

Lower Floor		
5/0 x 2/6 FIX		0.30
6/0 x 2/6 FIX		0.30
9/0 x 5/0 CSMT-FIX-CSMT		0.30

1	5		2	6
3	6		2	6
1	9		5	

0.0	0.00
12.5	3.75
45.0	13.50
45.0	13.50
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00

Sum of Vertical Fenestration Area and UA
 Vertical Fenestration Area Weighted U = UA/Area

1588.1	474.85
	0.30

Overhead Glazing (Skylights)

Component Description	Ref.	U-factor

Width		Height	
Qt.	Feet ^{Inch}	Feet ^{Inch}	

Area	UA
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00

Sum of Overhead Glazing Area and UA
 Overhead Glazing Area Weighted U = UA/Area

0.0	0.00
	0.00

Total Sum of Fenestration Area and UA (for heating system sizing calculations)

1588.1	474.85
--------	--------

Simple Heating System Size: Washington State

This heating system sizing calculator is based on the Prescriptive Requirements of the 2018 and 2021 Washington State Energy Code (WSEC) . This tool will calculate heating loads only. ACCA procedures for sizing cooling systems should be used to determine cooling loads.

Please complete the green drop-downs and boxes that are applicable to your project. As you make selections in the drop-downs for each section, some values will be calculated for you. If you do not see the selection you need in the drop-down options, please contact the WSU Energy Program at energycode@energy.wsu.edu or (360) 956-2042 for assistance.

This tool is for the permitting purposes only. A Manual J calculation is required to meet the requirement of the Washington State Energy Code.

Project Information

SEARS PLAT - LOT 2
 97414 - 78th Avenue SE
 Mercer Island, WA 98040

Contact Information

McCullough Architects
 5601 - 6th Ave S, #317
 Seattle, WA 98108

Heating System Type: All Other Systems Heat Pump

To see detailed instructions for each section, place your cursor on the word "Instructions"

Design Temperature

Instructions

Design Temperature 25
 Design Temperature Difference (ΔT) 45
 ΔT = Indoor (70 degrees) - Outdoor Design Temp

Area of Building

Conditioned Floor Area

Instructions Conditioned Floor Area (sq ft)

Average Ceiling Height

Instructions Average Ceiling Height (ft)

Conditioned Volume
 49,950

Glazing and Doors

Instructions

U-Factor X Area = UA
 0.300 476.40

Skylights

Instructions

U-Factor X Area = UA
 0.50 0.00

Insulation

Attic

Instructions

U-Factor X Area = UA
 0.024 54.77

Single Rafter or Joist Vaulted Ceilings

Instructions

U-Factor X Area = UA
 0.020 3.54

Above Grade Walls (see Figure 1)

Instructions

U-Factor X Area = UA
 0.056 170.35

Floors

Instructions

U-Factor X Area = UA
 0.029 41.88

Below Grade Walls and Slabs (see Figure 1)

Instructions Wall & Slab
 Depth

Wall U-Factor X Area = UA
 0.035 45.68
Slab F-Factor X Length = UA
 0.500 76.25

Slab on Grade (see Figure 1)

Instructions

F-Factor X Length = UA
 -- --

Location of Ducts

Instructions

Duct Leakage Coefficient
 1.100

Sum of UA 868.86
Envelope Heat Load 39,099 Btu / Hour
Sum of UA x ΔT
Air Leakage Heat Load 24,276 Btu / Hour
Volume x 0.6 x ΔT x 0.018
Building Design Heat Load 63,374 Btu / Hour
Air leakage + envelope heat loss
Building and Duct Heat Load 69,712 Btu / Hour
Ducts in unconditioned space: sum of building heat loss x 1.10
 Ducts in conditioned space: sum of building heat loss x 1
Maximum Heat Equipment Output 87,140 Btu / Hour
Building and duct heat loss x 1.40 for forced air furnace
 Building and duct heat loss x 1.25 for heat pump

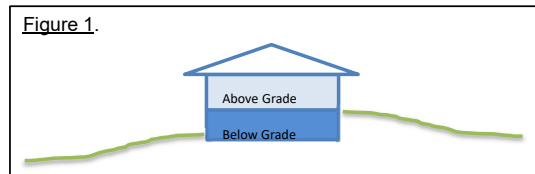


Figure 1.

Project Information
4995 sq. ft. single family medium dwelling unit two story structure with basement
Contact Information
McCullough Architects 5601 - 6Th Ave S, #317 Seattle, WA 98108 206-443-1181

Messages / Comments *	RESULT= PASS
<p>Note: Review required for custom entries: - Flat/Vaulted Ceilings</p> <p>UA Reduction = 6.61, Proposed UA is better than baseline by 1%</p>	
<p>Window area is 32% of floor area</p> <p>-</p> <p>Whole House Mechanical Ventilation Airflow Rate: 178.125 CFM with Run Time Percent of 66%, Balanced, Not Distributed</p> <p>Maximum allowable total measured duct leakage: 200 CFM25</p> <p><small>* Results assume your inputs are complete and correct. Results do not constitute an approval. Analysis should be reviewed by your AHJ.</small></p>	

ANALYSIS SET UP	
What code compliance pathway are you using?	U-Factor Compliance Path
Project Building Type?	New Construction
Occupancy Type?	R3 Single family dwellings and townhouses
Code Version?	WSEC 2021
Classification:	Medium Dwelling Unit -- 4995 sq. ft.
Baseline Description:	Code Baseline - Baseline and proposed window areas are equal.
About Your Selection:	Up to 15 sf exempt window and 24 sf exempt door allowable

RESULTS - Comparison of Baseline and Proposed Design **						
Component Performance, R occupancies			Proposed Design			
	Baseline Design			Proposed Design		
	U *	Area	UA	U	Area	UA
Doors U =	0.300	0	0.0		0	0.0
Overhead Glazing U =	0.500	0	0.0		0	0.0
Vertical Glazing U =	0.300	1,588	476.4	0.300	1,588	476.4
Flat/Vaulted Ceilings U =	0.024	2,459	59.0	0.024	2,459	58.5
Wall (above grade) U =	0.056	3,042	170.4	0.054	3,042	164.3
Floors over Crawlspace U =	0.029	1,444	41.9	0.029	1,444	41.9
Slab on Grade F =	0.540	0	0.0		0	0.0
Below Grade Wall U =	0.035	1,305	45.7	0.035	1,305	45.7
Below Grade Slab F =	0.500	153	76.5	0.500	153	76.5
	<small>* Values from Table R402.1.2 (Oct 2023)</small>					
	Baseline UA Total	869.8		Proposed UA Total	863.2	
	Required Credits	8.0		Proposed Credits	8.0 from Tables 406.2 and 406.3	
				UA Percent Reduction	1%	
				UA Reduction	6.6	
If the Proposed UA ≤ the Target UA, and the Proposed Credits from Table 406 are ≥ those required in Section R406, then the home meets the WSEC.						

** Results assume your inputs are complete and correct. Results do not constitute an approval. Analysis should be reviewed by your AHJ.

Table R406.2 Energy Equalization Credits					
System No.	Full Description	Select System Type	Fuel Normalization Credits (406.2)	Energy Credits (406.3)	Total Credits (406.2 & 406.3)
2	For heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) and supplemental heating provided by electric resistance or a combustion furnace meeting minimum standards Listed in Table C403.3.2(5)b found in the 2021 WSEC - COMMERCIAL ENERGY CODE.	Heat Pump with Supplemental Heating	1.5	6.5	8.0

Table R406.3 Energy Credits				
Option No.	Category	Select Options	Energy Credits	Brief Description of Selected Options*
1	Efficient Building Envelope	Not Selected	0.0	-
2	Air Leakage Control and Efficient Ventilation			
3.1 -3.10	High Efficiency HVAC		0.0	
3.11	High Efficiency HVAC: Smart Thermostat	Option 3.11	0.5	Connected Energy Star Certified smart thermostat.
4	High Efficiency HVAC Distribution System		0.0	

5.1	Efficient Water Heating: Drain Heat Recovery		Option 5.1	0.5	Drain Water Heat Recovery shall include Min. 2 showers incl. tub-showers w/ Min. efficiency of 40% for equal flow or 54% for unequal flow. Rated and labeled CSA B545.1 or IAPMMO IGC 346-2017
5.2	Efficient Water Heating: Compact Hot Water Distribution		Not Selected	0.0	-
5.3-5.8	Efficient Water Heating		Option 5.4	1.0	Energy star gas or propane water heater with min UEF of 0.91 OR Solar supplemental water heating OR GSHP meeting requirements of Option 3.4
6	Renewable Electric Energy	5,400 kWh	Option 6.1	4.5	On-site wind or solar electric energy, 0.5 credit per 600 kWh of generation up to maximum of 4.5 credits
7	Appliance Package			0.0	
Energy Credits				6.5	

*Refer to WSEC 2021 Table R406.3 for complete option descriptions and requirements <https://sbcc.wa.gov/state-codes-regulations-guidelines/state-building-code/energy-code>

Floor (over crawl or exterior)							
Plan ID	Component Description	Ref.	Floor U		Area	UA	
F2 / F3	R30 vented Joist	10-3	0.029		1,444	42	
Sum of Area and UA					1,444	42	
Area Weighted U-Value						0.029	

Slab on Grade (less than 2 feet below grade)							
Plan ID	Component Description	Ref.	Slab F		Slab Perim	FP	
Sum of Perimeter and FP					0	0	
Area Weighted U-Value							

Below Grade Walls and Slabs										
Plan ID	Component Description	Slab Depth	Ref.	Wall U	Wall Area	Wall UA	Slab F	Slab Perim	Slab UA	
W2	R21 Batt w/TB	7' depth	WSU	0.035	1,305	45.7	0.500	153	77	
Sum of Area, Length and UA					1,305	46		153	77	
Weighted U- and F-values						0.035			0.500	

Links to Download Forms, Checklists and Other Resources		Link
Compliance Certificate		Compliance Certificate
Insulation Certificate for Residential New Construction		Insulation Certificate
Duct Testing Affidavits		
	Existing Construction	Affidavit Existing
	New Construction	Affidavit New
Prescriptive Checklist for 2018 WSEC		Prescriptive Checklist
Alterations (Remodel) Worksheet		Worksheet
EER SEER2 COP HSPF2 Converter		https://www.adicotengineering.com/eer-seer2-cop-hspf2-kwton-converter

Show Ventilation Calculator? [Show](#)

Ventilation Requirements	
Conditioned Floor Area	4,995 sq. ft.
Number of Bedrooms	5
Run-Time Percent in Each 4-Hour Segment	66%
Is the system Balanced?	Balanced
Is the system Distributed?	Not Distributed
Ventilation Code Section	IRC, Chapter 15
Whole House Mechanical Ventilation Airflow Rate	178 CFM

Verify system meets definition of 'Balanced Whole-House Ventilation'

Show Distribution System Calculator? [Show](#)

HVAC Thermal Distribution System	
Is this a hydronic heating system?	No
Location of Ducts	Unconditioned Space
Location of Air Handler	Unconditioned Space
Is Duct Testing Required?	Yes
Maximum Duct Leakage:	
Is this a post-construction test?	Yes
Maximum total measured duct leakage per square foot	0.04 CFM25 per sq. ft.
Maximum allowable total measured duct leakage	200 CFM25

Show Heating System Sizing? [Show](#)

Heating System Sizing - Proposed Design	
Nearest Weather Station	Mercer Island
Indoor Design Temperature	70 F
Outdoor Design Temperature	25 F
Design Temperature Difference (ΔT)	45 F

Try Out BetterBuiltNW's HVAC Sizing Tool: <https://betterbuiltinw.com/resources/hvac-sizing-tool>

Conditioned Floor Area, Proposed Design	4,995 ft ²	
Conditioned Volume	<input type="text" value="49,950"/> ft ³	Average ceiling height = 10 ft. Volume = 49950 ft³
<small>Leave blank to use default of 8.5 ft. ceiling height</small>		
Average ceiling height	10.0 ft	
HVAC System Type	<input type="text" value="Heat Pump"/>	
Location of HVAC Distribution System	Unconditioned Space	
Sum of UA, including exempt door and window	<input type="text" value="863"/>	
Envelope Heat Load	<input type="text" value="38,844"/> Btu / Hour	
<small>Sum of UA X ΔT</small>		
Air Leakage Heat Load	<input type="text" value="24,276"/> Btu / Hour	
<small>((Volume X 0.6) X ΔT) X .018))</small>		
Building Design Heat Load	<input type="text" value="63,120"/> Btu / Hour	
<small>Air Leakage + Envelope Heat Loss</small>		
Building and Duct Heat Load	<input type="text" value="69,432"/> Btu / Hour	
<small>For ducts located in unconditioned space: Sum of Building Heat Loss X 1.1</small>		
<small>For ducts located in conditioned space or ductless: Sum of Building Heat Loss X 1</small>		
Maximum Heat Equipment Output	<input type="text" value="86,790"/> Btu / Hour	
<small>Building and Duct Heat Loss X 1.25 for heat pumps</small>	<input type="text" value="25.4"/> kW	
<small>Building and Duct Heat Loss X 1.40 for all other systems</small>		

ASSEMBLY U VALUE CALCULATIONS

PROJECT : 0
 PERMIT# 0

NOTES:

CEILINGS DO NOT HAVE TOP AND BOTTOM PLATES, SO SECTION 3 CAN HAVE 0 ENTER
 WITH TRUSSES, CREATE A PATH BETWEEN THE 3.5" BOTTOM CHORDS AND ANOTHER

ASSEMBLY #	unvented hybrid 3:" spf +R30 batt
SHEET #	

Surface Film Resistance (R-value) interior R_{si} :
 exterior R_{se} :

	Area Section 1	R per inch	R	Area Section 2 (framing)
1.	Int Gyp	0.900	0.563	Int Gyp
2.	R30 FG batt	3.800	30.400	
3.	3" HEATLOK HFO SPF	7.200	21.600	roof truss top chord
4.	1/2" roof sheathing	1.100	0.550	1/2" roof sheathing
5.			0.000	
6.			0.000	
7.			0.000	
8.			0.000	

Component u value 0.018
 Percentage of Sec. 1 75.0
 1.39
 2.09
 4 0.02087

ASSEMBLY #	VAULTED ROOF r30 BATTs, 3" RIGID EPS
SHEET #	

Surface Film Resistance (R-value) interior R_{si} :
 exterior R_{se} :

	Area Section 1	R per inch	R	Area Section 2 (framing)
1.	Int Gyp	0.900	0.563	Int Gyp
2.	FG batt HD R30	4.300	30.100	
3.				9.5" I JOIST
4.	1/2" ROOF SHEATING	1.100	0.550	1/2" ROOF SHEATING
5.	3" Rigid foam	5.000	15.000	3" Rigid foam

6.	CAP SHEET AND MEMBRANE	0.250	0.125	CAP SHEET AND MEMBRANE
7.			0.000	
8.			0.000	

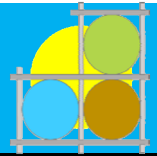
Component u value 0.021
Percentage of Sec. 1 96.0 Percentage
2.03
2.26
0.02262

Assembly No. C2

Surface Film Resistance (R-value) interior R_{si} :
exterior R_{se} :

	Area Section 1	R per inch	R	Area Section 2 (framing)
1.			0.000	
2.			0.000	
3.				
4.			0.000	
5.			0.000	
6.			0.000	
7.			0.000	
8.			0.000	

Component u value 1.036
Percentage of Sec. 1 88.0 Percentage
91.17
96.32
0.963168



ED

ABOVE IT THAT IS CONTINUOUS INSULATION, DON'T INCULDE ROOF LAYERS IF THE ATTIC IS VENTED.

INCLUDES SF SOLID FILL FOR 12" AT EAVE

0.74
0.23

R per inch	R	Area Section 3 (plates)	R per inch	R	Total Width Thickness [in]
	0.563	Int Gyp		0.563	0.625
3.800	19.000		3.800	3.800	8.000
1.100	3.850	roof truss top chord	1.100	1.100	3.000
	0.550			0.550	0.500
	0.000	SPF AT EAVE	7.200	43.200	6.000
	0.000			0.000	
	0.000			0.000	
	0.000			0.000	

	0.040		0.020	Total	18.1 in
Percentage of Sec. 2	10.0	Percentage of Sec. 3	15.0		
	0.40		0.30		

R-Value: 47.9 (hr.ft².F/BTU)

Assembly u value: 0.021

ON TOP

0.74
0.23

R per inch	R	Area Section 3 (plates)	R per inch	R	Total Width Thickness [in]
	0.563			0.563	0.625
	0.000			0.000	7.000
1.100	0.000			0.000	9.500
	0.550			0.550	0.500
	15.000			15.000	3.000

	0.125		0.125
	0.000		0.000
	0.000		0.000

0.500

Total

21.1	in

0.058
4.0
0.23

Percentage of Sec. 2

0.058
0.0
0.00

Percentage of Sec. 3

R-Value: 44.2 (hr.ft².F/BTU)

Assembly u value: **0.023**

--	--

0.74
0.23

Total Width Thickness [in]

R per inch	R	Area Section 3 (plates)	R per inch	R
	0.000		0.000	0.000
0.390	1.365		0.390	1.365
	0.000		0.000	0.000
	0.000		0.000	0.000
	0.000		0.000	0.000
	0.000		0.000	0.000
	0.000		0.000	0.000
	0.000		0.000	0.000

0.625
3.500
2.000
12.000

Total

18.1	in

0.429
12.0
5.15

Percentage of Sec. 2

0.429
0.0
0.00

Percentage of Sec. 3

R-Value: 1.0 (hr.ft².F/BTU)

Assembly u value: **0.963**



RESULTS

5,269 kWh/Year*

System output may range from 5,029 to 5,447 kWh per year near this location.

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at //sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

Disclaimer: The PVWatts® Model ("Model") is provided by the National Renewable Energy Laboratory ("NREL"), which is operated by the Alliance for Sustainable Energy, LLC ("Alliance") for the U.S. Department Of Energy ("DOE") and may be used for any purpose whatsoever.

The names DOE/NREL/ALLIANCE shall not be used in any representation, advertising, publicity or other manner whatsoever to endorse or promote any entity that adopts or uses the Model. DOE/NREL/ALLIANCE shall not provide any support, consulting, training or assistance of any kind with regard to the use of the Model or any updates, revisions or new versions of the Model.

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The energy output range is based on analysis of 30 years of historical weather data, and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)
January	1.43	178
February	2.32	263
March	3.19	392
April	4.77	554
May	5.13	609
June	5.66	631
July	6.22	709
August	5.90	680
September	4.61	522
October	2.80	340
November	1.71	208
December	1.45	184
Annual	3.77	5,270

Location and Station Identification

Requested Location	7414 78th avenue se, mercer island
Weather Data Source	Lat, Lng: 47.53, -122.22 0.8 mi
Latitude	47.53° N
Longitude	122.22° W

PV System Specifications

DC System Size	5 kW
Module Type	Standard
Array Type	Fixed (open rack)
System Losses	14.08%
Array Tilt	20°
Array Azimuth	180°
DC to AC Size Ratio	1.2
Inverter Efficiency	96%
Ground Coverage Ratio	0.4
Albedo	From weather file
Bifacial	No (0)

Monthly Irradiance Loss	Jan	Feb	Mar	Apr	May	June
	0%	0%	0%	0%	0%	0%
Monthly Irradiance Loss	July	Aug	Sept	Oct	Nov	Dec
	0%	0%	0%	0%	0%	0%

Performance Metrics

DC Capacity Factor

12.0%
