.5	Fix: U-Factor = 0.323 Operable: U-Factor = 0.34 SHGC = 0.38	

SHGC				
Visible transmittance				
Foundation	20	006	20	118
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-Facto	or = 0.54	F-Facto	or = 0.54
Thermal properties for basement walls	NA NA			
Dimensions	Based on floor area and aspect ratio			
Interior Partitions				
Construction	0.5 in gypsum board + 0.5 in gypsum board			
Dimensions	Based on floor plan and floor-to-floor height			
Internal Mass	6 inches standard wood (16.6 lb/ft²)			
Air Barrier System	2006		, ,	)18
Infiltration	1.04 cfm/ft2 @ 0.3 WC		0.25 cfm/ft2	2 @ 0.3 WC
'AC			·	
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	
HVAC Sizing	20	)06	20	⊥ )18

141

Air Conditioning	Autosized to design day		
Heating	Autosized to design day		
HVAC Efficiency	2006 2018		
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	
HVAC Control	2006	2018	
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 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	
Fan	2006	2018	
Fan schedules	RTF Schedules		

142

Fan efficiency: 60%

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.
Pump		
Pump Type	N/A	
Rated Pump Head	No	
Pump Power	N/A	
Cooling Tower		
Cooling Tower Type	NA	
Cooling Tower Power	NA	
Service Water Heating		
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	
ghting, Internal Loads & So	chedules - C405	
Lighting	2006	2018
Average power density (W/ft²)	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
Plug load		

Average power density (W/ft²)	RTF Assumptions		
Schedule	RTF Schedules		
Occupancy			
Average people	RTF Assumptions		
Schedule	RTF Schedules		
lisc.			
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	