



CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org

Acknowledgements

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The Runberg Architecture Group, designers of the LIHI Denny Park Apartments, provided construction documents for the project. Michelle Wang, a member of the Runberg Architecture Group design team, provided additional information through an interview in December, 2008. In addition, she gave Michael Utzinger a tour of the apartments in March, 2009.

The property owner, LIHI Denny Park Aparkments, LLC, graciously provided utility bills for natural gas, electricity and water consumption.

A number of University of Wisconsin-Milwaukee graduate students in architecture helped develop the REVIT model, input data into the building case study spread sheet and develop this document. Those students assisting in development of this case study include Allison Mastel, Payman Sadeghi, Leyla Sanati, NJ Unaka and Steve Wolner.

Michael Utzinger and James Wasley, editors Institute for Ecological Design University of Wisconsin-Milwaukee 2011



View of commons area roof deck looking west. Gardens for rain collection from roof at right.



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Contents





CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org Denny Park Apartments View looking south-southeast.

Project Overview

Overview

Location: Seattle, Washington Building type(s): Multi Family Residential Housing with Ground Floor Commercial and Underground Parking Garage New construction Urban setting Completed January 2006

Denny Park Apartments includes 50 units of affordable rental housing, 4,400 ft² of commercial space, and parking for 35 vehicles. The residential portion includes a community room, an office, common laundry facilities, and a common landscaped courtyard. The average residential unit size is 541 net square feet and includes 5 three bedroom, 8 two bedroom, 12 one bedroom and 25 studio units. The urban-infill project also includes new city sidewalks and right-ofway landscaping.

Of the housing units, 40% are reserved for households at or below 30% of the area median income (AMI), 50% are reserved for households at or below 50% AMI, and 10% are reserved for households at or below 60% AMI. The AMI for King County was, in 2004, \$70,100 for a family of three.

Environmental Aspects

The mixed-use, urban-infill project was designed to provide opportunities for occupants to live, work, and play in close proximity, and minimize dependence on automobiles.

The project's energy design focused on maximizing daylighting while minimizing western solar gain during the summer months. The building is oriented along an east-west axis, with half the units facing north and half facing south. The common room and courtyard (the heart of the project) are located at the south side of the building, where they are warmed by late-afternoon western sun. To encourage occupants to use the operable windows for natural ventilation and cooling,



West facade, Denny Park Apartments.

residential units were not provided with air conditioning. A central natural-gas hydronic system provides heat and hot water.

Innovative planters filter stormwater falling on the project site, releasing it slowly into the municipal system while allowing evaporation and transpiration. Low-flow plumbing fixtures reduce water use indoors.

Materials were selected largely for their cost-effectiveness and durability. A jobsite

recycling program led to the recycling of 91% of construction waste, by weight. Indoor air quality is protected by finishes with low chemical emissions and a no-smoking policy for the entire project.

Owner & Occupancy

Owned by Low Income Housing Institute, Corporation, nonprofit Occupants: Individual(s) Typically occupied by 90 people, 100 hours per person per week; and 20 visitors per

al ventilation and cooling,

week, 3 hours per visitor per week

Level 1 Building Case Study Metrics

Building Area	Gross Measured Area		
 Residential Commercial Parking Garage 	33,543 SF [3,116 M²] 4,078 SF [379 M²] 15,340 SF [1,425 M²]		
Total Building	52,961 SF [4,920 M²]		
Average Residential Unit	541 SF [50.3 M ²]		

The Gross Measured Area is the area of the building (or building sub area) measured to the inside face of the exterior walls. The metrics on this page are calculated without includeing the garage area.



LIHI Denny Park Apartments - 6th Floor



LIHI Denny Park Apartments - Ground Floor



LIHI Denny Park Apartments - Lower Level





LIHI Denny Park Apartments - 3rd thru 5th Floor



LIHI Denny Park Apartments - 2nd Floor

METRICS BASED ON GROSS MEASURED AREA NOT INCLUDING PARKING GARAGE

CONSTRUCTION COST

278.41 \$/ SF 2,996.82 \$/ M² 216,701 \$/ unit

TOTAL ENERGY USE AND COST

11 kwh/ sF-yr 118.4 kwh/ M²-yr 8,561 kwh/ unit-yr

0.52 \$/ SF-YR 5.59 404 \$/ unit-YR

5.59 \$/ M²-YR

RENEWABLE ENERGY GENERATED

0 kWh/ SF-YR

WATER USE AND COST

51.9 Gal/ SF-YR 2,115 L/ M²-YR

111 Gal / unit / Day

419 Liter / unit / Day

0.71 \$ / SF-YR 7.68 \$ / M²-YR 556 \$ / unit-YR

CARBON DIOXIDE EMISSIONS

7.49 LB CO₂/ SF-YR 36.6 kg CO₂/ M²-YR

2.91 Ton CO₂/ unit-YR

2.65 metric Tonne CO₂/ unit-YR

TO CONVERT AREA WEIGHTED METRICS TO INCLUDE THE GROSS MEASURED AREA OF THE PARKING GARAGE, MULTIPLY THE AREA WEIGHTED METRIC OF INTEREST BY 0.7348, THE RATIO OF GROSS MEASURED AREA WITHOUT THE PARKING GARAGE TO GROSS MEASURED AREA WITH THE PARKING GARAGE.

Level 1 Climate Analysis



Climate Narrative

The mild climate of the Pacific Coast is modified by the Cascade Mountains and, to a lesser extent, by the Olympic Mountains. The climate is characterized by mild temperatures, a pronounced though not sharply defined rainy season, and considerable cloudiness, particularly during the winter months. The Cascades are very effective in shielding the Seattle-Tacoma area from the cold, dry continental air during the winter and the hot, dry continental air during the summer months. The extremes of temperature that occur in western Washington are the result of the occasional pressure distributions that force the continental air into the Puget Sound area.

occasional pressure distributions that force the continental air into the Puget Sound area. But the prevailing southwesterly circulation keeps the average winter daytime temperatures in the 40s and the nighttime readings in the 30s. During the summer, daytime temperatures are usually in the 70s with nighttime lows in the 50s. Extremes of temperatures, both in the winter and summer, are usually of short duration. The dry season is centered around July and early August with July being the driest month of the year. The rainy season extends from October to March with December normally the wettest month, however, precipitation is rather evenly distributed through the winter and early soring months with more than 75 percent

of the yearly precipitation falling during the winter wet season. Most of the rainfall in the Seattle area comes from storms common to the middle latitudes. These disturbances are most vigorous during the winter as they move through western Washington. The storm track shifts to the north during the summer and those that reach the State are not the wind and rain producers of the winter months. Local summer afternoon showers and a few thunderstorms occur in the Seattle-Tacoma area but they do not contribute materially to the precipitation.

distributed through the winter and early spring months with more than 75 percent

SWING SEASONS: APRIL - JUNE, SEPT. - T. SWING MONTH: OCTOBER

SWING MONTH: MAY



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Level 1 Climate Analysis





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Level 1 Site Analysis / Site Design



9:00 am

Site Shading Study







N

Noon Summer Azumuth Angles: Sunrise: 53 degrees Sunset: 307 degrees



N

3:00 pm Winter Azumuth Angles: Sunrise: 125 degrees Sunset: 235 degrees





Source: High Performance Buildings Data Base

The site is an urban infill site on a previously developed industrial and commercial lot. Former uses of the site had resulted in minor soil contamination that was remedied before construction on Denny Park Apartments began. The building planters and sidewalk plantings reinforce the pattern of "green streets" in the neighborhood and the project's connection to Denny Park. To minimize the project's contribution to the urban heat-island effect, the team selected metal roofing that meets the Energy Star criteria.

One major feature of the project's watermanagement plan is the use of roof stormwater planters; the first of their kind to be approved within the city of Seattle, they were made possible through effort and coordination on the part of the civil engineer, Seattle Public Utilities, and the Seattle Department of Transportation. Rainwater running off of the metal roof is directed to stormwater planters located on the north and south sides of the building, on a raised plaza above commercial spaces, and on the parking garage. A mix of drainage aggregate and organic soil was specially engineered to achieve specific percolation rates. The native plants selected for receiving stormwater are also drought tolerant. The plants and planters permit the rainwater to be released back into the biosphere through evaporation and transpiration, and, after it has been naturally filtered, any overflow is piped into the municipal storm system in a controlled manner. The soil in the sidewalk planting strips at the street level was improved with an engineered structural soil to a minimum depth of 18 inches to allow the groundwater to recharge more quickly. Drip irrigation was provided to help establish the landscaping for the first two years; this system was projected to use 32% less water than a conventional spray system. Low-flow toilets and faucets, Energy Star dishwashers, and front-loading clothes washers reduce water use inside the building.



Level 1 Program Distribution



Ground Floor Entry, Commercial and Upper Level Parking Plan



Commons Room on 2nd floor with access to outdoor south facing court

Provide description of program here.



Lower Level Parking Plan



Level 1 Program Distribution

Continue program description here.



Third, Fourth & Fifth Floor Plan







AIA

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Level 1 Resource Consumption

Resource Use and Costs

Denny Park Apartments consumes natural gas for space heating and water heating. Electricity provides illumination, mechanical ventilation, cooking and meets plug loads. Water is consumed primarily in the residences, including the common laundries. The total resouce cost for 2007 was \$48,157. Each cost component, natural gas, electricity, water and sewer are illusatrated in the graph below.

Sewer costs are based on water consumption which was 2,707 ccf in 2007. The combined sewer and water cost was 58% of the total resource bill for Denny Park Apartments.

Unit costs are \$2.87 per ccf (100 cubic feet of water consumed) for water supply and \$7.42 per ccf for sanitary waste handling. Unit energy costs are \$0.057 per kWh for electricity and \$0.043 per kWh energy equivelent of natural gas (\$1.26 per therm of natural gas). the fraction used for heating water can be estimated by assuming the natural gas use during july, August and September represents only hot water heating. Monthly natural gas use is illustrated at right. Averaging the summer gas use per month and multiplying by 12 gives an estimate of 4,503 therms for hot water heating (44%) and 5,745 therms for space heating (56%).

Natural gas and electricity use are compared in the graph at lower right. All energy consumption is given in kWh. (One therm is equivelent to 29.3 kWh). Electricity (129,160 kWh) and estimated hot water use (131,929 kWh) are nearly equal (30% and 31% of the total annual use). Estimated space heating (168,338 kWh) is roughly 40% of the total annual energy use.



Although natural gas is not submittered,







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Level 1 Lessons Learned

Runberg Architecture Group

- Owner commitment to sustainability goals is very important. The owner needs to involve all members of their team, especially the operations/maintenance staff, and develop a plan for ensuring continuity and communicating procedures. In affordable housing, some of the maintenance (particularly landscaping) is often done by residents (as volunteers or as part of a community-building program) who lack the training or information on the proper maintenance of unusual features (e.g., stormwater planters or "structural soil").
- 2. Remember to account for the human dimension and psychological factors. Science may predict that a centralized hot water and hydronic heating system is the most energy-efficient solution; however if residents are not individually responsible for a utility bill for heat and/or hot water, they may not have the incentive to conserve. Incorporate incentives into an educational plan or include a means of submetering the utilities.
- 3. Trash compactors save landfill space!
- 4. At the time of construction of this project (2004), many multifamily residential contractors were not familiar with green building practices. A separate paragraph in each section of the specifications to highlight the sustainable building requirements would have made these requirements easier to find.
- 5. The Owner must continually commit to educating the residents about the sustainable features of the building.



Level 2 Building Design Variables

ENCLOSURE AF	REA / GROSS EA	GLAZING AREA PER GRO MEASURED AREA	OSS	OPERABLE WINDOW AREA F GROSS MEASURED FLOOR	PER AREA	HEATING VARIAB	BLES	
Residential Area	0.78	SOUTH FACING GLAZING		Residential	3.3%	Heating Capacity	5.51	Watt / SF
Comercial Area	1.56	Residential	3.5%	Commercial	0%		59.3	Watt/ M ²
Parking Garage	3.93	Commercial	0%	Parking Garage	0%			
Total Building	0.97	Parking Garage	0%			Installed Heat Power	6.01 64.7	Watt / SF Watt/ M ²
ENCLOSURE HE	EAT TRANSFER RATE	EAST FACING GLAZING	1 10/	VENTILATION VARIABLES FO	DR		04 20	
PER MEASURE	D FLOOR AREA	Residential	1.1/0	RESIDENTILA AREA ONLY		Heating Efficiency	91.27	0
Residential Area	0.07 Btu/ HR-SF-°F		1.7 % ^%	OUTDOOR AIR VENTILATION	1	BUILDING BALAN	ICE POINT	r
	0.37 Watt/ M ² -°C	Parking Garage	U /0	RATE				
Comercial Area	0.40 Btu/ HR-SF-°F	NORTH FACING GLAZING		0.05 CFM/ SF			57.0	°F
	2.29 Watt/ M ² -°C	Residential	4.2%	0.26 L/S-M ²			13.9	°C
Parking Garage	4.47 Btu/ HR-SF-°F	Commercial	27.0%					
	25.4 Watt/ M ² -°C	Parking Garage	0%	INSTALLED VENTILATION CA	PACITY			
Total Building	0.13 Btu/ HR-SF-°F	WEST FACING GLAZING		0.65 CEM/ SE				
-	0.72 Watt/ M ² -°C	Residential	2.5%	0.26 L/ S-M ²				
		Commercial	11.1%					
		Parking Garage	0%	FAN POWER DENSITY				
		TOTAL GLAZING		0.40 Watt/ SF				
		Residential	11.3 %	4.26 Watt/ M ²				
		Commercial	39.9%					
		Parking Garage	0%	FAN VOLUME FLOW EFFICIE	INCY			
				1.6 cfm/ Watt				
				0.73 L/ S/ W				
		LIGHTING POWER DENS	SITY					
		Residential	64 Watt/ SF	FAN THERMAL TRANSFER				
		Commercial	Not Provided	EFFICIENCY				
		Parking Garage	Not Provided	1.7 вtu/ нг.°г-w 3.19 кJ/ нг.°с-w				



Level 2 Massing and Orientation



Enclosure Efficiency

Explain design variables for enclosure here

ENCLOSURE AREA / GROSS
MEASURED AREA

Total Building	0.97
Comercial Area	1.56
Residential Area	0.78

Above: Section through Denny Park Apartments looking east.

Below: Axon of Denny Park Apartments from southeast.

Below Right: Axon of Denny Park Apartments from southwest.





Level 2 Envelope: Aperture Distribution

		GLAZING AREA PER G MEASURED AREA SOUTH FACING GLAZING	ROSS
		Residential	3.5%
		Commercial	0%
		Parking Garage	0%
		EAST FACING GLAZING	
		Residential	1.1%
		Commercial	1.7%
		Parking Garage	0%
			3
		Residential	4.2%
South Elevation	West Elevation	Commercial	27.0%
		Parking Garage	0%
		WEST FACING GLAZING	
		Residential	2.5%
		Commercial	11.1%
		Parking Garage	0%
		TOTAL GLAZING	
		Residential	11.3%
		Commercial	39.3%
		Parking Garage	0%
			AREA PER
	59843	Commercial	0%
		Commonoida	- /0

KEY Fixed Glazing Operable Glazing



Envelope- Thermal Enclosure

	Envelope Variables Explain design variables for envelope here	ENCLOSURE HE PER GROSS ME AREA	AT TRANSFER RATE ASURED FLOOR
		Residential Area	0.07 Btu/ HR-SF-°F 0.37 Watt/ M²-°C
NOOF - WALL DE TAIL		Comercial Area	0.40 Btu/ HR-SF-°F 2.29 Watt/ M²-°C
GLAZING - WALL DETAIL		Parking Garage	4.47 Btu/ HR-SF-°F 25.4 Watt/ M²-°C
FLOOR - WALL DETAIL		Total Building	0.13Btu/ HR-SF-°F 0.72 Watt/ M ² -°C
GROUND - WALL DETAIL AT 2 nd FLOOR COURT		I 5/8" TYPE BARRIER I 8-21 FIBE I 2 X 6 WOO I 9LYWOOI 5/8" TYPE EXTERIOF BUILDING METAL OF	CAL WALL SECTION 'X' GYPSUM WALLBOARD AND VAPOR ERGLASS THERMAL BATT INSULATION OD STUDS D WHERE NEEDED FOR SHEAR 'X' FIBERGLASS- REINFORCED R GYPSUM SHEATHING B PAPER R FIBERCEMENT SIDING



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Providing Illumination- Daylighting

SOUTH

BUILDING GLAZING RATIOS PER

GROSS MEASURED FLOOR AREA

3.0%



Ground Floor Daylighting Plan



2nd Floor Daylighting Plan



CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org LIHI Denny Park Apartments



Levels 3-5 Daylighting Plan

PRIMARY DAYLIGHTING ZONE AREA

PER GROSS MEASURED FLOOR

AREA



Providing Illumination- Electric Lighting





Providing Fresh Air- Natural Ventilation

The residential areas of the Denny Park apartments are equipped with operable windows, while the commercial facilities and the parking garage is not. The apartments are ventilated on one side only, due to the doubleloaded corridor configuration of the floor plan.



Levels 1 Parking



Typical Residential Floor Plan



BUILDING GLAZING RATIOS PER RESIDENTIAL GROSS NEASURED AREA

11.3%

OPERABLE WINDOW AREA PER RESIDENTIAL GROSS NEASURED AREA

3.3%



Primary Natural Ventilation
 Space two or more inlet/outlets and clear cross or stack ventilation paths.
 Secondary Natural Ventilation

Space with inlets/ outlets on a single face and no clear cross or stack ventilation path when internal doors are closed.

Not Naturally Ventilated



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Providing Fresh Air- Mechanical Ventilation





Exhausting Air- Mechanical Ventilation

Fresh air is brought into the building through vents on the west end of the central hallway, creating a pressurized zone. Air is drawn into the apartments from the pressurized hallway through two exhaust fans located above the kitchen stove and in the bathroom. The fans can be adjusted to allow in more or less air. Air in the hallway that is not brought into an apartment is collected at the east end of the hallway and exhausted.





Typical Unit Exhaust Plan

LIHI Denny Park Apartments



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Appendix

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Sources





Site Plan







1Bike Storage3Elevator Machine Room5Trash/ Recycling2Parking4Water/ Sprinkler Mechanical Room6Mechanical Room



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LEVEL 2 FLOOR PLAN

1 Kitchen 5 Office

2 Bedroom 6 Storage

3 Living Room 7 Common Room

4 Bathroom 8 Conference



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LEVEL 3-5 FLOOR PLANS

- 1 Kitchen 7 Common Room 8 Conference
- 2 Bedroom
- 3 Living Room 9 Laundry 10 Electrical Storage
- 4 Bathroom
- 5 Office 11 Public Balcony
- 12 Private Balcony 6 Storage



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LIHI Denny Park Apartments

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Level 6 Floor Plan

- 1 Bedroom 6 Deck
- 2 Bathroom 7 Common Room
- 3 Kitchen 8 Conference
- 4 Living Room 9 Laundry
- 5 Laundry 10 Electric Storage



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Section Looking East



Addidtional Photographs - Exterior



Looking Southwest

View of Garage Entry



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Addidtional Photographs - Exterior





Looking East along North Facade



CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org **Commercial and Residential Entries**

Addidtional Photographs - Resident's Court



Looking East



CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org Double Rain Garden along Court

Addidtional Photographs - Resident's Court



Note Apartment Ventilation Exhaust at Top Center of Photograph

LIHI Denny Park Apartments

Rain Garden Detail



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Addidtional Photographs - Common Spaces



Common Room Looking Southwest



Upper Floor Laundry Room



LIHI Denny Park Apartments



Hallway looking West with Elevator and Window

Note Drop Ceiling at West End for Ventilation Fan

Addidtional Photographs - Apartments



Studio Apartment - View toward Living Space

Studio Apartment - View toward Kitchen



Photographs



Studio Apartment Alternate - View toward Living Space

Studio Apartment Alternate - View toward Kitchen

Sleeping Nook behand Kitchen



Studio Apartment Alternate - Living Space



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Level 1 Case Study - Project Information

Level 1 Case Study - Measured Resource Consumption

UNU Denny Bark Anastroante			uction Cost	
Bunharn Arabitecture Crean	2006	Design Costs	00001 0000	¢
Runberg Architecture Group	2006	Design Costs	- ∲	
	washington		\$ 10,035,029	
Building Type	Multi-Tarrilly Housing	LEED COSIS	nation	\$ •
Number of Housing Units	50 Units	Total Costa	JCallOIT	÷ 10.935.030
Ownership Type	Νοπ-ριοιιι	Total Costs		φ 10,035,025
Building Floor Areas		Dis	tinct Building Ar	eas
		Main Area	SubArea 1	SubArea 2
Area Name	Total Building	Residential	Commercial	Parking Garage
			Connected, Conditioned	Connected, Unconditioned
Gross Floor Area	55,290 SF	35,088 SF	4,317 SF	15,885 SF
Gross Measured Area	52,961 SF	33,543 SF	4,078 SF	15,340 SF
Major Vertical Penetrations	2,834 SF	1,975 SF	301 SF	558 SF
Building Common Area	2,525 SF	1,589 SF	198 SF	738 SF
Floor Common Area	2,914 SF	2,914 SF	0 SF	0 SF
Usable (Assignable) Area	44,688 SF	27,065 SF	3,579 SF	14,044 SF
Total Occupied Area	50,127 SF	31,568 SF	3,777 SF	14,782 SF
Mechanically Heated Area	30,644 SF	27,065 SF	3,579 SF	0 SF
Mechanically Cooled Area	0 SF	0 SF	0 SF	0 SF
Mechanically Ventilated Area	45,426 SF	27,065 SF	3,579 SF	14,782 SF
Parking Garage	14,044 SF	0 SF	0 SF	14,044 SF
Daylit Area	15,660 SF	12,740 SF	2,920 SF	0 SF
Metric Analysis Area	38,917 SF	33,543 SF	4,078 SF	1,296 SF
Area	per Housing Unit	541 SF		
OCCUPANCY				
Staff	Number of People	Time in Building	ETE	
Full Time Staff	1	100%	1.0 FTE	
Part Time Staff	2	25%	0.5 FTE	
Total Staff			1.5 FTE	
Residents	Number		F.T.E	
Residents	120	40	120.0 FTE	
	0	0	0.0 FTE	
			120.0 FTE	
Total Occupants	Residents	120 People	121.5 FTE	
Building Area Used in Met	rics Calculations	Area		
Is Parking Garage include	d in Calculations?	No		

LIHI Donny Bark Aparte	nonte		Solar PV Canacity	0	00 kW DC posk
Dunhara Arabitaatura Graun	lients			_	
Runberg Architecture Group	Washington		Solar Thermal Area		
Seallie	washington		wind System Capacity	0	.00 KW DC peak
Scope 1 Energy & E	missions: Site C	ombustion			
Fossil Fuels	Natural Gas				
Comments	Date	Days	Fuel Purchased		Cost of Fue
Natural Gas Consumption	27-Dec-06				
	26-Jan-07	30	1,478 Therm	\$	1,889.16
	27-Feb-07	32	1,375 Therm	\$	1,796.80
	28-Mar-07	29	1,051 Therm	\$	1,381.91
	26-Apr-07	29	722 Therm	\$	1,015.57
	29-May-07	33	754 Therm	\$	992.15
	27-Jun-07	29	464 Therm	\$	624.92
	27-Jul-07	30	347 Therm	\$	476.59
	27-Aug-07	31	370 Therm	\$	506.48
	26-Sep-07	30	409 Therm	\$	554.93
	25-Oct-07	29	743 Therm	\$	865.24
	27-Nov-07	33	1,151 Therm	\$	1,291.34
	27-Dec-07	30	1,385 Therm	\$	1,550.75
Annual Total		365	10,248 Therm	\$	12,945.84
Natural Gas in kBtu & CO2	Emissions		1,024,810 kBtu		67.78 Ton CO2
Fossil Fuels	LPG (Propane)				
Comments	Date	Days	Fuel Purchased		Cost of Fue
Propane Consumption	1-Jan-09				
	1-Feb-09	31	0 gal	\$	-
	1-Mar-09	28	0 gal	\$	-
	1-Apr-09	31	0 gal	\$	
	1-May-09	30	0 gal	\$	
	1-Jun-09	31	0 gal	\$	
	1-Jul-09	30	0 gal	\$	
	1-Aug-09	31	0 gal	\$	-
	1-Sep-09	31	0 gal	\$	
	1-Oct-09	30	0 gal	\$	-
	1-Nov-09	31	0 gal	\$	_
	1-Dec-09	30	0 gal	\$	_
	1-Jan-10	31	0 gal	\$	-
Annual Total		365	0 gal	\$	-
Propane in kBtu & CO2 Emi	ssions		0 kBtu		0.00 Ton CO2

CND Case Study

Project Data

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CND Case Study

Resource Data

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Level 1 Case Study	 Measured 	Resource	Consumption
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Level 1 Case Study - Measured Resource Consumption

Fossil Fuels	Heating Oil			
Comments	Date	Days	Fuel Purchased	Cost of Fue
Heating Oil Consumption	1-Jan-09			
	1-Feb-09	31	0 gal	\$ -
	1-Mar-09	28	0 gal	\$ -
	1-Apr-09	31	0 gal	\$-
	1-May-09	30	0 gal	\$-
	1-Jun-09	31	0 gal	\$-
	1-Jul-09	30	0 gal	\$-
	1-Aug-09	31	0 gal	\$-
	1-Sep-09	31	0 gal	\$-
	1-Oct-09	30	0 gal	\$ -
	1-Nov-09	31	0 gal	\$-
	1-Dec-09	30	0 gal	\$-
	1-Jan-10	31	0 gal	\$-
Annual Total		365	0 gal	\$-
Heating Oil in kBtu & CO2 E	missions		0 kBtu	0.00 Ton CO2
Fossil Fuel Summary	Energy		CO2	Cost of Fuel
	1,024,810 kBtu		67.78 Ton CO2	\$ 12,945.84
Biofuels	Wood		Wood Species	Oak - White
Comments	Fuel	Quantity	Energy Equivelent	Cost of Biofue
		0.00 Cords	0 kBtu	\$ -
			0 kBtu	\$ -
			0 kBtu	\$ -
			0 kBtu	\$ -
Annual Total			0 kBtu	\$ -
			Biofuels CO2 Emissions	0.00 Ton CO2

Grid Electricity	Purchases			
Comments	Date	Days	Electricity Purchased	Cost of Service
	22-Nov-06		\$	-
	26-Jan-07	65	23,760 kWh \$	1,398.83
	29-Mar-07	62	22,440 kWh \$	1,267.33
	24-May-07	56	20,720 kWh \$	1,170.86
	25-Jul-07	62	21,600 kWh \$	1,221.56
	25-Sep-07	62	20,840 kWh \$	1,179.00
	26-Nov-07	62	19,800 kWh \$	1,120.45
	26-Nov-07	0	0 kWh \$	-
	26-Nov-07	0	0 kWh \$	-
	26-Nov-07	0	0 kWh \$	-
	26-Nov-07	0	0 kWh \$	-
	26-Nov-07	0	0 kWh \$	
	26-Nov-07	0	0 kWh \$	-
Annual Total		369	127,760 kWh \$	7,278.27
Electricity in Heat Units	5		436,045 kBtu	

Solar Electricity	Total Solar Electricity Generated or Purchased						
Comments	Date	Days	Electricity Produced				
	1-May-08						
	1-Jun-08	31	0 kWh				
	1-Jul-08	30	0 kWh				
	1-Aug-08	31	0 kWh				
	1-Sep-08	31	0 kWh				
	1-Oct-08	30	0 kWh				
	1-Nov-08	31	0 kWh				
	1-Dec-08	30	0 kWh				
	1-Jan-09	31	0 kWh				
	1-Feb-09	31	0 kWh				
	1-Mar-09	28	0 kWh				
	1-Apr-09	31	0 kWh				
	1-May-09	30	0 kWh				
Annual Total		365	0 kWh	\$ -			
Electricity in Heat Units			0 kBtu				

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Resource Data

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CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org

Level 1 Case Study - Measured Resource Consumption

Level 1 Case Study - Measured Resource Consumption

Wind Electricity	Wind Electricity Sol	d to Grid		
Comments	Date	Days	Electricity sold	
Enter Wind electricity	1-Jan-09			
sold to grid here here.	1-Feb-09	31	0 kWh	\$
	1-Mar-09	28	0 kWh	\$ -
	1-Apr-09	31	0 kWh	\$ -
	1-May-09	30	0 kWh	\$
	1-Jun-09	31	0 kWh	\$ -
	1-Jul-09	30	0 kWh	\$
	1-Aug-09	31	0 kWh	\$
	1-Sep-09	31	0 kWh	\$ -
	1-Oct-09	30	0 kWh	\$ -
	1-Nov-09	31	0 kWh	\$
	1-Dec-09	30	0 kWh	\$
	1-Jan-10	31	0 kWh	\$ -
Annual Total		365	0 kWh	\$ -
Electricity in Heat Units			0 kBtu	
Electricity Use Summa	iry			
Electricity Consumed in Bu	uilding		436,045 kBtu	
Net Grid Electricity Purcha	sed and Cost		436,045 kBtu	\$ 7,278.27
Net Solar & Wind Electricit	y Sold and Value		0 kBtu	\$ -

Water Consumption				
Comments	Date	Days	Water Purchased	Cost of Service
	3-Jan-07			
	27-Feb-07	55	235 ccf	\$2,353.55
	1-May-07	63	361 ccf	\$3,560.24
	28-Jun-07	58	621 ccf	\$6,588.51
	31-Aug-07	64	622 ccf	\$6,772.40
	30-Oct-07	60	472 ccf	\$4,764.36
	2-Jan-08	64	396 ccf	\$3,813.78
	2-Jan-08	0		
Annual Water Total		364	2,700 ccf \$	27,776.53

Scope 2 Carbon Dioxide Emissions due to	Electricity Cons	umption & Sales	
Electricity Region & Grid Emissions	Western	0.357 Lb CO2/kBtu	77.93 Ton CO2
Solar & Wind Electricity Sold		-	0.00 Ton CO2
Net Carbon Dioxide Emissions			77.93 Ton CO2

Building Energy Use Su	ımm	ary
Annual Fuel Cost	\$	20,224
Building Consumption		1,460,854 kBtu
Net Fuel Imports		1,460,854 kBtu
Renewable Energy Fraction		0%

Building Submetered Energy Use	Main Area	Subarea 1	Subarea 2
	Residential	Commercial	Parking Garage
Annual Electricity Use by Area	0 kBtu	0 kBtu	0 kBtu
Renewable Electricity	0 kBtu	0 kBtu	0 kBtu
Grid Purchased Electricity	0 kBtu	0 kBtu	0 kBtu
Annual Fossil Fuel Use by Area	Residential	Commercial	Parking Garage
Natural Gas	0 kBtu	0 kBtu	0 kBtu
Fuel Oil	0 kBtu	0 kBtu	0 kBtu
Propane	0 kBtu	0 kBtu	0 kBtu
Annual Biofuel Use by Area	Residential	Commercial	Parking Garage
	0 kBtu	0 kBtu	0 kBtu
Annual Electricity Use by Function	Residential	Commercial	Parking Garage
Lighting	0 kBtu		
Plug Loads	0 kBtu		
Pumps			
Fans			
Heating			
Cooling			

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Resource Data

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Level 1 Case Study - Building Resource Use Metrics

LIHI Denny Park Apartments	Building Type and Ow	nership		
Runberg Architecture Group	Building Type	Multi-family Housing	Year Completed	
Seattle Washington	Ownership Type	Non-profit	2006	
Costs per Gross Measured Area	IP Units	Metric Units	per Residence	
Unit Construction Cost	278.41 \$/sf	2996.82 \$/m^2	216,701 \$/unit	
Unit Energy Cost per year	0.52 \$/sf-yr	5.59 \$/m^2-yr	404.48 \$/unit-yr	
Unit Water Costs per year	0.71 \$/sf-yr	7.68 \$/m^2-yr	555.53 \$/unit-yr	
Energy Use per Gross Measured Area	IP Heat Units	IP Electrical Units	Metric Electrical Unit	per Residence
Energy Utilization Intensity	37.5 kBtu/SF-yr	11.0 kWh/SF-yr	118.4 kWh/m^2-yr	8,561 kWh/yr/unit
Site Renewable Energy Generation Intensity	0.0 kBtu/SF-yr	0.0 kWh/SF-yr	0.0 kWh/m^2-yr	0 kWh/yr/unit
Net Imported Energy Intensity	37.5 kBtu/SF-yr	11.0 kWh/SF-yr	118.4 kWh/m^2-yr	8,561 kWh/yr/unit
Carbon Dioxide Emissions	IP Units	Metric Units		
Scope 1 - Fossil Fuels	67.78 Ton CO2	61.54 metric T CO2		
Scope 1 - Biofuels	0.00 Ton CO2	0.00 metric T CO2		
Scope 2 - Grid Electricity	77.93 Ton CO2	70.76 metric T CO2		
Scope 2 - Solar PV Electricity	0.00 Ton CO2	0.00 metric T CO2		
Total Emissions	145.71 Ton CO2	132.31 metric T CO2		
Net Fossil Fuel Emissions	145.71 Ton CO2	132.31 metric T CO2		
CO2 Emissions per Gross Measured Area	7.49 Lb CO2/SF-yr	36.6 kg CO2/m^2-yr		
CO2 Emissions per unit	2.91 Ton CO2	2.65 metric T CO2		
Water Usage	IP Units	Metric Units	per Residence	
Water Usage per Gross Measured Area	51.9 gal/sf-yr	2,114.6 l/m^2-yr	110.7 gal/unit/day	
Site Recycled Water	0%			
Site Rainfall Harvested	0%			
Resource Use per Occupant	IP Units	Metric Units		
Occupant Utilization Intensity	320 sf/FTE	30 m^2/FTE		
Occupant Energy Intensity	12,023 kBtu/FTE-yr	3,523 kWh/FTE-yr		
Occupant Imported Energy Intensity	12,023 kBtu/FTE-yr	3,523 kWh/FTE-yr		
Occupant Net CO2 Emissions Intensity	1.20 T CO2/FTE-yr	1.09 mT CO2/FTE-yr		
Occupant Water Intensity	16,624 gal/FTE-yr	62,924 I/FTE-yr		
Daylighting per	Gross Measured Area			
Percent Daylit Spaces	40.2%			
Floor Area Efficiencies	per Gross Area			
Measured Area/Gross Area Ratio	95.8%			
Usable (Assignable) Area/Gross Area Ratio	80.8%			
Occupied Area/Gross Area Ratio	90.7%			
Mechanically Heated to Occupied Area Ratio	61.1%			
Mechanically Cooled to Occupied Area Ratio	0.0%			
Mechanically Ventilated to Occupied Area Ra	90.6%			
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CND Case Study

Level 1 - Metrics

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Level 2 Case Study - Building Enclosure Heat Transfer

LIHI Denny	Park Apartm	ents			Building E	nclosure Heat Tra	nsfer Rate										
Runberg Archi	itecture Group				Residential	UA	2,666 Btu/hr-F										
Seattle		Nashington			Commercial	UA	1.729 Btu/hr-F										
		J			Parking Garage	LIΔ	5 792 Btu/br-E										
					Puilding		4 429 Btu/br E										
					Bulluling	OA Building	4,430 Dlu/III-F										
Main Buildi	ing Area Exte	rior Enclosu	ire Surface Taked	offs, Infiltrat	tion Rates and Heat	Transfer Calculat	ions										
Area Name	:			Residential	Gros	s Measured Area	33,543 SF										
Main Area I	ENCLOSURE	HEAT LOSS	RATE TROUGH	THE GROU	ND PER UNIT LENG	GTH OF PERIMETE	R										
Condition					Length	Transfer Rate	UA_perimeter										
1	Slab-on-Grade	w/ext. Slab			0.0 Ft	0.00 Btu/hr-ft-F	0 Btu/hr-F										
2	Slab-on-Grade				0.0 Ft	0.00 Btu/hr-ft-F	0 Btu/hr-F										
4	Crawl Space				0.0 Ft	0.00 Btu/hr-ft-F	0 Btu/hr-F										
Total	Chain Opuloo				0.0 Ft	0.00 21411 111	0 Btu/hr-F										ļ
CONDITION		URE SURFA	CES (Walls & Ro	of	Opaque	Enclosure Calcu	ations	Door Calc	lations	Windo	w Calculations		Wi	ndow Area	for Each ()rientation	
CONDITION				,01)	Opuqui	Enclosure Guieu	utionio	Bool Guid		mildo	a ouloulutions	Operable		nuon Arec		memation	
	Gross	1	Percent Operable		Net Enclosure	Enclosure Surface R	UA enclosure					Window	South	West	North	East /	Horizontal
Orientation	Surface Area	Window Area	Windows	Door Area	Surface Area	Value	Surface	Door R Value	UA Door	Window R Value	UA Window	Area					
South	5,627 SF	1,178 SF	32%	240 SF	4,209 SF	22.28 hr-SF-F/Btu	189 Btu/hr-F	1.00 hr-SF-F/Btu	240 Btu/hr-F	3.33 hr-SF-F/Btu	354 Btu/hr-F	377 SF	1,178 SF	0 SF	0 SF	0 SF	0 SF
South	0.5F	0.5F	0%	0.5F	0.5F	22.28 M-SF-F/Blu 22.28 hr SE E/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 ///-SF-F/Blu 2.22 br SE E/Btu	0 Btu/hr-F	0.5F	0.5F	0.5F	0.5F	0.5F	0.5F
South	0.SF	0 SF	0%	0 SF	0.5F	22.28 hr-SE-E/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
East	3,226 SF	376 SF	43%	0 SF	2,850 SF	22.28 hr-SF-F/Btu	128 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	113 Btu/hr-F	162 SF	0 SF	0 SF	0 SF	376 SF	0 SF
East	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
East	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
East	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
East	0 SF	0 SF	0%	U SF	0 SF	22.28 nr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/nr-F	0 5F	U SF	0 SF	U SF	U SF	0.5F
West	3,021 SF	034 SF	21%	0 SF	2,107 SF	22.20 III-3F-F/Blu 22.28 hr-SE-E/Btu	0 Btu/hr-F	1.00 hr-SF-F/Blu	0 Btu/hr-F	3.33 hr-SE-F/Btu	230 Blu/III-F	225 SF	0 SF	034 SF	0 SF	0 SF	0.5F
West	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SE-E/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
West	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
West	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
North	5,857 SF	1,399 SF	25%	0 SF	4,458 SF	22.28 hr-SF-F/Btu	200 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	420 Btu/hr-F	350 SF	0 SF	0 SF	1,399 SF	0 SF	0 SF
North	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
North	0 SF	0 SF	0%	U SF	U SF	22.28 nr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0.5F	U SF	USF	0 5F	U SF	0.5F
North	0.SF	0 SF	0%	0.SF	0.SF	22.20 III-31 -I /Dtu 22.28 hr-SE-E/Btu	0 Btu/hr-F	1.00 hr-SE-E/Btu	0 Btu/hr-F	3.33 hr-SE-E/Btu	0 Btu/hr-F	0.SE	0.SF	0.SF	0.SF	0.SF	0.SF
North	0 SF	0 SF	0%	0 SF	0 SF	22.28 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
Horizontal	1,082 SF	0 SF	0%	0 SF	1,082 SF	38.64 hr-SF-F/Btu	28 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
Horizontal	2,690 SF	0 SF	0%	0 SF	2,690 SF	38.64 hr-SF-F/Btu	70 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
Horizontal	2,640 SF	0 SF	0%	0 SF	2,640 SF	38.64 hr-SF-F/Btu	68 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
Horizontal	380 SF	0 SF	0%	0 SF	380 SF	38.64 hr-SF-F/Btu	10 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
Horizontal	1 456 SE	0 SF	0%	0 SF 0 SF	220 SF 1 456 SE	38.64 hr-SF-F/Btu 38.64 hr-SE-E/Btu	38 Btu/hr-F	1.00 hr-SF-F/Btu 1.00 hr-SE-F/Btu	0 Btu/hr-F	3.33 hr-SF-F/Btu 3.33 hr-SF-F/Btu	0 Btu/hr-F	0.SF	0 SF	0 SF	0 SF	0.SF	0.SF
TOTAL	26,199 SF	3.787 SF	070	240 SF	22.172 SF	50.04 m-61 47 Did	834 Btu/hr-F	1.00 11-01 -1 /2/4	240 Btu/hr-F	0.00 11-01 -1751	1.137 Btu/hr-F	1.114 SF	1.178 SF	834 SF	1.399 SF	376 SF	0 SF
	20,100 01	0,101.01		2.0 01	22,2 01		001 544.114		210 210/114		.,	,,	.,	00.01	.,		0.01
MAIN AREA	A AIR VOLUM	E & INFILTR	ATION														
Average Ceilin	ng Height		8.0 ft														
Conditioned A	Air Volume		252,544 CF														
Infiltration Rat	te		0.10 A.C.H														
L	JA_Inmitration		454.6 Btu/nr-F														



Level 2 Case Study - Building Enclosure Heat Transfer

SubArea 1	Relation to Main Area		Floor Area	Commercial 4.078 SF	UA_subArea_1	1,729 Btu/hr-F 136 Btu/hr-F										
Sub Area 4						100 544111 1										
Condition	HEAT LUSS RATE TO TH	IE GROUND P	Length	Transfer Rate	UA_perimeter											
1 2	Basement (uninsulated)		257.0 Ft 0.0 Ft	1.07 Btu/hr-ft-F 0.00 Btu/hr-ft-F	275 Btu/hr-F 0 Btu/hr-F											
Total			257.0 Ft		275 Btu/hr-F											
SubArea 1	ENCLOSURE HEAT TRA	NSFER RATE		Opaque	Enclosure Calcul	ations	Door Calcu	llations	Windo	w Calculations	Operable	Win	idow Area	for Each C	rientation	1
Orientation	Gross F Surface Area Window Area	ercent Operable Windows	Door Area	Net Enclosure I Surface Area	Enclosure Surface R- Value	UA enclosure Surface	Door R Value	UA Door	Window R Value	UA Window	Window	South	West	North	East	Horizontal
South West	514 SF 0 SF 1.851 SF 453 SF	0%	0 SF 0 SF	514 SF 1.398 SE	13.00 hr-SF-F/Btu 13.00 hr-SF-F/Btu	40 Btu/hr-F 108 Btu/hr-F	1.00 hr-SF-F/Btu 1.00 hr-SF-F/Btu	0 Btu/hr-F 0 Btu/hr-F	1.79 hr-SF-F/Btu 1.79 hr-SF-F/Btu	0 Btu/hr-F 253 Btu/hr-F	0 SF 0 SF	0 SF 0 SF	0 SF 453 SF	0 SF 0 SF	0 SF 0 SF	0 SF 0 SF
North	2,526 SF 1,103 SF	0%	0 SF	1,423 SF	13.00 hr-SF-F/Btu	109 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	1.79 hr-SF-F/Btu	616 Btu/hr-F	0 SF	0 SF	0 SF	1,103 SF	0 SF	0 SF
Horizontal	845 SF 0 SF	0%	148 SF 0 SF	397 SF 845 SF	30.00 hr-SF-F/Btu	28 Btu/hr-F	1.00 hr-SF-F/Btu 1.00 hr-SF-F/Btu	0 Btu/hr-F	1.79 hr-SF-F/Btu 1.79 hr-SF-F/Btu	40 Btu/hr-F 0 Btu/hr-F	0 SF 0 SF	0 SF 0 SF	0 SF 0 SF	0 SF 0 SF	0 SF	0 SF 0 SF
TOTAL	6,352 SF 1,627 SF		148 SF	4,577 SF		315 Btu/hr-F		148 Btu/hr-F		909 Btu/hr-F	0 SF	0 SF	453 SF	1,103 SF	71 SF	0 SF
COMMON	WALL BETWEEN SubArea	1 & Main Area	a				Door Calcu	lations	Window	w Calculations		Wir	dow Area	for Each C	rientation	1
	Gross P	ercent Operable		Net Enclosure	Enclosure Surface R	UA enclosure					Operable Window	South	West	North	East	Horizontal
Orientation	Surface Area Window Area	Windows	Door Area	A 078 SE	Value	Surface 136 Btu/br-F	Door R Value	UA Door	Window R Value	UA Window	Area	0.SF	0 SE	0 SE	0 SE	0.SE
West	0 SF 0 SF	0%	0 SF	0 SF	1.00 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF	0 SF	0 SF	0 SF	0 SF
TOTAL	4,078 SF 0 SF	0%	0 SF	4,078 SF	1.00 nr-SF-F/Btu	136 Btu/hr-F	1.00 fir-SF-F/Btu	0 Btu/hr-F	1.00 hr-SF-F/Btu	0 Btu/hr-F	0 SF	0 SF 0 SF	0 SF	0 SF 0 SF	0 SF	0 SF
			1													
Average Ceil	ling Height	12.0 ft														
Infiltration Ra	ed Air Volume ate	45,324 CF 0.10 A.C.H														
	UA_infiltration	82 Btu/hr-F														
SubArea 2	Relation to Main Area			Parking Garage	UA_SubArea_2	5,720 Btu/hr-F										
SubArea 2	Relation to Main Area	ed	Floor Area	Parking Garage 1,296 SF	UA_SubArea_2 UA_Common_2	5,720 Btu/hr-F 130 Btu/hr-F										
SubArea 2 SubArea 2	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH	ed IE GROUND P	Floor Area	Parking Garage 1,296 SF TH OF PERIMETEI	UA_SubArea_2 UA_Common_2 R	5,720 Btu/hr-F 130 Btu/hr-F										
SubArea 2 SubArea 2 Condition	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH	ed IE GROUND P	Floor Area ER UNIT LENG	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate	UA_SubArea_2 UA_Common_2 R UA_perimeter	5,720 Btu/hr-F 130 Btu/hr-F										
SubArea 2 SubArea 2 Condition	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Stab-on-Grade Basement (uninsulated)	ed IE GROUND P	Floor Area ER UNIT LENG Length 0.0 Ft 155.0 Ft	Parking Garage 1,296 SF STH OF PERIMETEI Transfer Rate 0.00 Btu/hr-ft-F 1.07 Btu/hr-ft-F	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F	5,720 Btu/hr-F 130 Btu/hr-F										
SubArea 2 SubArea 2 Condition 2 Total	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Stab-on-Grade Basement (uninsulated)	ed IE GROUND P	Floor Area ER UNIT LENG Length 0.0 Ft 155.0 Ft 155.0 Ft	Parking Garage 1,296 SF STH OF PERIMETEI Transfer Rate 0.00 Btu/hr-ft-F 1.07 Btu/hr-ft-F	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F	5,720 Btu/hr-F 130 Btu/hr-F										
SubArea 2 SubArea 2 Condition 7 Total SubArea 2	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Slab-on-Grade Basement (uninsulated) ENCLOSURE HEAT TRA	ed IE GROUND P NSFER RATE	Floor Area ER UNIT LENG Length 0.0 Ft 155.0 Ft 155.0 Ft	Parking Garage 1,296 SF STH OF PERIMETEI Transfer Rate 0.00 Btu/mr-fr-F 1.07 Btu/mr-fr-F	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul	5,720 Btu/hr-F 130 Btu/hr-F ations	Door Calcu	lations	Window	w Calculations		Wir	ndow Area	for Each C	Prientation	1
SubArea 2 SubArea 2 Condition 2 Total SubArea 2	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Slab-on-Grade Besement (uninsulated) ENCLOSURE HEAT TRA Gross F	ed IE GROUND P NSFER RATE Percent Operable	Floor Area ER UNIT LENG Length 0.0 Ft 155.0 Ft 155.0 Ft	Parking Garage 1,296 SF STH OF PERIMETE 7 Transfer Rate 0.00 Buuhr-fr- 1.07 Btu/hr-fr- 1.07 Btu/hr-fr- Opaque Net Enclosure I	UA_SubArea_2 UA_Common_2 R UA_Perimeter 0 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R-	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure	Door Calcu	lations	Window	w Calculations	Operable Window	Win South	idow Area West	for Each C North	Prientation East	1 Horizontal
SubArea 2 SubArea 2 Condition 7 2 Total SubArea 2 Orientation South	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Slab-on-Grade Basement (uninsulated) ENCLOSURE HEAT TRA Gross I TATISE 0 SF	ed IE GROUND P NSFER RATE Percent Operable Windows	Floor Area ER UNIT LENG Length 0.0 Ft 155.0 Ft 155.0 Ft Door Area 0 SF	Parking Garage 1,296 SF BTH OF PERIMETEL Transfer Rate 0.00 Bluin-R-R- 1.07 Bluin-R-R- Opaque Net Enclosure Surface Area 1,731 SF	UA_SubArea_2 UA_Common_2 R UA_Perimeter 0 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr=F-Ff2tU	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3.462 Bu/hr-F	Door Calcu Door R Value	Ilations UA Door 0 Btu/hr:F	Window Window R Value	v Calculations	Operable Window Area 0 SF	Wir South 0 SF	idow Area West	for Each C North 0 SF	Drientation East 1	I Horizontal
SubArea 2 Condition 7 2 Total SubArea 2 Orientation South West	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Slab-on-Grade Basement (uninsulated) ENCLOSURE HEAT TRA Gross F Surface Area Window Area 1,731 SF 0	ed IE GROUND P NSFER RATE Percent Operable Windows 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Ft 155.0 Ft 0.5F 0.5F 0.5F	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate 0.00 Bturkreft- 1.07 Bturkreft- 1.07 Bturkreft- Opaque Net Enclosure Surface Area 1,731 SF 0 SF	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.59 hrsF-F8tu 1.00 hrsF-F8tu 1.00 hrsF-F8tu	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F	Door Calct Door R Value 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu	UA Door 0 Blu/hr-F 0 Blu/hr-F	Window Window R Value 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu 1.00 sF-F/Blu	w Calculations 0 Blumr-F 0 Blumr-F	Operable Window Area 0 SF 0 SF	Win South	odow Area West	for Each C North	Drientation East 1 0 SF 0 SF 0 SF	Horizontal
SubArea 2 Condition 7 Total SubArea 2 Orientation South West North East	Relation to Main Area Connected, Uncondition HEAT LOSS RATE TO TH Slab-on-Grade Besement (uninsulated) ENCLOSURE HEAT TRA Gross F SUTA32 SC 0 SF	IE GROUND P NSFER RATE Vercent Operable Windows 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 FI 155.0 Ft 155.0 Ft 155.0 Ft 155.0 Ft 200 SF 280 SF 280 SF	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate 0.00 Btu/hr-R-F 1.07 Btu/hr-R-F 0.07 Btu/hr-R-F 0.07 Btu/hr-R-F 0.07 Btu/hr-R-F 0.07 Btu/hr-R-F 0.05 SF 0.05 SF	UA_SubArea_2 UA_Common_2 B UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.59 hr-SF-#68tu 1.00 hr-SF-#68tu 0.50 hr-SF-#68tu 0.50 hr-SF-#68tu	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 1,812 Btu/hr-F	Door Calco Door R Value 1.00 hr-SF-FBlu 1.00 hr-SF-FBtu 1.00 hr-SF-FBtu 1.00 hr-SF-FBtu	UA Door 0 Blu/hr-F 0 Blu/hr-F 200 Blu/hr-F 200 Blu/hr-F	Window R Value 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu	v Calculations 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF	Win South 0 SF 0 SF 0 SF 0 SF	dow Area West 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF	Prientation East 0 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 2 Total SubArea 2 Orientation South West North East Horizontal	Relation to Main Area Connected, Uncondition Connected, Uncondition PHEAT LOSS RATE TO THE Stab-on-Grade Basement (uninsulated) PENCLOSURE HEAT TRA Gross F Strace Area Window Area 1,731 SF 0 SF 0 SF 0 SF	ad IE GROUND P NSFER RATE Percent Operable Windows 0% 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 0 SF 280 SF 280 SF 280 SF	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate 0.00 Bturkrr.Rr.F 1.07 Bturkrr.Rr.F Opaque Net Enclosure Surface Area 1,731 SF 0 SF 906 SF 0 SF 0 SF 2,637 SF	UA_SubArea_2 UA_Common_2 B UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-#68tu 1.00 hr-SF-#68tu 0.50 hr-SF-#68tu 1.00 hr-SF-#68tu	5,720 Btu/hr-F 130 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F	Door Calct Door R Value 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu	UA Door 0 Blu/hr-F 0 Blu/hr-F 200 Blu/hr-F 200 Blu/hr-F 200 Blu/hr-F 200 Blu/hr-F	Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu	v Calculations O Blum-F O Blum-F O Blum-F O Blum-F O Blum-F O Blum-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Wir South 0 SF	Idow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Drientation East 1 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 Total SubArea 2 Orientation South West North East Horizontal	Relation to Main Area Connected, Uncondition Connected, Uncondition HEAT LOSS RATE TO TH Stab-on-Grade Basement (uninsulated) ENCLOSURE HEAT TRA Gross F 1,731 SF 0 SF 0 SF 0 SF	ad IE GROUND P NSFER RATE Percent Operable Windows 0% 0% 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 0 SF 280 SF 280 SF	Parking Garage 1,296 SF TH OF PERIMETEI Transfer Rate 0.00 Bturkreft- 1.07 Bturkreft- Opaque Net Enclosure Surface Area 1,731 SF 0 SF 906 SF 0 SF 2,637 SF	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-#68tu 1.00 hr-SF-#68tu 0.50 hr-SF-#68tu 1.00 hr-SF-#68tu 0.50 hr-SF-#68tu 0.50 hr-SF-#68tu	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F	Door Calct Door R Value 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu	UA Door 0 Blu/hr-F 0 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F	Window R Value 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu 1.00 hr:SF-F/Blu Windou	v Calculations 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Win South 0 SF	udow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF for Each C	Drientation East 0 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 2 Total SubArea 2 Orientation South West North East Horizontal TOTAL	Relation to Main Area Connected, Uncondition Connected, Uncondition HEAT LOSS RATE TO TH Stab-on-Grade Basement (uninsulated) ENCLOSURE HEAT TRA Gross F 1,731 SF 0 SF 0 SF 0 SF	ad IE GROUND P NSFER RATE Vercent Operable Windows 0% 0% 0% 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 280 SF 280 SF 280 SF	Parking Garage 1,296 SF TH OF PERIMETEI Transfer Rate 0.00 Bturkreft- 1.07 Bturkreft- Opaque Net Enclosure Surface Area 1,731 SF 0 SF 906 SF 0 SF 2,637 SF	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-#68tu 1.00 hr-SF-#68tu 0.50 hr-SF-#68tu 1.00 hr-SF-#68tu 0.50 hr-SF-#68tu 0.50 hr-SF-#68tu	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F	Door Calct 1.00 hr-SF-FBtu 1.00 hr-SF-FBtu 1.00 hr-SF-FBtu 1.00 hr-SF-FBtu 1.00 hr-SF-FBtu 1.00 hr-SF-FJBtu	UA Door 0 Blu/hr-F 0 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F lations	Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu Windor	v Calculations 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Wir South O SF O SF O SF O SF O SF O SF O SF O SF	dow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF for Each C	Prientation East 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 2 Total SubArea 2 Orientation South West North East Horizontal COMMON	Relation to Main Area Connected, Uncondition Connected, Uncondition PHEAT LOSS RATE TO THE Stab-on-Grade Basement (uninsulated) Stab-on-Grade Basement (uninsulated) PENCLOSURE HEAT TRA Gross F 1,731 SF 0 SF 0 SF 0 SF	ad IE GROUND P NSFER RATE Percent Operable Windows 0% 0% 0% 0% 2 & Main Area Vercent Operable Windows	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 280 SF 280 SF 280 SF 280 SF	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate 0.00 Bturkreft- 1.07 Bturkreft- 1.07 Bturkreft- Opaque Net Enclosure Surface Area 1,731 SF 0 SF 0 SF 2,637 SF Net Enclosure Surface Area	UA_SubArea_2 UA_Common_2 R UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-/78tu 1.00 hr-SF-/78tu 0.50 hr-SF-/78tu 1.00 hr-SF-/78tu 0.50 hr-SF-/78tu 0.50 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu 1.00 hr-SF-/78tu	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F 5,274 Btu/hr-F	Door Calct Door R Value 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu Door SF-F/Blu Door Calct	UA Door O Blum-F O Blum-F 280 Blum-F 280 Blum-F 280 Blum-F 280 Blum-F Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacobian Jacob	Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu Window R Value	v Calculations O Blumr-F O Blumr-F O Blumr-F O Blumr-F O Blumr-F O Blumr-F v Calculations UA Window	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Wir South OSF OSF OSF OSF OSF OSF Wir South	dow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF for Each C North	Drientation East 1 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF rrientation East 1	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 2 Total SubArea 2 Orientation South West Horizontal COMMON Corientation	Relation to Main Area Connected, Uncondition Connected, Uncondition PHEAT LOSS RATE TO THE Stab-on-Grade Basement (uninsulated) Stab-on-Grade Basement (uninsulated) PENCLOSURE HEAT TRA Gross F 1,731 SF 0 SF 0 SF 0 SF Surface Area Window Area 1,295 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	ad IE GROUND P NSFER RATE Percent Operable Windows 0% 0% 0% 0% 2 & Main Area Vercent Operable Windows 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 280 SF 280 SF 280 SF 280 SF 280 SF 0	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate 0.00 Bturkrr.R-F 1.07 Bturkr.R-F 1.07 Bturkr.R-F 0.05F 0.5F 0.5F 2,637 SF Net Enclosure Surface Area 1,296 SF 0.5F 0.5F 0.5F 0.5F	UA_SubArea_2 UA_Common_2 B UA_perimeter 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-F6Btu 1.00 hr-SF-F6Btu 0.50 hr-SF-F6Btu 1.00 hr-SF-F6Btu 0.50 hr-SF-F6Btu 1.00 hr-SF-F6Btu 1.00 hr-SF-F6Btu 1.00 hr-SF-F6Btu 1.00 hr-SF-F6Btu 1.00 hr-SF-F6Btu	5,720 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 1,812 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F UA enclosure Surface Surface 130 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F 0 Btu/hr-F	Door Calct 1.00 hr-SF-FBlu 1.00 hr-SF-FBlu 1.00 hr-SF-FBlu 1.00 hr-SF-FBlu 1.00 hr-SF-FBlu Door Calct Door R Value 1.00 hr-SF-FBlu	UA Door O Blum-F O Blum-F 280 Blum-F 280 Blum-F 280 Blum-F 280 Blum-F UA Door O Blum-F O Blum-F	Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu Window Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu	v Calculations 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F 0 Blumr-F v Calculations UA Window 0 Blumr-F 0 Blumr-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF Operable Window Area 0 SF	Wir South OSF OSF OSF OSF OSF Wir South OSF	dow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF for Each C North 0 SF	Drientation East 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 2 Total SubArea 2 Orientation South West North East Horizontal COMMON Orientation Horizontal Orientation	Relation to Main Area Connected, Uncondition Connected, Uncondition Particle Area Stab-on-Grade Basement (uninsulated) Particle Area (Uncondition) Cross F 1.731 SF 0 SF 0 SF 0 SF	ad IE GROUND P NSFER RATE Percent Operable Windows 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 280 SF 280 SF 280 SF 280 SF 0	Parking Garage 1,296 SF STH OF PERIMETELI Transfer Rate 0.00 Bturkr.R.F. 1.07 Bturkr.R.F. Opaque Net Enclosure Surface Area 1,73 SF 0 SF 906 SF 0 SF 2,637 SF Net Enclosure Surface Area 1,296 SF 0 SF	UA_SubArea_2 UA_Common_2 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-F8tu 1.00 hr-SF-F8tu	5,720 Btu/hr-F 130 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 5,274 Btu/hr-F UA enclosure Surface 130 Btu/hr-F 130 Btu/hr-F 130 Btu/hr-F	Door Calct 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu Door Calct Door R Value 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu	UA Door 0 Blu/hr-F 0 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F 1ations UA Door 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F	Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu Window Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu	v Calculations 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F v Calculations UA Window 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Wir South OSF OSF OSF OSF OSF Wir South OSF OSF OSF	dow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF for Each C North 0 SF 0 SF	Drientation East 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
SubArea 2 Condition 7 2 Total SubArea 2 SubArea 2 Orientation South West North East Horizontal COMMON Orientation Horizontal West North Horizontal Orientation	Relation to Main Area Connected, Uncondition Connected, Uncondition Particle Area Stab-on-Grade Basement (uninsulated) Particle Area (Uncondition) Cross F 1.731 SF 0 SF 0 SF<	ad IE GROUND P NSFER RATE Percent Operable Windows 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0%	Floor Area ER UNIT LENG Length 0.0 Fl 155.0 Fl 155.0 Fl 0 SF 0 SF 0 SF 280 SF 280 SF 280 SF 280 SF 0	Parking Garage 1,296 SF TH OF PERIMETEL Transfer Rate 0.00 Bturkref.F 1.07 Bturkref.F 1.07 Bturkref.F 0 Opaque Net Enclosure Surface Area 1,731 SF 0 SF 0 SF 2,637 SF Net Enclosure Surface Area 1,296 SF 0 S	UA_SubArea_2 UA_Common_2 0 Btu/hr-F 166 Btu/hr-F 166 Btu/hr-F Enclosure Calcul Enclosure Surface R- Value 0.50 hr-SF-F/8tu 1.00 hr-SF-F/8tu 0.50 hr-SF-F/8tu 1.00 hr-SF-F/8tu 1.00 hr-SF-F/8tu 1.00 hr-SF-F/8tu 1.00 hr-SF-F/8tu 1.00 hr-SF-F/8tu 1.00 hr-SF-F/8tu	5,720 Btu/hr-F 130 Btu/hr-F 130 Btu/hr-F ations UA enclosure Surface 3,462 Btu/hr-F 0 Btu/hr-F 1,812 Btu/hr-F 5,274 Btu/hr-F 5,274 Btu/hr-F 0 Btu/hr-F 130 Btu/hr-F 130 Btu/hr-F 130 Btu/hr-F	Door Calct 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu Door Calct Door R Value 1.00 hr-SF-F/Blu 1.00 hr-SF-F/Blu	UA Door 0 Blu/hr-F 0 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F 280 Blu/hr-F 1ations UA Door 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F 0 Blu/hr-F	Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu Window Window R Value 1.00 hr:SF-FBlu 1.00 hr:SF-FBlu	v Calculations 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F v Calculations UA Window 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F 0 Btu/hr-F	Operable Window Area 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Wir South OSF OSF OSF OSF Wir South OSF OSF OSF OSF	dow Area West 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF for Each C North 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Drientation East 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF	Horizontal 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF 0 SF
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Level 2 Case Study - Lights

LIHI Denny Park Apartment	ts
Runberg Architecture Group	
Seattle	Washington

	LIGHTING Main E	Building Area	Residential		
Luminaire	Power per Lamp	Lamp/Luminaire	# Luminaires	Installed Power	Control
R	18 W	54	1	972 W	Manual
н	64 W	47	2	6,016 W	Occupant Sensor
G	62 W	10	1	620 W	Manual
F	32 W	1	1	32 W	Daylight
N	15 W	30	1	450 W	Daylight
J	62 W	28	2	3,472 W	Daylight
А	28 W	7	1	196 W	Occupant Sensor
D	18 W	74	1	1,332 W	Occupant Sensor
С	18 W	118	1	2.124 W	Manua
В	18 W	55	1	990 W	Manua
Ē	20 W	55	2	2.200 W	Manua
к <u>т</u>	18 W	50	1	900 W	Manua
F	18 W	8	1	144 W	Manua
L K	60 W	2	1	120 W	Manua
IX.	0.14/	2		120 W	Manua
	0 14	0	0	0.00	Manua
	0 10	0	0	0 00	Manua
	0 10	0	0	0.00	ivianua
	00	0	0	0 W	Manua
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	0 W	0	0	0 W 0	Occupant Sensor
	0 W	0	0	0 W 0	Exit alwavs on
otal Installed I	ights. Main Area			19.568 W	
NSTALLED I	IGHTING SubAr	'oa 1	Commercial		
Luminairo	Bower per Lamp	Lamp/Luminairo	# Luminairos	Installed Bower	Control
Lummane					Manua
	0 14	0	0	0.00	Manual
	0 10	0	0	0 00	Manual
	0 11	0	0	0 00	Manual
				0 W 0	
otal - Lights in	Sub Area 1				
otal - Lights in	Sub Area 1 _IGHTING SubAr	rea2 Pai	king Garage		
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Level 2 Case Study - HVAC and Service Hot Water Systems

LIHI Denny	Park Apartments	T			
Runberg Arch	itecture Group				
Seattle	Washington	L			
HVAC	Ventilation Fans				
Main Build	ing Area	Residential			
Supply Fans	Function	Max. Air Flow	Constant Volume, Variable or VFD	Motor HP	Motor Watts
FC-1 FC-2	Corridor Level 2 Corridor Level 3	400 cfm 400 cfm	Constant Volume Constant Volume	0.50 Hp 0.50 Hp	373 W 373 W
FC-3 FC-4	Corridor Level 4	400 cfm	Constant Volume	0.50 Hp	373 W
FC-5	Corridor Level 6	400 cfm	Constant Volume	0.50 Hp	373 W
Total Installe	d Supply Fan CFM & Power	2,000 cfm	Complex Forme Mant	2.50 Hp	1,864 W
			Supply Fans Volu	me Flow Efficiency	1.1 cfm/W
Exhaust			Control: Constant		
Fans	Function	Max. Air Flow	Variable or VFD	Motor HP	Motor Watts
EF-1 EF-2	Studio & 1 Bedroom Studio Baths (37) 2 bedroom Baths (8)	1,850 cfm 720 cfm	Constant Volume	2.73 Hp 0.54 Hp	2,036 W
EF-3	3 Bedroom Baths (5)	500 cfm	Constant Volume	0.60 Hp	447 W
EF-4 EF-5	Level P1 LP Garage	4,500 cfm 9,500 cfm	Variable Speed	1.50 Hp 3.00 Hp	2,237 W
EF-6	Attic Corridor Exhaust	250 cfm	Constant Volume	1.00 Hp	746 W
EF-8	Level P1 Elevator machine Room	750 cfm	Constant Volume	0.17 Hp	124 W
EF-9 EPE-1	Boiler Room Exhaust Elevator Pressurization	326 cfm 0 cfm	Constant Volume Constant Volume	0.14 Hp 0.00 Hp	107 W
HB-1	Typical Kitchen (.17 HP x 50)	2,500 cfm	Variable Speed	8.33 Hp	6,212 W
Total Installe	d Exhaust Fan CFM & Power	21,996 cfm	Fultanet Fana Maat	18.18 Hp	13,554 W
			Exhaust Fans Heat	Transfer Efficiency	1.8 Btu/nr-F-W
Main Area	Installed Fan CFM & Power	23.996 cfm	Exhidust I diis Void	20.68 Hp	15.418 W
		,	All Fans Heat	Transfer Efficiency	1.7 Btu/hr-F-W
Main Area	Outdoor Air Supply		All Fans Volu	Ime Flow Efficiency	1.6 cfm/W
	Outdoor Air Ventilation Rate	2,000 cfm			
FANS - Sub	Area 1	Commercial			
Supply			Constant Volume.		
Fans	Function	Max. Air Flow	Variable or VFD	Motor HP	Motor watts
		0 cfm	Constant Volume	0.00 Hp	0 W
Iotal Installe	d Supply Fan CFM & Power	UCTM	Supply Fans Heat	Transfer Efficiency	0.0 Btu/hr-F-W
			Supply Fans Volu	me Flow Efficiency	0.0 cfm/W
Exhaust Fans	Function	Max. Air Flow	Control: Constant, Variable or VFD	Motor HP	Motor Watts
		0 cfm 0 cfm	Constant Volume	0.00 Hp 0.00 Hp	0 W
Total Installe	d Exhaust Fan CFM & Power	0 cfm	Exhaust Fans Heat	0.00 Hp Transfer Efficiency	0 W 0.0 Btu/br-F-W
			Exhaust Fans Volu	me Flow Efficiency	0.0 cfm/W
SubArea 1	Installed Fan CFM & Power	0 cfm	All Eans Heat	0.00 Hp	0 W
SubArea 1	SubArea 1 Outdoor Air Supply			ime Flow Efficiency	0.0 cfm/W
	Outdoor Air Ventilation Rate	0 cfm			
FANS - Sub	Fraction of Supply Air that is Outdoor Air	arking Garage			
Currely Ford	Function 1	Man Ais Flam	Constant Volume,	Matas	MataaWawa
Supply Paris	Function	0 cfm	Variable or VFD	0.00 Hp	0 W
		0 cfm	Constant Volume	0.00 Hp	0 W
Total Installe	d Supply Fan CFM & Power	0 cfm	Supply Fans Heat	0.00 Hp Transfer Efficiency	0 W 0.0 Btu/br-F-W
			Supply Fans Volu	me Flow Efficiency	0.0 cfm/W
Exhaust Fan	s Function	Max. Air Flow	Constant Volume, Variable or VFD	Motor HP	Motor Watts
		0 cfm 0 cfm	VFD Constant Volume	0.00 Hp	0 W 0 W
Total Installe	d Exhaust Fan CFM & Power	0 cfm	Constant Volume	0.00 Hp	0 W
			Exhaust Fans Heat	Transfer Efficiency	0.0 Btu/hr-F-W
SubArea 2	Installed Fan CFM & Power	0 cfm	Exhaust Fans Volu	0.00 Hp	0.0 Cim/W 0 W
	• •		All Fans Heat	Transfer Efficiency	0.0 Btu/hr-F-W
SubArea 2	Outdoor Air Supply		All Fans Volu	Ime Flow Efficiency	0.0 cfm/W
	Fraction of Supply Air that is Outdoor Air	0 Cfm			
FANS - Tot	al Building				
	Supply Fans CFM	2,000 cfm		Supply Fans Power	1,864 W
1			Supply Fans Heat Supply Fans Volu	inanster Efficiency ime Flow Efficiency	1.2 Btu/hr-F-W 1.1 cfm/W
	Exhaust Fans CFM	21,996 cfm	E	xhaust Fans Power	13,554 W
			Supply Fans Heat Supply Fans Volu	Transfer Efficiency	1.8 Btu/hr-F-W 1.6 cfm/W
Total Build	ing Installed Fan CFM & Power	23,996 cfm			15,418 W
Total Duild	ing Outdoor Air Supply		All Fans Heat	Transfer Efficiency	1.7 Btu/hr-F-W
rotal Build	Outdoor Air Supply	2,000 cfm	All Fans Volu	Ime Flow Efficiency	1.6 cfm/W
	Fraction of Supply Air that is Outdoor Air	100%			
Fan Charao	cteristics		Flow Rate	Motor Watts	Flow Efficienncy
1	Consta Variable Freque	ency Drive Fans	6,370 cfm 0 cfm	4,999 W 0 W	1.3 cfm/W 0.0 cfm/W
1	Varia	ble Speed Fans	16,500 cfm	9,567 W	1.7 cfm/W
CMD Cose Shut	her.	All Fans	22,870 cfm	14,566 W	1.6 cfm/W

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Level 2 Case Study - HVAC and Service Hot Water Systems

HVAC	Pumps				
Main Buildi	ng Area	Residential			
Line Pumps	Function	Flow Rate	Control	Motor HP	Motor Watts
BP-1	Boiler B-1	25.0 gpm	Constant	0.75 Hp	559 W
BP-2	Boiler B-2	25.0 gpm	Constant	0.75 Hp	559 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0.00
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
		0.0 gpm	Constant	0.00 Hp	0 W
Total Line Put	mps	50.0 gpm		1.50 Hp	1,119 W
			Pump He	at Transfer Efficiency	22.4 Btu/hr-F-W
Redundant (le	ad/lag) Pumps		Pump Vo	olume Flow Efficiency	0.04 gpm/W
Redundant (it		0.0 gpm	VFD	0.00 Hp	0 W
		0.0 gpm	VFD	0.00 Hp	0 W
Total - Redun	dant Pumps	0.0 gpm		0.00 Hp	0 W
Total - Main B	uilding Area Pumps	50.0 gpm		1.50 Hp	1,119 W
PUMPS - Su	JbArea 1	Commercial			
Line Pumps	Function	Flow Rate	Control	Motor HP	Motor Watt
		0.0 apm	VFD	0.00 Hp	0 W
		0.0 gpm	VFD	0.00 Hp	0 W
Total Line Pu	nps	0.0 gpm		0.00 Hp	0 W
		-	Pump He	at Transfer Efficiency	0.0 Btu/hr-F-W
			Pump Vo	olume Flow Efficiency	0.00 gpm/W
Redundant (le	ad/lag) Pumps				
		0.0 gpm	VFD	0.00 Hp	0 W
		0.0 gpm	VFD	0.00 Hp	0 W
Total - Redun	dant Pumps	0.0 gpm		0.00 Hp	0 W
Total - SubAre	ea1 Pumps	0.0 gpm		0.00 Hp	0 W
PUMPS - Su	ubArea 2 P	arking Garage			
Line Pumps	Function	Flow Rate	Control	Motor HP	Motor Watt
		0.0 gpm	VFD	0.00 Hp	0 W
		0.0 gpm	VFD	0.00 Hp	0 W
Total Line Pu	mps	0.0 gpm		0.00 Hp	0 W
			Pump He	at Transfer Efficiency	0.0 Btu/hr-F-W
			Pump Vo	lume Flow Efficiency	0.00 gpm/W
Redundant (le	ead/lag) Pumps	0.0.		0.0011	
		0.0 gpm	VFD	0.00 Hp	0 W
Total - Reduc	dant Pumps	0.0 gpm	VFD	0.00 Hp	0.00
Total- SubArea2 Pumps 0.0 gpm			0.00 Hp	0 W	
PUMPS - To	tal Building	o.o gpin	Elow Rate	Motor Watte	Flow Efficienne
Line Pumpe		Constant Speed	50.0 cmm	1 110 W	0.04 gpm/M
Line i unips	Variable	Frequency Drive	0.0 gpm	1,119 W	0.04 gpm/M
	Vallable	Variable Spood	0.0 gpm	0 W	0.00 gpm/M
	Т	variable Speed	50.0 gpm	0 W	0.00 gpm/W
		and sume sumps	50.0 gpm	1,119 W	0.04 9011/14
Redundant Pu	umps		0.0 gpm	0 W	

Level 2 Case Study - HVAC and Service Hot Water Systems

HVAC	Providing Heat: Boilers, Furna	ces, Radiant & Electric H	leaters		
Main Buildi	ng Area	Residential			
Boiler	Function	Fuel	Rated Output	Input	Efficiency
B-1	Hydronic Baseboard Heat	Natural Gas	366 kBtu/hr	399 kBtu/hr	92%
B-2	Hydronic Baseboard Heat	Natural Gas	366 kBtu/nr 700 kBtu/hr	399 kBtu/nr	92%
Total Bollers	Eurotion	Fuel	732 KBtu/nr Pated Output	798 KBtu/nr	0.917293233
Fumace	Function	Fuei	0 kBtu/hr	0 kBtu/hr	0%
					0%
Total Furnaces			0 kBtu/hr	0 kBtu/hr	
Radiant Heate	Function	Fuel	Rated Output	Input	Efficiency
			0 kBtu/nr	0 kBtu/nr	0%
Total Radiant I	Jastara		0 kBtu/br	0 kBtu/br	0%
Flectric Heater	Function	Fuel	Rated Output	Input	Efficiency
			0 kBtu/hr	0 kBtu/hr	0%
					0%
Total Electric H	leaters		0 kBtu/hr	0 kBtu/hr	
Total - Main B	uilding Area Heat Production		732 kBtu/hr	798 kBtu/hr	92%
SubArea 1		Commercial			
Boiler	Function	Fuel	Rated Output	Input	Efficiency
			0 kBtu/hr	0 kBtu/hr	0%
T (al Dailars			0 liDhulha	0. liDhu/ha	0%
Total Boilers	Constitute a	Fuel	0 kBtu/nr	0 kBtu/nr	Efficiency
Furnace	Function	Fuel	Rated Output	0 kBtu/br	Efficiency
			0 KBlann	0 KD(a/m	0%
Total Furnaces	j		0 kBtu/hr	0 kBtu/hr	
Radiant Heate	r Function	Fuel	Rated Output	Input	Efficiency
			0 kBtu/hr	0 kBtu/hr	0%
					0%
Total Radiant H	leaters		0 kBtu/hr	0 kBtu/hr	
Electric Heater	Function	Fuel	Rated Output	Input	Efficiency
			U KDLU/III	U KDlu/III	0%
Total Electric H	leaters		0 kBtu/hr	0 kBtu/hr	
Total - SubArr	a 1 Heat Production		0 kBtu/hr	0 kBtu/hr	0%
SubArea 2		Parking Garag	ge		
Boiler	Function	Fuel	Rated Output	Input	Efficiency
Done			0 kBtu/hr	0 kBtu/hr	0%
					0%
Total Boilers			0 kBtu/hr	0 kBtu/hr	
Furnace	Function	Fuel	Rated Output	Input	Efficiency
			0 kBtu/hr	0 kBtu/hr	0%
Total Europeor			0 kBtu/br	0 kBtu/br	070
Rediant Heate	r Function	Fuel	Rated Output	Input	Efficiency
Naulant Hoato			0 kBtu/hr	0 kBtu/hr	0%
					0%
Total Radiant I	leaters		0 kBtu/hr	0 kBtu/hr	
Electric Heater	Function	Fuel	Rated Output	Input	Efficiency
			0 kBtu/hr	0 kBtu/hr	0%
			01.01.4	01.01 //	0%
Total Electric H	eaters		0 kBtu/nr	0 kBtu/nr	0%
Iotai - SubAre	a 2 Heat Production		0 KBtu/III	0 KBtu/III	0%
Total Buildi	ng Heat Production		Rated Output	Input	Efficiency
		Boilers	732 kBtu/hr	798 kBtu/hr	92%
		Furnaçõe	0 kBtu/br	0 kBtu/br	0%
		Fumaces	U KBIU/III	U KBIU/III	070
		Radiant Heaters	0 KBtu/nr	0 KBtu/nr	0%
		Electric Heaters	0 kBtu/hr	0 kBtu/hr	0%
1		Tetel	722 kB4u/ba	709 kD4u/ba	0.00/

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HVAC Data

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HVAC Data

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CARBON NEUTRAL DESIGN BUILDING CASE STUDY PROJECT The Society of Building Science Educators www.sbse.org

Level 2 Case Study - Building Design Variables

I IHI Donny Park Ana	rtmonte	Basis of Analysis Gross Measured Area			
Punbarg Arabitacture Croup		Dasis of Analysis Gross Measured A			
Runberg Architecture	Gloup	Parking Garage Included in Analysis? No			
Renewable Resource	e Variables per Gross	s Measured Area	IP Units	Metric Units	
Solar PV Density			0.00 Wpeak/SF	0.0 Wpeak/m ²	
Wind Electric Density			0.00 Wpeak/SF	0.0 Wpeak/m ²	
Solar Thermal Density			0.000 SF/SF	0.000 m^2/m^2	
Building Enclosure	/ariables per Gross I	leasured Area	IP Units	Metric Units	
Enclosure Area per Gross Measured Area		Total Building	0.91 SF/SF	0.91 m^2/m^2	
	Main Area	Residential	0.78 SF/SF	0.78 m^2/m^2	
	SubArea 1	Commercial	1.56 SF/SF	1.56 m^2/m^2	
	SubArea 2	Parking Garage	2.25 SF/SF	2.25 m^2/m^2	
Heat Transfer Rate per	Gross Measured Area	Total Building	0.12 Btu/hr-sf-°F	0.66 W/m^2-°C	
	Main Area	Residential	0.08 Btu/hr-sf-°F	0.45 W/m^2-°C	
	SubArea 1	Commercial	0.42 Btu/hr-sf-°F	2.41 W/m^2-°C	
	SubArea 2	Parking Garage	4.41 Btu/hr-st-°F	25.06 W/m^2-°C	
Illumination Variable	s per Gross Measure	ed Area	IP Units	Metric Units	
Lighting Power Density	y	Total	0.503 Watt/SF	5.41 Watt/m^2	
	Main Area	Residential	0.583 Watt/SF	6.28 Watt/m^2	
	SubArea 1	Commercial Deriving Corese	0.000 Watt/SF	0.00 Watt/m ²	
	SubArea 2	Parking Garage	0.000 Wall/SF	0.00 Wall/III^2	
Building Glazing per G	ross measured Area	Main Area	Subarea 1	Subarea 2	
Cauth	Iotal Building	Residential	Commercial	Parking Garage	
South	3.0%	3.5%	0.0%	0.0%	
North	6.4%	1.176	27.0%	0.0%	
West	3.3%	2.5%	27.0%	0.0%	
Horizontal	0.0%	0.0%	0.0%	0.0%	
Total Glazing	13.9%	11.3%	39.9%	0.0%	
Ventilation Variables	per Gross Measured	l Area	IP Units	Metric Units	
Operable Window Area	,	Total	2.9%	2.9%	
	Main Area	Residential	3.3%	3.3%	
	SubArea 1	Commercial	0.0%	0.0%	
	SubArea 2	Parking Garage	0.0%	0.0%	
Outdoor Air Ventilation	Rate	Total	0.05 cfm/SF	0.26 l/s-m^2	
	Main Area	Residential	0.06 cfm/SF	0.30 l/s-m^2	
	SubArea 1	Commercial	0.00 cfm/SF	0.00 l/s-m^2	
Cummles Ain Ventiletien	SubArea 2	Parking Garage	0.00 cfm/SF	0.00 l/s-m^2	
Supply Air ventilation	Lapacity Main Area	Desidential	0.05 cfm/SF	0.20 I/S-m^2	
	SubArea 1	Commercial	0.00 cfm/SF	0.30 l/s-m^2	
	SubArea 2	Parking Garage	0.00 cfm/SF	0.00 l/s-m^2	
		r anning barage	0.00 0.000	0.00 #0 #11 2	
Heating Capacities per Gross Measured		Area	IP Units	Metric Units	
Heating Capacity	Main Arres	Iotal	5.51 Watt/SF	59.3 W/m^2	
	Main Area	Commornial	6.39 Watt/SF	68.8 W/m/2	
	SubArea 1	Commercial Parking Carego	0.00 Watt/SF	0.0 W/m^2	
SubArea 2			6.01 Watt/SF	64.7 W/m^2	
ristanca Fowe	Main Area	Residential	6.97 Watt/SF	75.0 W/m^2	
	SubArea 1	Commercial	0.00 Watt/SF	0.0 W/m^2	
	SubArea 2	Parking Garage	0.00 Watt/SF	0.0 W/m^2	
-			•		

Level 2 Case Study - Building Design Variables

Cooling Capacities per Gross Measured	Area	IP Units	Metric Units
Cooling Capacity	Total	0 SF/Ton	0.0 m^2/kW
Main Area	Residential	0 SF/Ton	0.0 m^2/kW
SubArea	Commercial	0 SF/Ton	0.0 m^2/kW
SubArea	2 Parking Garage	0 SF/Ton	0.0 m^2/kW
Installed Power	Total	0.00 Watt/SF	0.0 W/m^2
Main Area	Residential	0.00 Watt/SF	0.0 W/m^2
SubArea	Commercial	0.00 Watt/SF	0.0 W/m^2
SubArea	2 Parking Garage	0.00 Watt/SF	0.0 W/m^2
Fan Efficiencies per Gross Measured Ar	ea	IP Units	Metric Units
Fan Power Density (supply & exhaust)	Total	0.40 Watt/SF	4.26 Watt/m^2
Main Area	Residential	0.46 Watt/SF	4.95 Watt/m^2
SubArea	Commercial	0.00 Watt/SF	0.00 Watt/m^2
SubArea	Parking Garage	0.00 Watt/SF	0.00 Watt/m^2
Fan Volume Flow Efficiency	Total	1.6 cfm/W	0.73 Liter/s/W
- Main Area	Residential	1.6 cfm/W	0.73 Liter/s/W
SubArea	Commercial	0.0 cfm/W	0.00 Liter/s/W
SubArea	Parking Garage	0.0 cfm/W	0.00 Liter/s/W
Fan Thermal Transfer Efficiency	Total	1.7 Btu/hr-°F-W	3.19 kJ/hr-°C-W
Main Area	Residential	1.7 Btu/hr-°F-W	3.19 kJ/hr-°C-W
SubArea	Commercial	0.0 Btu/hr-°F-W	0.00 kJ/hr-°C-W
SubArea	Parking Garage	0.0 Btu/hr-°F-W	0.00 kJ/hr-°C-W
Fan Characteristics	Flow Rate	Motor Watts	Flow Efficienncy
Constant Volume Fans	6.370 cfm	4,999 W	1.3 cfm/W
Variable Frequency Drive Fans	0 cfm	0 W	0.0 cfm/W
Variable Speed Fans	16,500 cfm	9,567 W	1.7 cfm/W
	-	•	
Pump Efficiencies per Gross Measured	Area	IP Units	Metric Units
Pump Power Density	Total	0.03 Watt/SF	0.31 Watt/m^2
Main Area	Residential	0.03 Watt/SF	0.36 Watt/m^2
SubArea	Commercial	0.00 Watt/SF	0.00 Watt/m^2
SubArea	2 Parking Garage	0.00 Watt/SF	0.00 Watt/m^2
Pump Volume Flow Efficiency	Total	0.04 gpm/W	0.00 Liter/s/W
Main Area	Residential	0.04 gpm/W	0.00 Liter/s/W
SubArea	Commercial	0.00 gpm/W	0.00 Liter/s/W
SubArea	2 Parking Garage	0.00 gpm/W	0.00 Liter/s/W
Pump Thermal Transfer Efficiency	Total	22.4 Btu/hr-°F-W	42.48 kJ/hr-°C-W
Main Area	Residential	22.4 Btu/hr-°F-W	42.48 kJ/hr-°C-W
SubArea	Commercial	0.0 Btu/hr-°F-W	0.00 kJ/hr-°C-W
SubArea	2 Parking Garage	0.0 Btu/hr-°F-W	0.00 kJ/hr-°C-W
Pump Characteristics	Flow Rate	Motor Watts	Flow Efficienncy
Constant FlowPumps	50.0 gpm	1,119 W	0.04 gpm/W
Variable Frequency Drive Pumps	0.0 gpm	0 W	0.00 gpm/W
Variable Speed Pumps	0.0 gpm	ow	0.00 apm/W

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Level 2 Metrics

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Level 2 Metrics

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Level 2 Case Study - Building Design Variables

Plug Load Power per Gross Measured Area		IP Units	Metric Units
	Total	0.00 Watt/SF	0.00 Watt/m^2
Main Area	Residential	0.00 Watt/SF	0.00 Watt/m^2
SubArea ²	I Commercial	0.00 Watt/SF	0.00 Watt/m^2
SubArea 2	2 Parking Garage	0.00 Watt/SF	0.00 Watt/m^2
Elevator & Escalator Power per Gross M	IP Units	Metric Units	
	Total	0.00 Watt/SF	0.00 Watt/m^2
Main Area	Residential	0.00 Watt/SF	0.00 Watt/m^2
SubArea 2	I Commercial	0.00 Watt/SF	0.00 Watt/m^2
SubArea 2	2 Parking Garage	0.00 Watt/SF	0.00 Watt/m^2
Description of Description of Course Management	4 4 4 4 4	10.11-24-	Made Halts
Process Load Power per Gross Measured Area		IP Units	Metric Units
	Total		0.00 Watt/m^2
Main Area	Residential	0.00 Watt/SF	0.00 Watt/m^2
SubArea 2	1 Commercial	0.00 Watt/SF	0.00 Watt/m^2
SubArea 2	2 Parking Garage	0.00 Watt/SF	0.00 Watt/m^2
Relayer Reint Fatimates		10.11-11-	
Balance Point Estimates		IP UNITS	Metric Units
Thermostat Settings Heating]	68.0 °F	20.0 °C
Cooling]	77.0 °F	25.0 °C
Internal Heat Generation based on Total Electric	49,777 BTU/hr	14,584 W	
		1.28 BTU/hr/SF	4.03 W/m^2
Building Balance Point Heating]	57.0 °F	13.9 °C
Cooling	3	66.0 °F	18.9 °C

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Level 2 Metrics

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Sources

Actual Utility Data used in analysis

Websites-High Performance Buildings Data Base

AIA COTE Top 10

acknowledgements

Student team (?)

