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Air System Information

əm (1)
NDÈÉ
ZCAV
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Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load		Tons
Total coil load		MBH
Sensible coil load		MBH
Coil CFM at Aug 1500	6158	CFM
Max block CFM		CFM
Sum of peak zone CFM		CFM
Sensible heat ratio	0.859	
CFM/Ton		
ft²/Ton		
BTU/(hr·ft²)		
Water flow @ 10.0 °F rise		gpm

Central Heating Coil Sizing Data

Max coil load		MBH
Coil CFM at Des Htg	6158	CFM
Max coil CFM	6158	CFM
Water flow @ 20.0 °F drop	24.36	gpm

Supply Fan Sizing Data

Actual max CFM	CFM
Standard CFM 6087	CFM
Actual max CFM/ft ² 1.18	CFM/ft ²

Outdoor Ventilation Air Data

Design airflow CFM	3	CFM
CFM/ft ² 0.6	1	CFM/ft ²

Number of zones	1	
Floor Area		ft²
Location	Tacoma, Washington	

Zone CFM Sizing	Sum of space airflow rates
Space CFM Sizing	Individual peak space loads

Load occurs at	Aug 1500	
OA DB / WB	36.0 / 65.0	°F
Entering DB / WB	31.2 / 65.5	°F
Leaving DB / WB	56.7 / 55.2	°F
Coil ADP	53.9	°F
Bypass Factor	0.100	
Resulting RH		%
Design supply temp.		°F
Zone T-stat Check	1 of 1	OK
Max zone temperature deviation	0.0	°F

Load occurs at Des Htg	
BTU/(hr·ft ²)	5
Ent. DB / Lvg DB 43.4 / 80.5	°F

Fan motor BHP	0.00	BHP
Fan motor kW	0.00	kW
Fan static	0.00	in wg

CFM/person	10.76	CFM/person



Air System Name	System (1)	Number of zones	1	
Equipment Class	UNDEF	Floor Area		ft²
Air System Type	SZCAV	Location	Tacoma, Washington	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Zone Terminal Sizing Data

					Reheat	Zone	Zone	
	Design	Minimum		Reheat	Coil	Htg Unit	Htg Unit	Mixing
	Supply	Supply		Coil	Water	Coil	Water	Box Fan
	Airflow	Airflow	Zone	Load	gpm	Load	gpm	Airflow
Zone Name	(CFM)	(CFM)	CFM/ft ²	(MBH)	@ 20.0 °F	(MBH)	@ 20.0 °F	(CFM)
Zone 1	6158	6158	1.18	0.0	0.00	0.0	0.00	0

Zone Peak Sensible Loads

	Zone		Zone	Zone
	Cooling	Time of	Heating	Floor
	Sensible	Peak Sensible	Load	Area
Zone Name	(MBH)	Cooling Load	(MBH)	(ft²)
Zone 1	130.3	Jul 1500	73.7	5235.6

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
116 WOMEN	1	1.3	Jul 1500	59	1.5	185.8	0.32
111,12,13,14 PRESCHOOL	1	124.1	Jul 1500	5815	64.7	4429.4	1.31
110 STORAGE	2	0.7	Jul 1500	43	1.1	89.6	0.48
118 STORAGE	1	0.4	Jul 1400	21	0.4	70.8	0.29
117 MENS RESTROOM	1	1.6	Jun 1800	88	2.4	154.5	0.57
108 STORAGE	1	0.7	Jul 1700	43	1.1	89.6	0.48
109 STORAGE	1	0.8	Jul 1500	47	1.3	126.3	0.37



	DESIGN COOLING			C	ESIGN HEATIN	G
	COOLING DATA	A AT Aug 1500		HEATING DATA	AT DES HTG	
	COOLING OA D	B/WB 86.0 °F	/ 65.0 °F	HEATING OA D	B/WB 19.0 °F	/ 14.8 °F
		Sensible	Latent		Sensible	Latent
ZONE LOADS	Details	(BTU/hr)	(BTU/hr)	Details	(BTU/hr)	(BTU/hr)
Window & Skylight Solar Loads	256 ft ²	6009	-	256 ft ²	-	-
Wall Transmission	4471 ft ²	4210	-	4471 ft²	12446	-
Roof Transmission	5193 ft ²	7954	-	5193 ft ²	7091	-
Window Transmission	256 ft ²	775	-	256 ft ²	5668	-
Skylight Transmission	0 ft ²	0	-	0 ft²	0	-
Door Loads	576 ft²	1365	-	576 ft²	9988	-
Floor Transmission	5236 ft ²	0	-	5236 ft ²	2656	-
Partitions	0 ft ²	0	-	0 ft²	0	-
Ceiling	0 ft ²	0	-	0 ft²	0	-
Overhead Lighting	5236 W	17864	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	295	82599	79650	0	0	0
Infiltration	-	7724	-9134	-	35810	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	128499	70516	-	73659	0
Zone Conditioning	-	127697	70516	-	72716	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	6158 CFM	0	-	6158 CFM	0	-
Ventilation Load	3173 CFM	33593	-44063	3173 CFM	170730	0
Supply Fan Load	6158 CFM	0	-	6158 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	161290	26453	-	243446	0
Central Cooling Coil	-	161290	26454	-	0	0
Central Heating Coil	-	0	-	-	243446	-
>> Total Conditioning	-	161290	26454	-	243446	0
Key:	Positiv	ve values are clg	loads	Positiv	ve values are hto	j loads
	Negativ	ve values are hte	g loads	Negati	ve values are cl	g loads

	Dedicated Outdoor Air System (DOAS) Sizing Summary for Sy	City of Popullup
Pro	ject Name: 2024-037 Step by Step ELC	Building Planning Engineering Public Works
Pre	pared by: Middlebrook Engineering LLC	Fire

Air System Name	System (2)
Equipment Class	TERM
Air System Type	

Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated

Ventilation Fan Sizing Data

Actual max CFM	CFM
Standard CFM 1354	CFM
Actual max CFM/ft ² 0.28	CFM/ft ²

Outdoor Ventilation Air Data

Design airflow CFM 137	0	CFM
CFM/ft ²	28	CFM/ft ²

Number of zones	6	
Floor Area		ft²
Location	Tacoma, Washington	

Zone CFM Sizing	Sum of space airflow rates
Space CFM Sizing	Individual peak space loads

Fan motor BHP	0.00	BHP
Fan motor kW	0.00	kW
Fan static	0.00	in wg

CFM/person 20.45 CFM/person



Air System Name	System (2)	Number of zones		
Equipment Class	TERM	Floor Area		ft²
Air System Type		Location	Tacoma, Washington	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Terminal Unit Sizing Data - Cooling

	Total	Sens	Coil	Coil	Water	Time	
	Coil	Coil	Entering	Leaving	Flow	of	
	Load	Load	DB / WB	DB / WB	@ 10.0 °F	Peak Coil	Zone
Zone Name	(MBH)	(MBH)	(°F)	(°F)	(gpm)	Load	CFM/ft ²
Zone 1	12.5	12.5	77.8 / 64.7	60.5 / 58.7	-	Sep 1500	1.46
Zone 2	13.1	13.1	77.6 / 64.8	60.3 / 58.8	-	Sep 1400	1.21
Zone 3	13.5	13.4	77.4 / 64.8	59.8 / 58.6	-	Sep 1400	1.22
Zone 4	12.0	12.0	78.0 / 65.0	60.2 / 58.8	-	Aug 1400	1.34
Zone 5	35.0	33.8	76.4 / 65.0	60.3 / 59.3	-	Aug 1500	2.75
Zone 6	23.9	21.4	77.0 / 65.6	60.3 / 59.2	-	Jul 1400	0.57

Terminal Unit Sizing Data - Heating, Fan, Ventilation

		Heating	Htg Coil				
	Heating	Coil	Water	Fan			OA Vent
	Coil	Ent/Lvg	Flow	Design	Fan	Fan	Design
	Load	DB	@20.0 °F	Airflow	Motor	Motor	Airflow
Zone Name	(MBH)	(°F)	(gpm)	(CFM)	(BHP)	(kW)	(CFM)
Zone 1	14.8	59.7 / 80.3	-	676	0.000	0.000	255
Zone 2	15.4	60.2 / 80.5	-	710	0.000	0.000	257
Zone 3	15.5	60.3 / 80.6	-	714	0.000	0.000	255
Zone 4	14.5	59.0 / 80.6	-	632	0.000	0.000	257
Zone 5	35.8	67.7 / 84.7	-	1977	0.000	0.000	100
Zone 6	26.9	64.1 / 85.1	-	1200	0.000	0.000	246

VRF Outdoor Unit Sizing Data

	Cooling [MBH]	Cooling [Tons]	Heating [MBH]
Peak Coincident Indoor Unit Loads	107.2	8.9	123.1
Estimated Piping / Line Losses	0.0	0.0	0.0
Total Required ODU Capacity	107.2	8.9	123.1

Note: VRF piping / line losses are based on typical loss factors for this class of equipment. Actual line loss varies widely from one product to another. Therefore, when selecting equipment it is critical to consult manufacturer's guidance to utilize actual line loss data.

Zone Peak Sensible Loads

	Zone		Zone	Zone
	Cooling	Time of	Heating	Floor
	Sensible	Peak Sensible	Load	Area
Zone Name	(MBH)	Cooling Load	(MBH)	(ft²)
Zone 1	12.3	Sep 1400	8.3	463.3
Zone 2	12.8	Sep 1400	8.8	586.8
Zone 3	12.9	Sep 1400	8.9	585.3
Zone 4	11.5	Sep 1400	7.9	470.9
Zone 5	34.9	Jul 1500	34.2	718.1
Zone 6	21.7	Jul 1500	20.1	2098.3



Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
130 TODDLER AGE 1-3	1	12.3	Sep 1400	676	8.3	463.3	1.46
Zone 2							
128 TODDLER AGE 1-3	1	12.1	Sep 1400	664	7.7	466.8	1.42
TODDLERS RESTROOM (1)	1	0.8	Jul 1400	46	1.0	120.0	0.38
Zone 3							
126 TODDLERS RESTROOM(2)	1	0.8	Jul 1400	45	1.0	118.7	0.38
127 TODDLER AGE 1-3	1	12.1	Sep 1400	668	7.9	466.6	1.43
Zone 4							
125 TODDLER AGE 1-3	1	11.5	Sep 1400	632	7.9	470.9	1.34
Zone 5							
101 VESTIBULE	1	9.1	Jun 1700	501	8.7	93.0	5.38
102 LOBBY	1	26.8	Aug 1400	1476	25.4	625.1	2.36
Zone 6							
107 RECEPTION	1	3.3	Jul 1400	180	1.2	210.3	0.86
104 OFFICE	1	2.0	Jun 1500	111	1.7	146.7	0.76
103 OFFICE	1	3.0	Jun 1500	164	2.9	180.8	0.91
120 HALLWAY	1	9.1	Jul 1500	501	10.4	1019.3	0.49
119 RESTROOM	2	0.4	Jul 1400	20	0.4	59.4	0.34
121 JNT'S CL	1	0.7	Jul 1500	41	0.9	109.1	0.37
105 RESTROOM	1	0.4	Jul 1400	20	0.4	59.4	0.34
106 WORK	1	1.3	Jul 1400	74	0.5	79.9	0.92
124 MECH/IT	1	1.3	Aug 1500	69	1.4	174.0	0.40



	DESIGN COOLING			DESIGN HEATING		
	COOLING DAT	A AT Aug 1500		HEATING DATA	AT DES HTG	
	COOLING OA D	B/WB 86.0 °F	/ 65.0 °F	HEATING OA D	B/WB 19.0 °F	/ 14.8 °F
		Sensible	Latent		Sensible	Latent
ZONE LOADS	Details	(BTU/hr)	(BTU/hr)	Details	(BTU/hr)	(BTU/hr)
Window & Skylight Solar Loads	1848 ft ²	40450	-	1848 ft ²	-	-
Wall Transmission	2965 ft ²	4033	-	2965 ft ²	8253	-
Roof Transmission	4863 ft ²	8100	-	4863 ft ²	6640	-
Window Transmission	1848 ft ²	5201	-	1848 ft ²	38061	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	4923 ft ²	0	-	4923 ft ²	2428	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	4923 W	16796	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	328 W	1117	-	0	0	-
People	67	18760	18090	0	0	0
Infiltration	-	7074	-7333	-	32796	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	101531	10757	-	88178	0
Zone Conditioning	-	97020	10757	-	86390	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	1370 CFM	0	-	1370 CFM	0	-
Ventilation Load	1370 CFM	7142	-7955	1370 CFM	36726	0
Ventilation Fan Load	1370 CFM	0	-	1370 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	104162	2802	-	123117	0
Terminal Unit Cooling	-	104216	2988	-	0	0
Terminal Unit Heating	-	0	-	-	123074	-
>> Total Conditioning	-	104216	2988	-	123074	0
Кеу:	Positiv	/e values are clo	loads	Positive values are htg loads		
	Negativ	ve values are hte	g loads	Negativ	ve values are cl	g loads

	Dedicated Outdoor Air System (DOAS) Sizing Summary for Sy	City of Populiup
Pr	roject Name: 2024-037 Step by Step ELC	Building Planning Engineering Public Works
Pr	epared by: Middlebrook Engineering LLC	Fire

Air System Name	System (3)
Equipment Class	TERM
Air System Type	

Sizing Calculation Information

Calculation Months	Jan to Dec
Sizing Data	Calculated
-	

Ventilation Fan Sizing Data

Actual max CFM	CFM
Standard CFM 1172	CFM
Actual max CFM/ft ² 0.48	CFM/ft ²

Outdoor Ventilation Air Data

Design airflow CFM 1	186	CFM
CFM/ft ²	0.48	CFM/ft ²

Number of zones		
Floor Area	2460.9	ft²
Location	Tacoma, Washington	

Zone CFM Sizing	
Space CFM Sizing	Individual peak space loads

Fan motor BHP	0.00	BHP
Fan motor kW	0.00	kW
Fan static	0.00	in wg

CFM/person 17.97 CFM/person



Air System Name	System (3)	Number of zones		
Equipment Class	TERM	Floor Area	2460.9	ft²
Air System Type		Location	Tacoma, Washington	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Terminal Unit Sizing Data - Cooling

	Total	Sens	Coil	Coil	Water	Time	
	Coil	Coil	Entering	Leaving	Flow	of	
	Load	Load	DB / WB	DB / WB	@ 10.0 °F	Peak Coil	Zone
Zone Name	(MBH)	(MBH)	(°F)	(°F)	(gpm)	Load	CFM/ft ²
Zone 1	5.1	5.1	78.5 / 65.6	60.6 / 59.4	-	Aug 1500	2.08
Zone 2	14.7	14.7	79.4 / 65.1	60.3 / 58.4	-	Jul 1600	1.66
Zone 3	15.1	15.0	79.3 / 65.2	59.6 / 58.2	-	Jul 1500	1.46
Zone 4	14.3	14.3	79.0 / 65.2	59.8 / 58.5	-	Jun 1600	1.60
Zone 5	15.3	15.2	79.2 / 65.2	59.7 / 58.4	-	Jul 1500	1.49
Zone 6	5.1	5.1	78.5 / 65.6	60.6 / 59.4	-	Aug 1500	2.08
Zone 7	12.0	11.4	77.9 / 65.1	59.7 / 58.5	-	Aug 1700	1.64

Terminal Unit Sizing Data - Heating, Fan, Ventilation

	Heating Coil Load	Heating Coil Ent/Lvg DB	Htg Coil Water Flow @20.0 °F	Fan Design Airflow	Fan Motor	Fan Motor	OA Vent Design Airflow
Zone Name	(MBH)	(°F)	(gpm)	(CFM)	(BHP)	(kW)	(CFM)
Zone 1	6.1	59.2 / 80.8	-	266	0.000	0.000	54
Zone 2	22.5	52.5 / 81.8	-	721	0.000	0.000	237
Zone 3	22.3	52.8 / 81.9	-	715	0.000	0.000	237
Zone 4	22.0	52.4 / 82.0	-	696	0.000	0.000	237
Zone 5	22.6	53.1 / 82.1	-	729	0.000	0.000	237
Zone 6	6.1	59.2 / 80.8	-	266	0.000	0.000	54
Zone 7	16.4	58.0 / 84.0	-	589	0.000	0.000	130

VRF Outdoor Unit Sizing Data

	Cooling [MBH]	Cooling [Tons]	Heating [MBH]
Peak Coincident Indoor Unit Loads	80.5	6.7	118.1
Estimated Piping / Line Losses	0.0	0.0	0.0
Total Required ODU Capacity	80.5	6.7	118.1



Zone Peak Sensible Loads

	Zone		Zone	Zone
	Cooling	Time of	Heating	Floor
	Sensible	Peak Sensible	Load	Area
Zone Name	(MBH)	Cooling Load	(MBH)	(ft²)
Zone 1	4.8	Sep 1400	3.3	128.2
Zone 2	13.1	Jun 1600	10.4	433.6
Zone 3	12.9	Jun 1600	9.4	488.8
Zone 4	12.6	Jun 1600	9.0	433.7
Zone 5	13.2	Jul 1600	9.8	488.9
Zone 6	4.8	Sep 1400	3.3	128.2
Zone 7	10.7	Aug 1700	9.7	359.5

Space Loads and Airflows

			Time of				
Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
132 CONFERENCE	1	4.8	Sep 1400	266	3.3	128.2	2.08
Zone 2							
133 INFANT 1-12 MO	1	13.1	Jun 1600	721	10.4	433.6	1.66
Zone 3							
135 INFANT 1-12 MO	1	12.6	Jun 1600	696	9.0	433.6	1.60
134 RESTROOM	1	0.3	Jul 1400	19	0.3	55.2	0.34
Zone 4							
136 INFANT 1-12 MO	1	12.6	Jun 1600	696	9.0	433.7	1.60
Zone 5							
138 INFANT 1-12 MO	1	12.9	Jul 1600	711	9.4	433.7	1.64
137 RESTROOM	1	0.3	Jul 1400	19	0.3	55.2	0.34
Zone 6							
132 CONFERENCE	1	4.8	Sep 1400	266	3.3	128.2	2.08
Zone 7							
139 PREP KITCHEN	1	10.7	Aug 1700	589	9.7	359.5	1.64



	D	ESIGN COOLIN	G	DESIGN HEATING			
	COOLING DATA	A AT Jul 1500		HEATING DATA AT DES HTG			
	COOLING OA D	B/WB 86.0 °F	/ 65.0 °F	HEATING OA D	B/WB 19.0 °F	/ 14.8 °F	
		Sensible	Latent		Sensible	Latent	
ZONE LOADS	Details	(BTU/hr)	(BTU/hr)	Details	(BTU/hr)	(BTU/hr)	
Window & Skylight Solar Loads	1056 ft ²	26788	-	1056 ft ²	-	-	
Wall Transmission	3561 ft ²	4039	-	3561 ft²	9913	-	
Roof Transmission	2576 ft ²	4124	-	2576 ft²	3517	-	
Window Transmission	1056 ft ²	3119	-	1056 ft ²	22821	-	
Skylight Transmission	0 ft ²	0	-	0 ft²	0	-	
Door Loads	42 ft ²	108	-	42 ft²	793	-	
Floor Transmission	2461 ft ²	0	-	2461 ft²	1774	-	
Partitions	0 ft ²	0	-	0 ft²	0	-	
Ceiling	0 ft ²	0	-	0 ft²	0	-	
Overhead Lighting	2461 W	8396	-	0	0	-	
Task Lighting	0 W	0	-	0	0	-	
Electric Equipment	424 W	1445	-	0	0	-	
People	66	18480	17820	0	0	0	
Infiltration	-	3426	-3430	-	15886	0	
Miscellaneous	-	0	0	-	0	0	
Safety Factor	0% / 0%	0	0	0%	0	0	
>> Total Zone Loads	-	69926	14390	-	54705	0	
Zone Conditioning	-	67735	14390	-	54317	0	
Plenum Wall Load	0%	0	-	0	0	-	
Plenum Roof Load	0%	0	-	0	0	-	
Plenum Lighting Load	0%	0	-	0	0	-	
Exhaust Fan Load	1186 CFM	0	-	1186 CFM	0	-	
Ventilation Load	1186 CFM	12400	-13974	1186 CFM	63734	0	
Ventilation Fan Load	1186 CFM	0	-	1186 CFM	0	-	
Space Fan Coil Fans	-	0	-	-	0	-	
Duct Heat Gain / Loss	0%	0	-	0%	0	-	
>> Total System Loads	-	80135	416	-	118051	0	
Terminal Unit Cooling	-	80135	388	-	0	0	
Terminal Unit Heating	-	0	-	-	118051	-	
>> Total Conditioning	-	80135	388	-	118051	0	
Кеу:	Positiv	/e values are clo	loads	Positive values are htg loads			
	Negativ	ve values are ht	g loads	Negative values are clg loads			