

MUKESH PARIKH RESIDENCE

305, S NEGLEY AVENUE, PITTSBURGH, PA

1.INTRODUCTION

Client name : Mukesh Parikh

Site area : 4427 sf

Climate : Humid Subtropical Climate

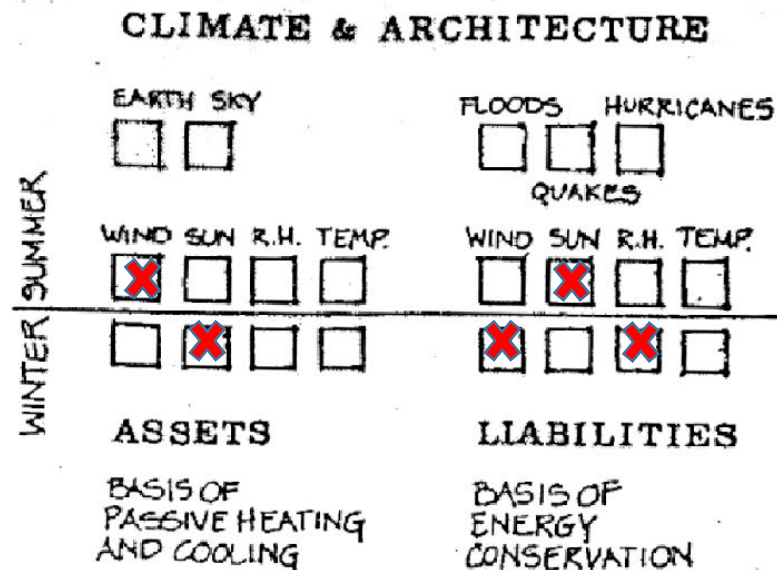
Location : Pittsburgh

The residence is located in Shadyside neighborhood of Pittsburgh. It is a brick clad structure with wooden cladding on last floor and roof shingles. It consists of three floors, an unvented attic and a heated basement. It has living room, kitchen and dining, three bedrooms and a big common room on the third floor. It has two occupants during weekdays and three during weekends. It has an entrance on northwest direction and the rear side of the house enjoys adequate sun exposure.

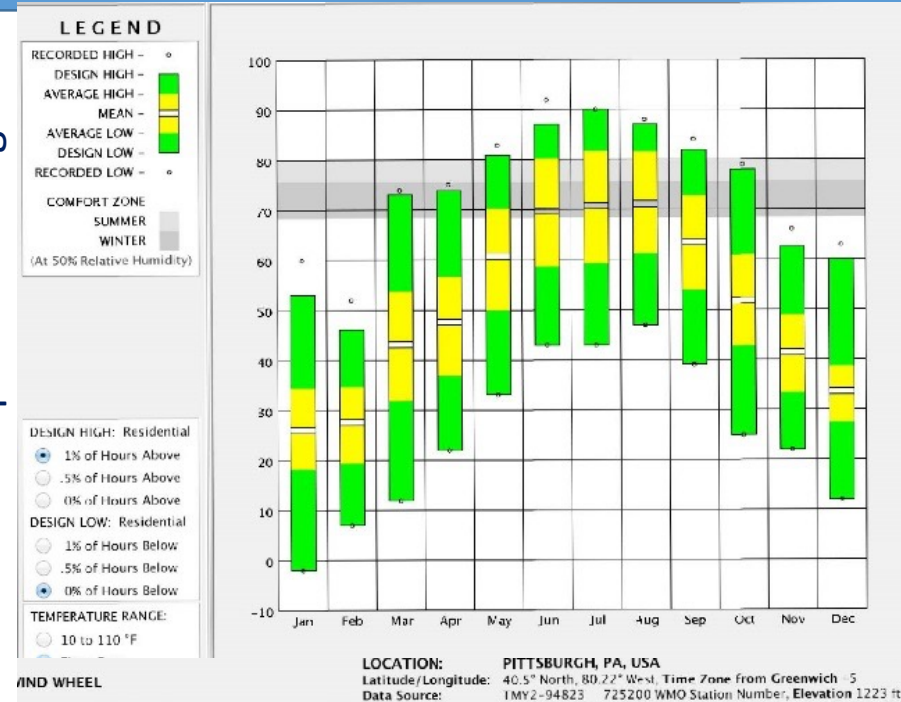


2 . SITE ANALYSIS

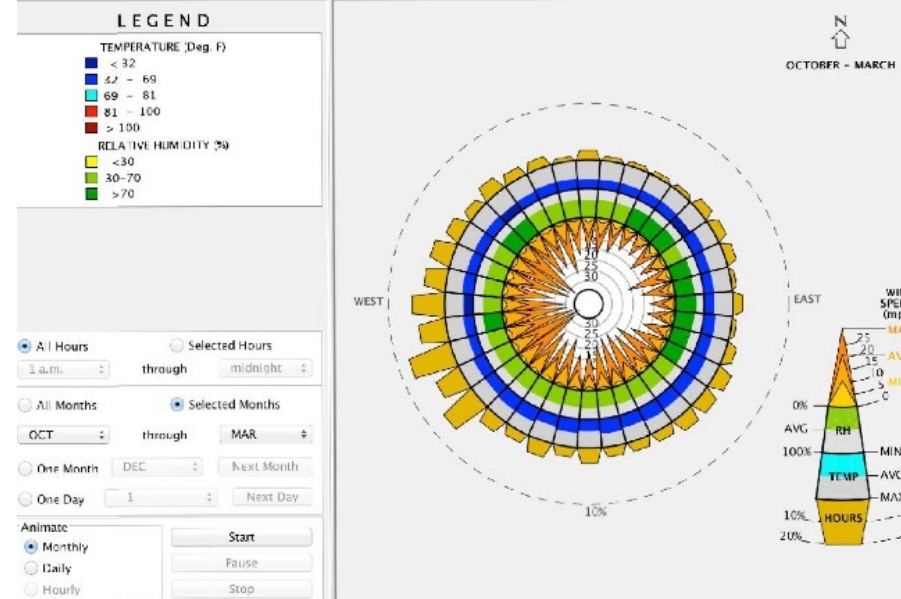
- Pittsburgh lies in humid continental climate zone. The hottest months are from June to August while the winter is harsh, from October to March.
- The wind is prevalent from South and West direction almost throughout the year. It is more intense from southwest during peak of winter



Mean Temperature Range



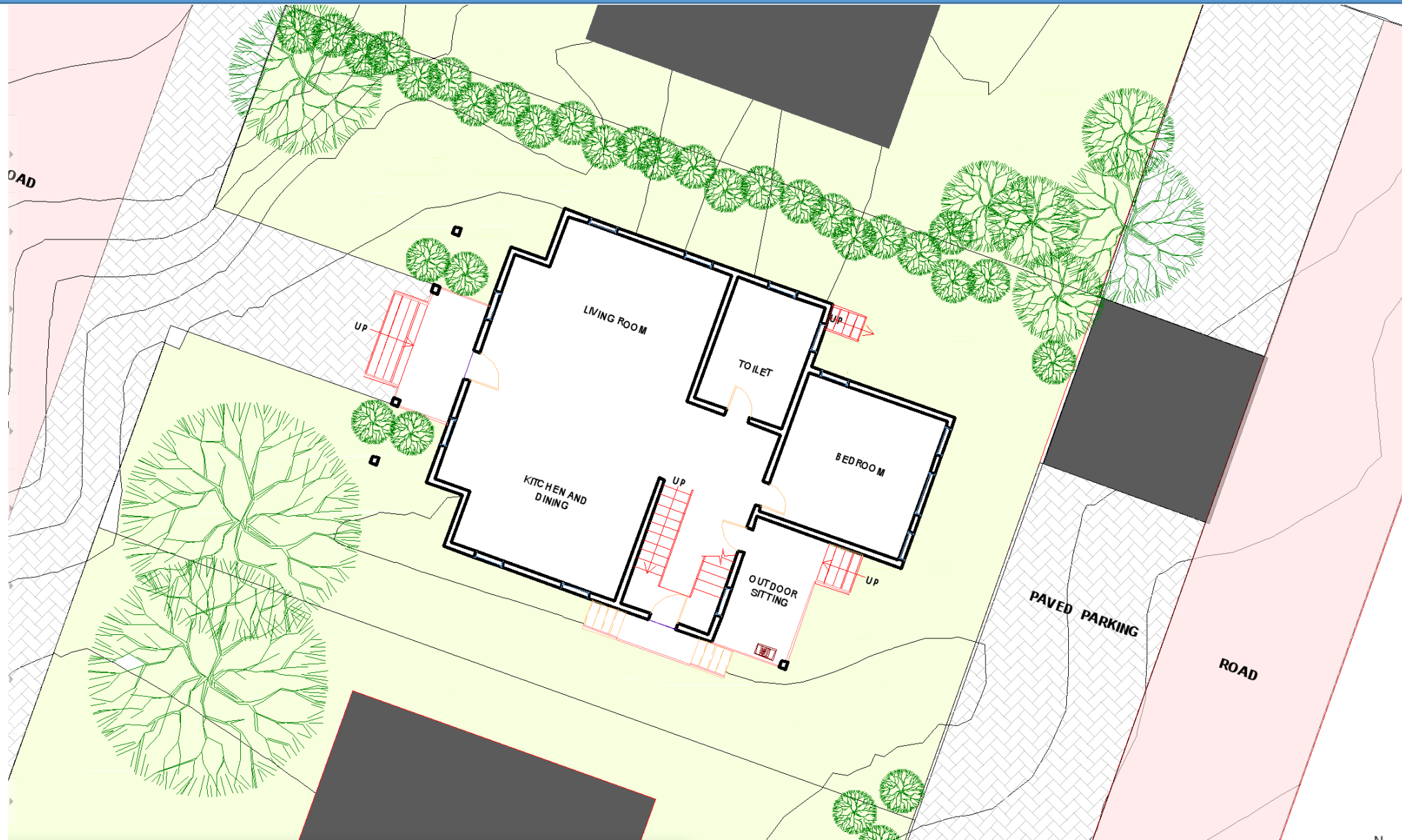
Wind Data



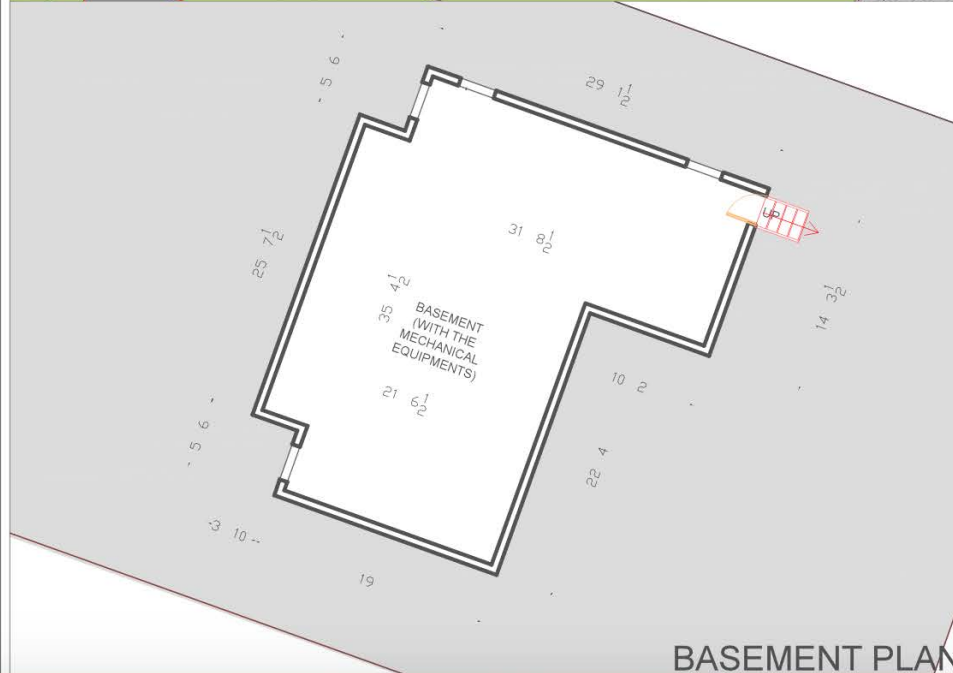
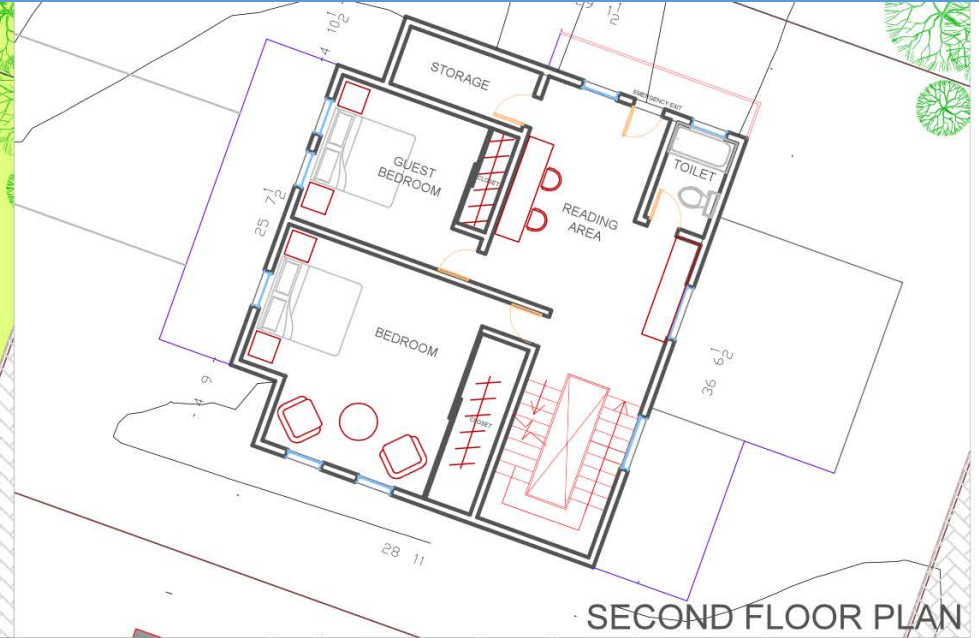
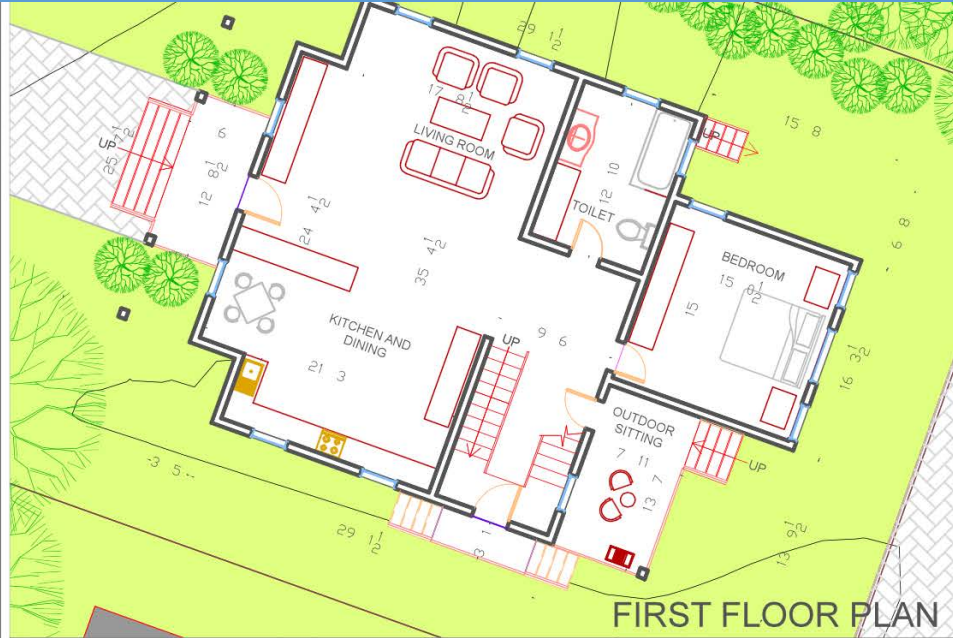
Design Priorities

- Increasing southern sun exposure in spaces that are used mostly during the day, as Pittsburgh remains fairly cold throughout the year.
- Having wind barrier in west direction to avoid strong wind during cold winter while having a provision for south west wind to prevail during summer.
- Compact designing to prevent heat loss during winter.
- Insulating the spaces wherever the infiltration rate seems to be high. Tightening of envelope strategies should be applied.
- Identification of secondary spaces and their placement in less advantageous direction in order to get climatic advantage for most used spaces.
- Operable windows to ensure air movement depending on respective seasonal conditions.
- Using trees as a natural asset in controlling sun shades and wind.
- Directing the flow of surface runoff in such a way that it does not affect the junctions of ground with the building, which can result in mold growth, weakening of wall etc.

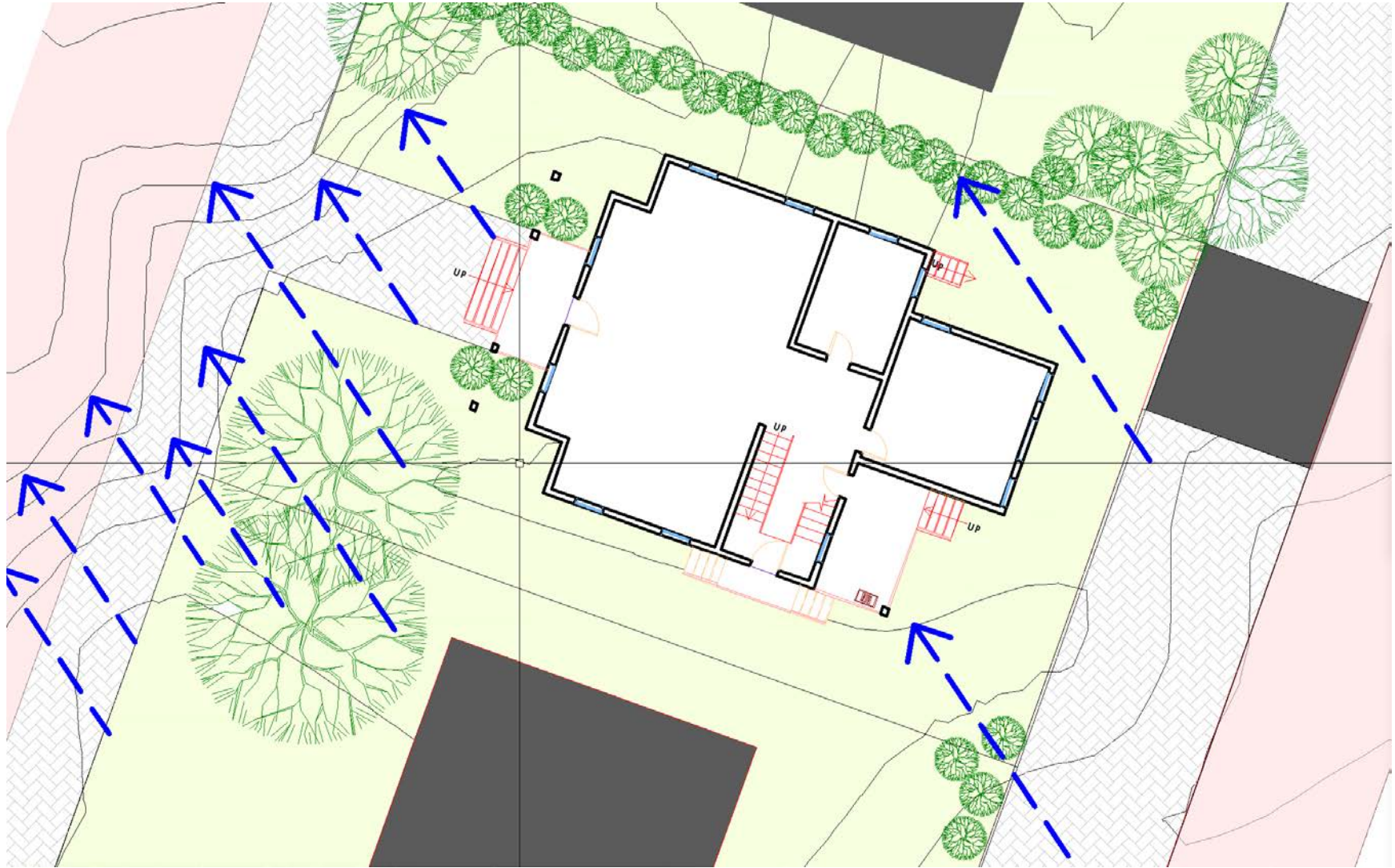
Site Plan



Existing Floor Plans



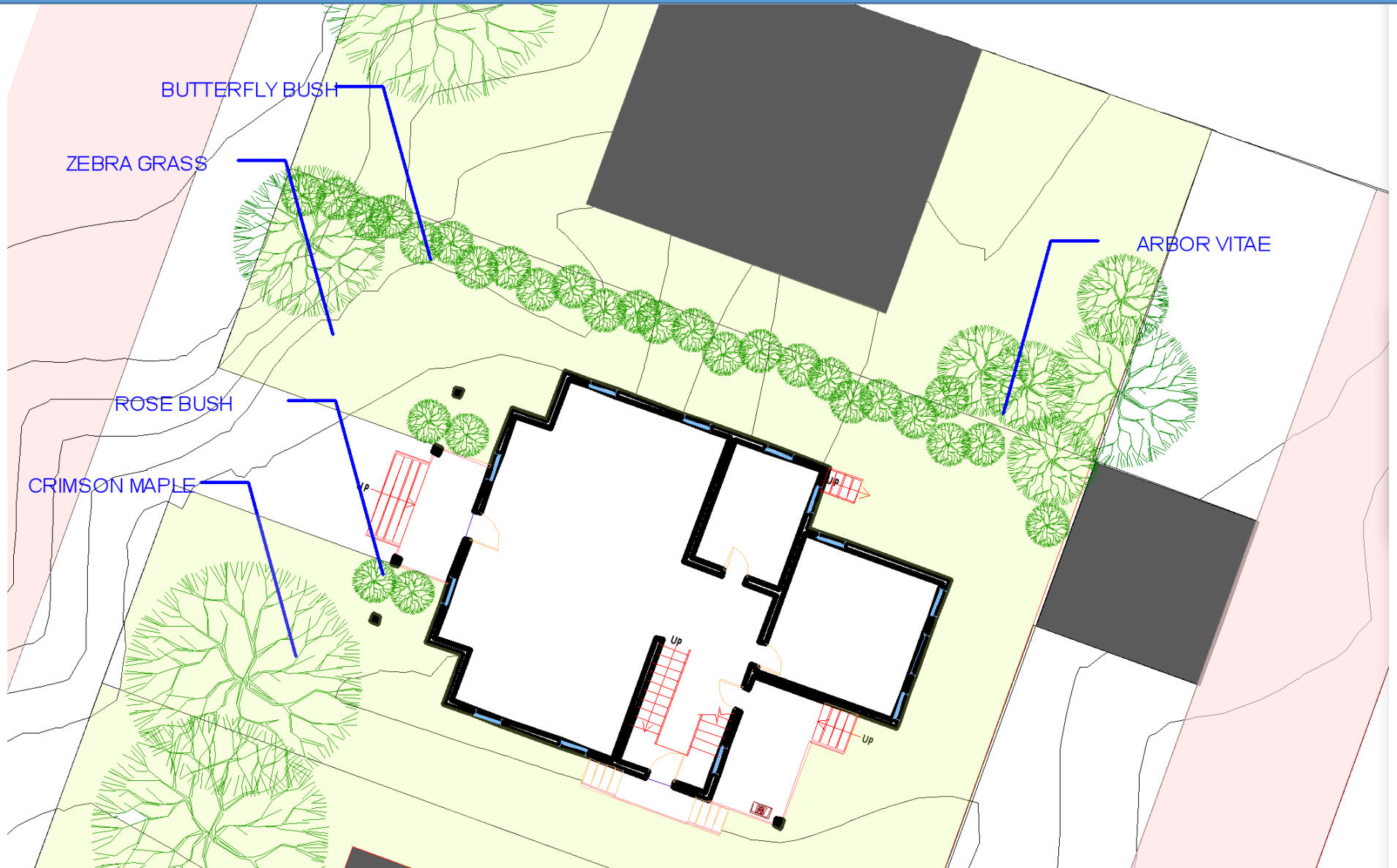
Drainage Analysis



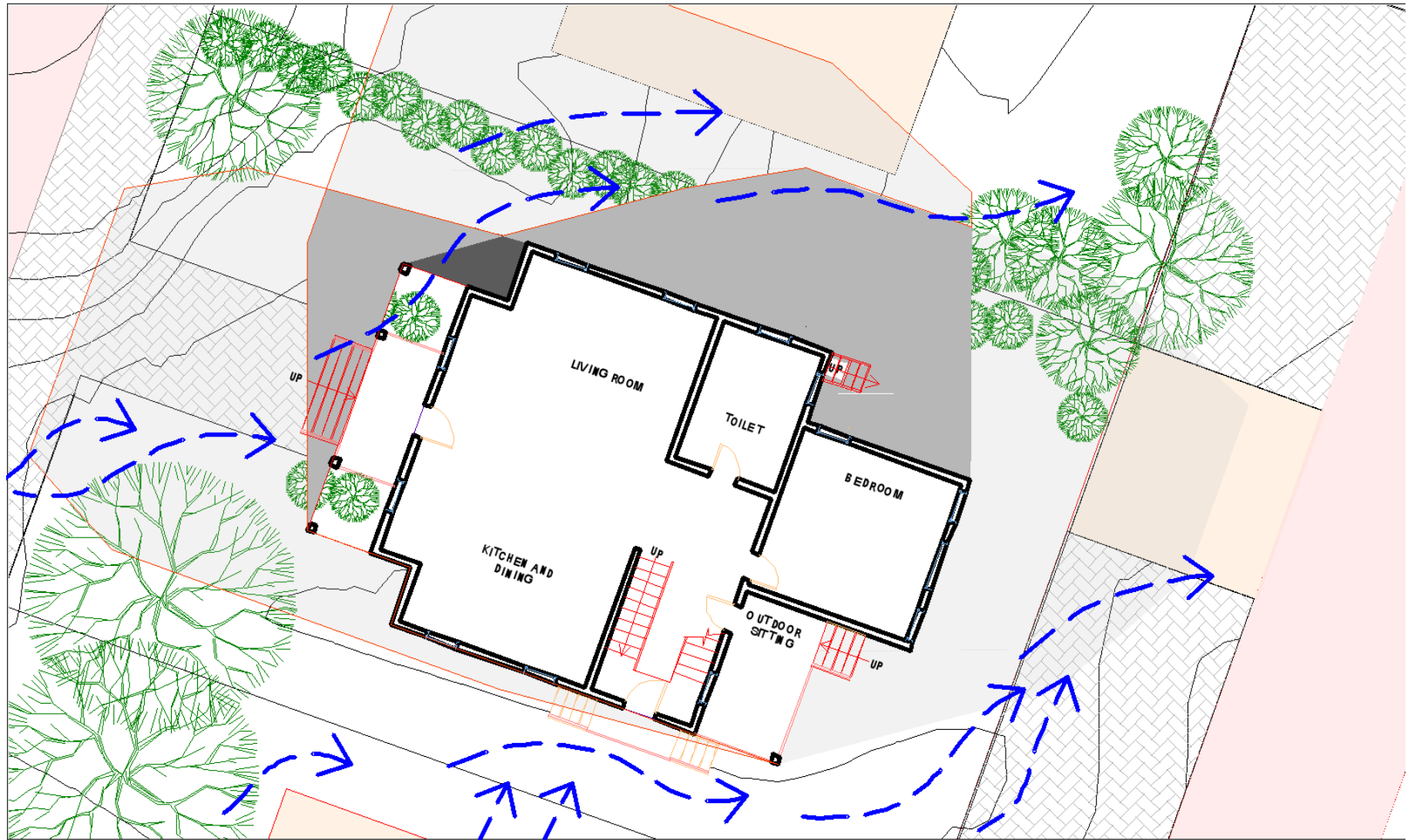
- The direction of the contours is such that the surface runoff is towards the road, hence no water clogging takes place on site.



Vegetation (Existing)



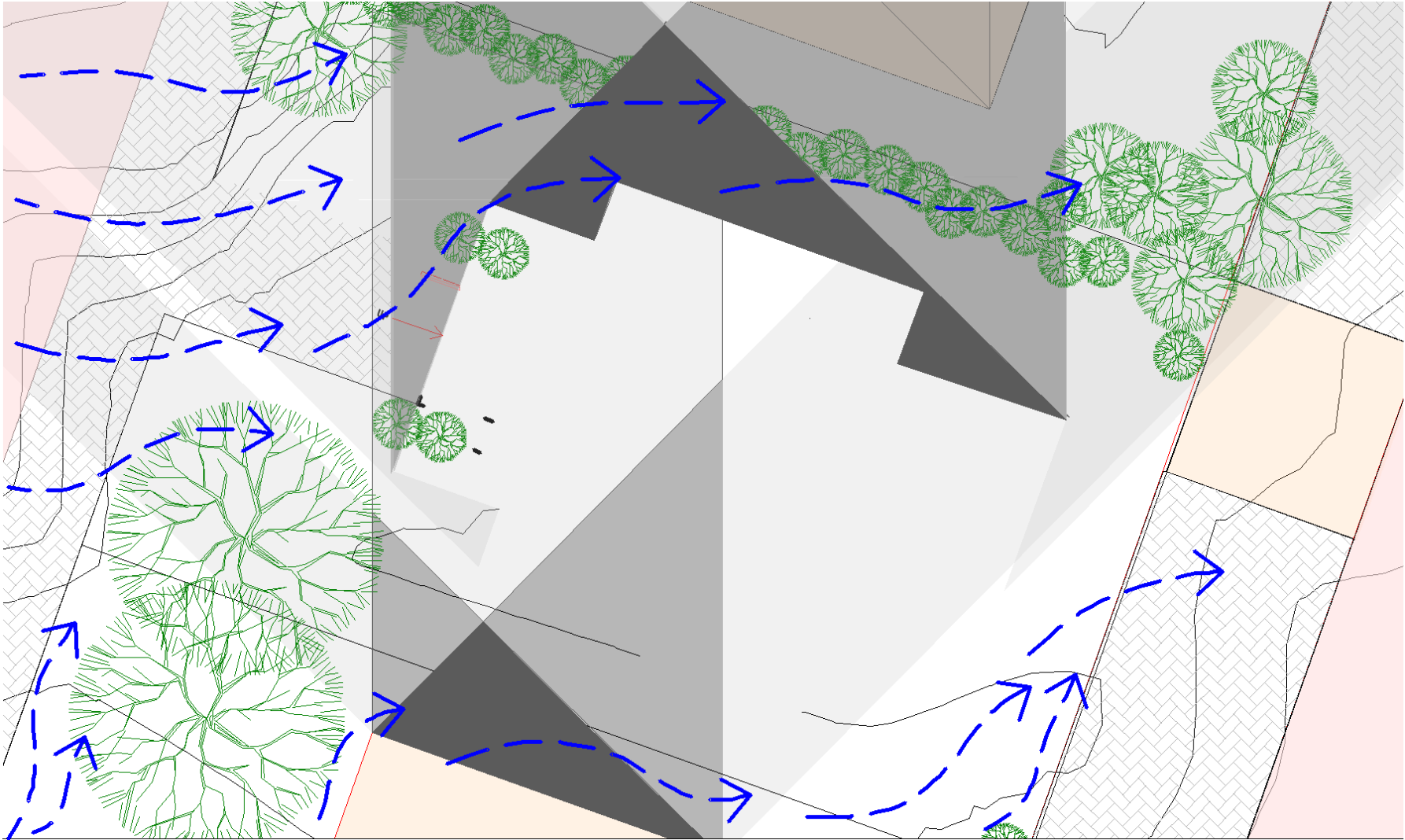
Summer Sun Shadow and wind analysis on site



This diagram shows sun shadows during summer, at 9:00 AM, 12:00 PM and 3:00 PM. The wind is strong from west which is preferable during summer. The living room and kitchen are most used spaces, hence they should be exposed to wind in summer as well.



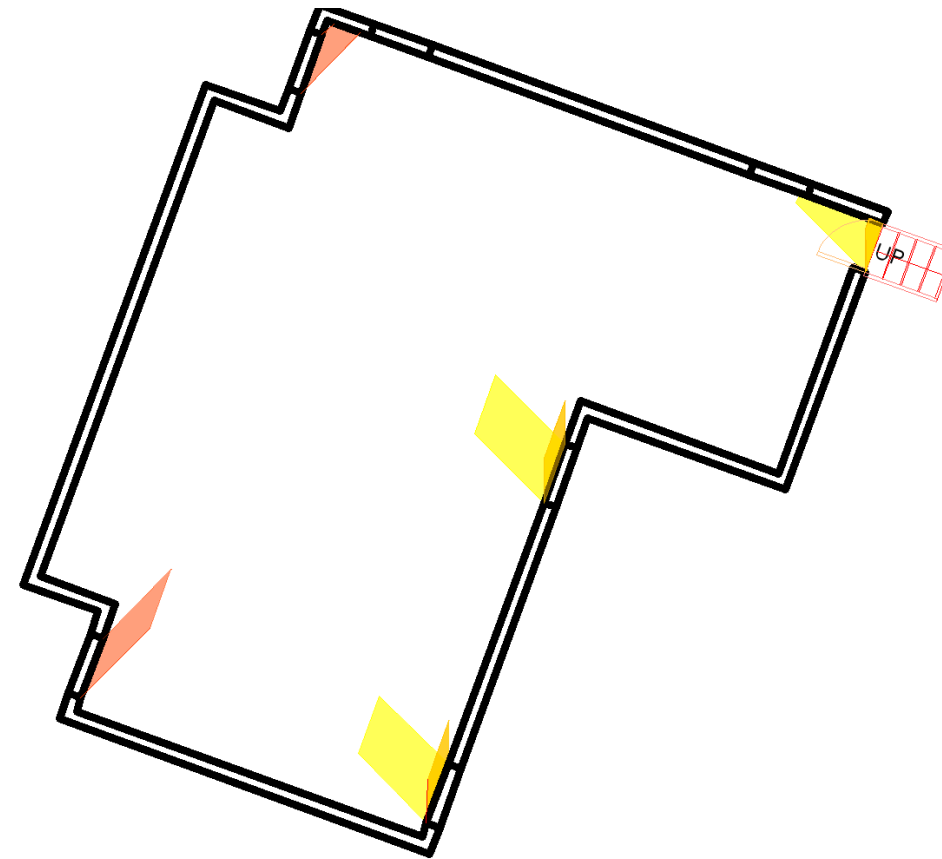
Winter sun shadow and wind analysis on site



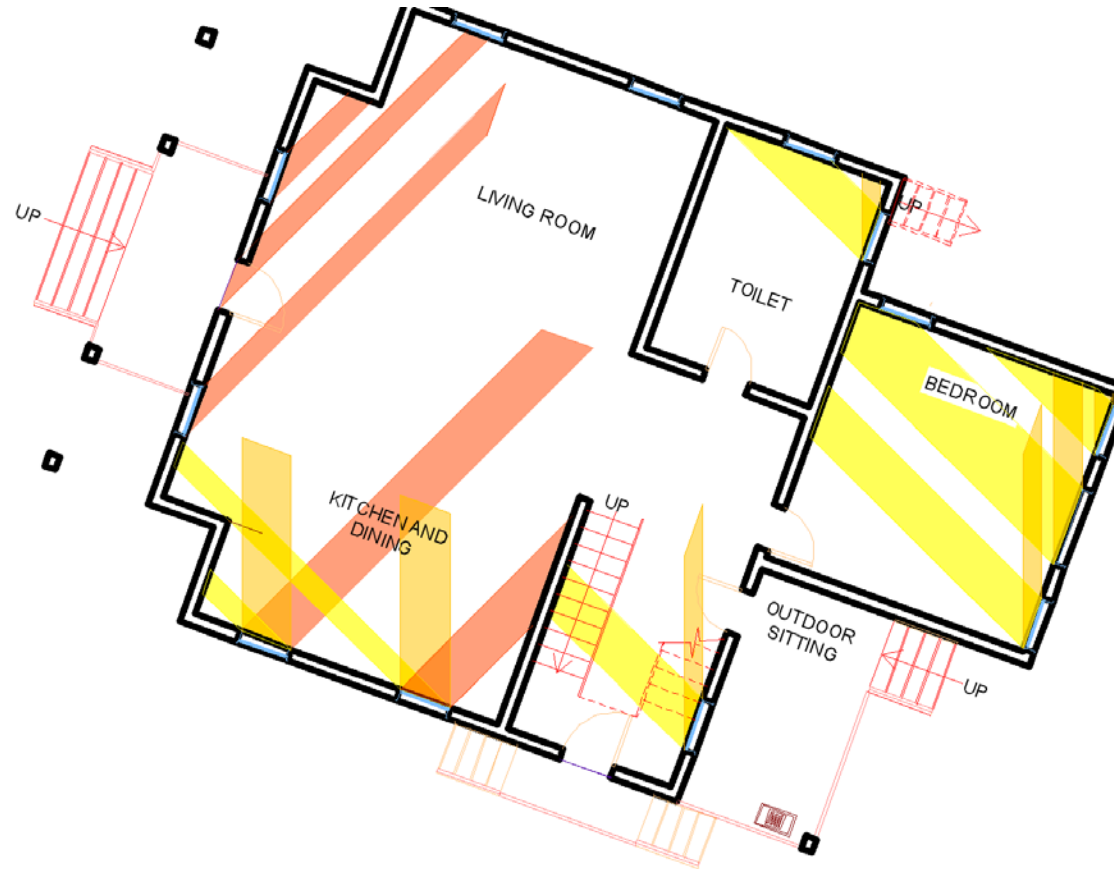
This diagram shows sun shadows during winter, at 9:00 AM, 12:00 PM and 3:00 PM. The kitchen and dining space remain shaded during winter. Also, the wind direction is strong from the western direction as well as from south west. The trees on southwest block the sharp flow, hence they are planted strategically.



Sun penetrations in house (WINTER)



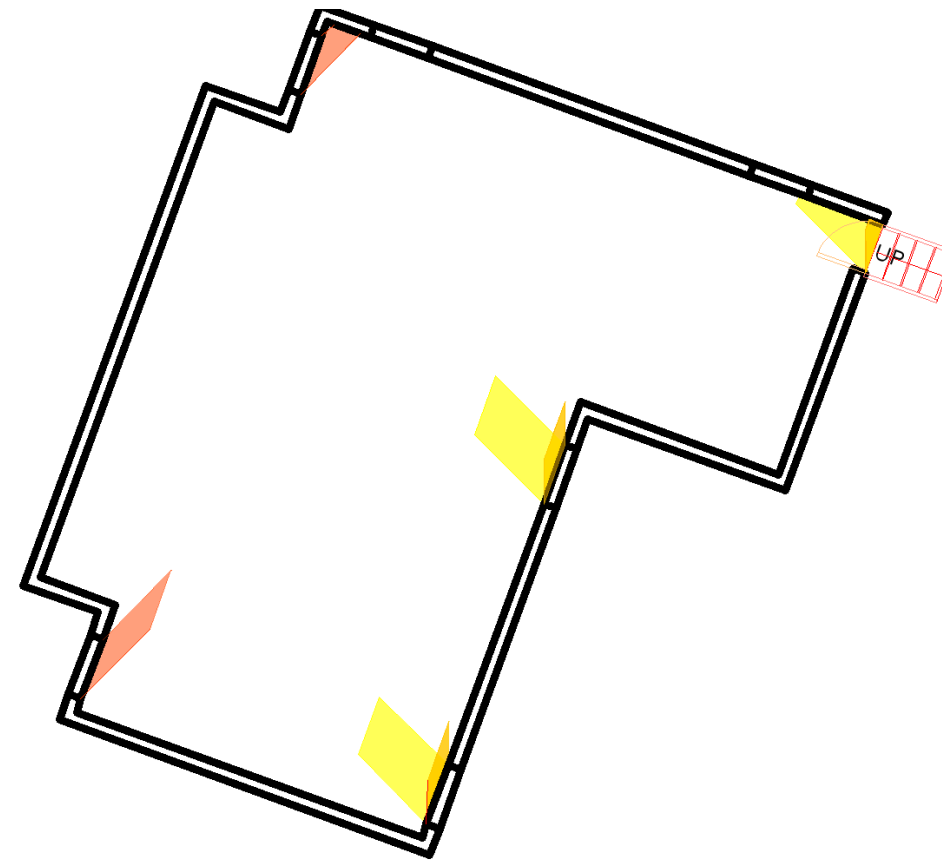
- Basement



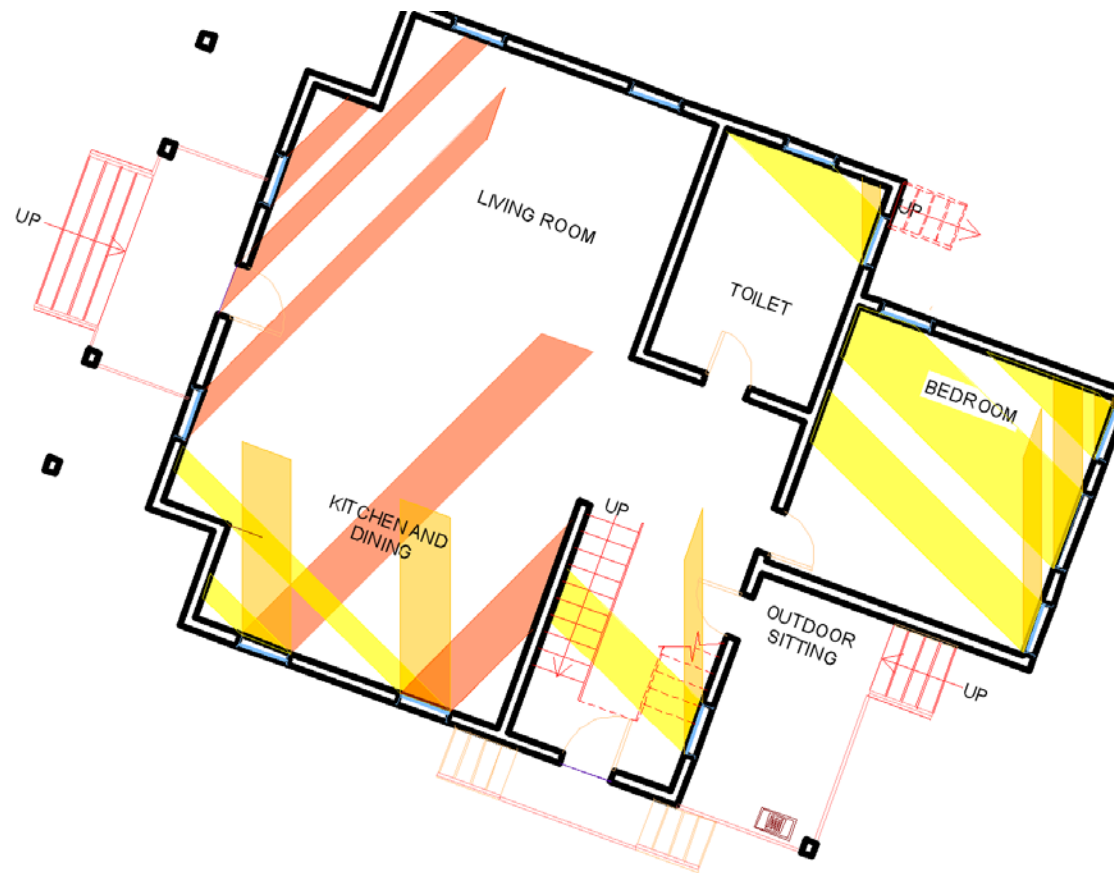
- First Floor



Sun penetrations in house (WINTER)



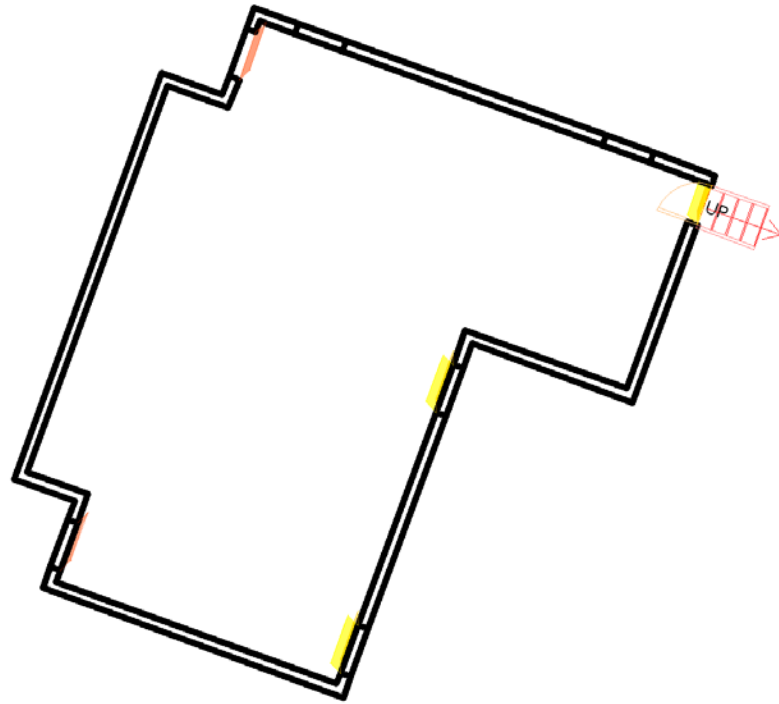
- Second Floor



- Third Floor



Sun penetrations in house (SUMMER)



- Basement



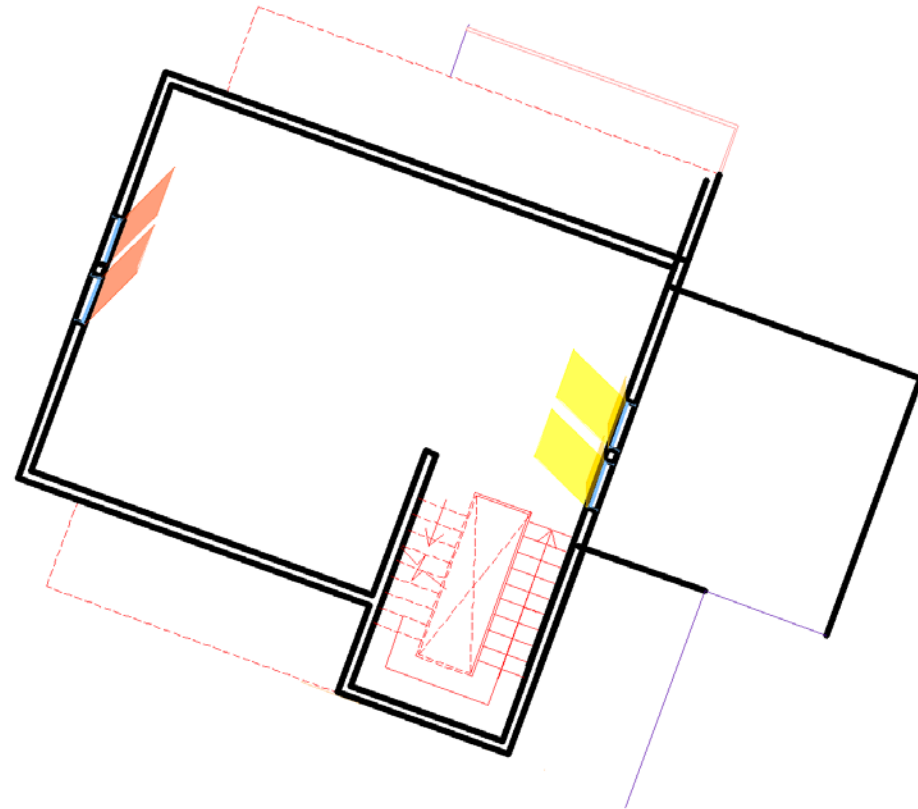
- First Floor



Sun penetrations in house (SUMMER)



- Second Floor



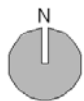
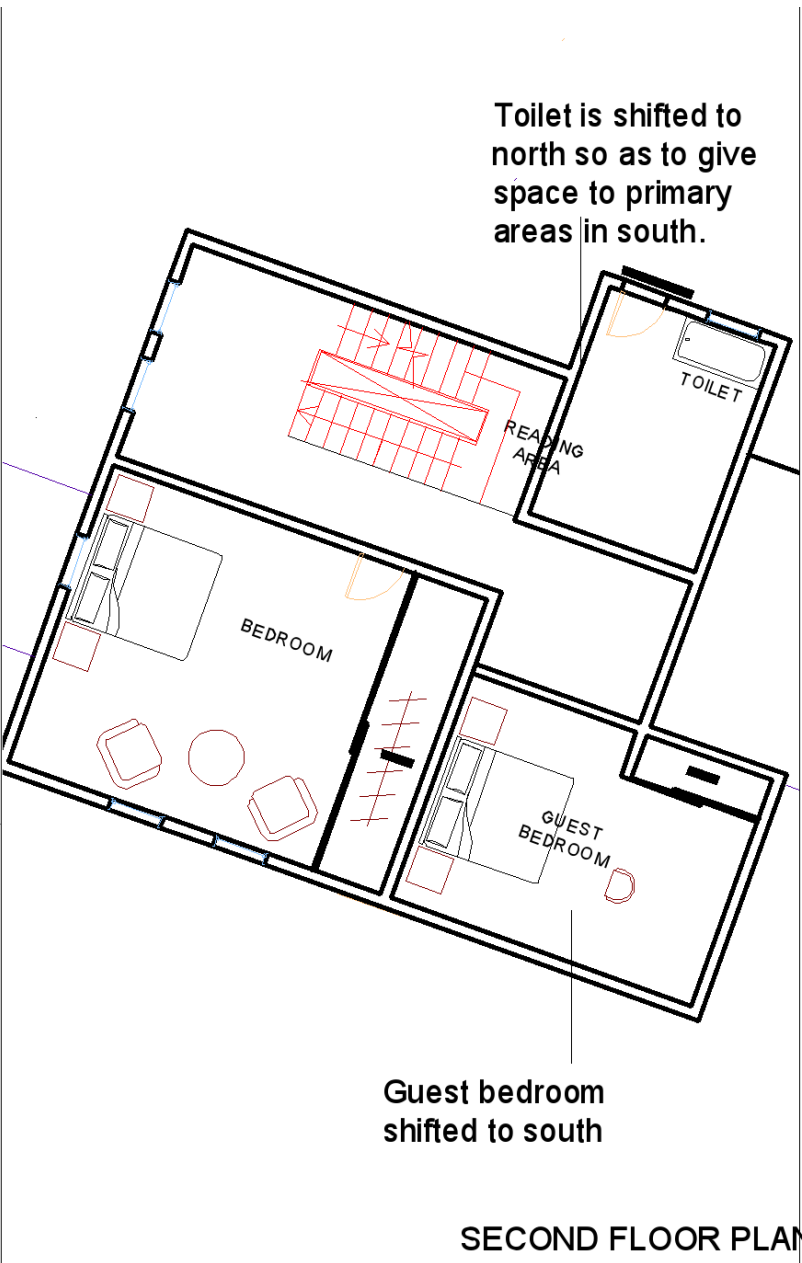
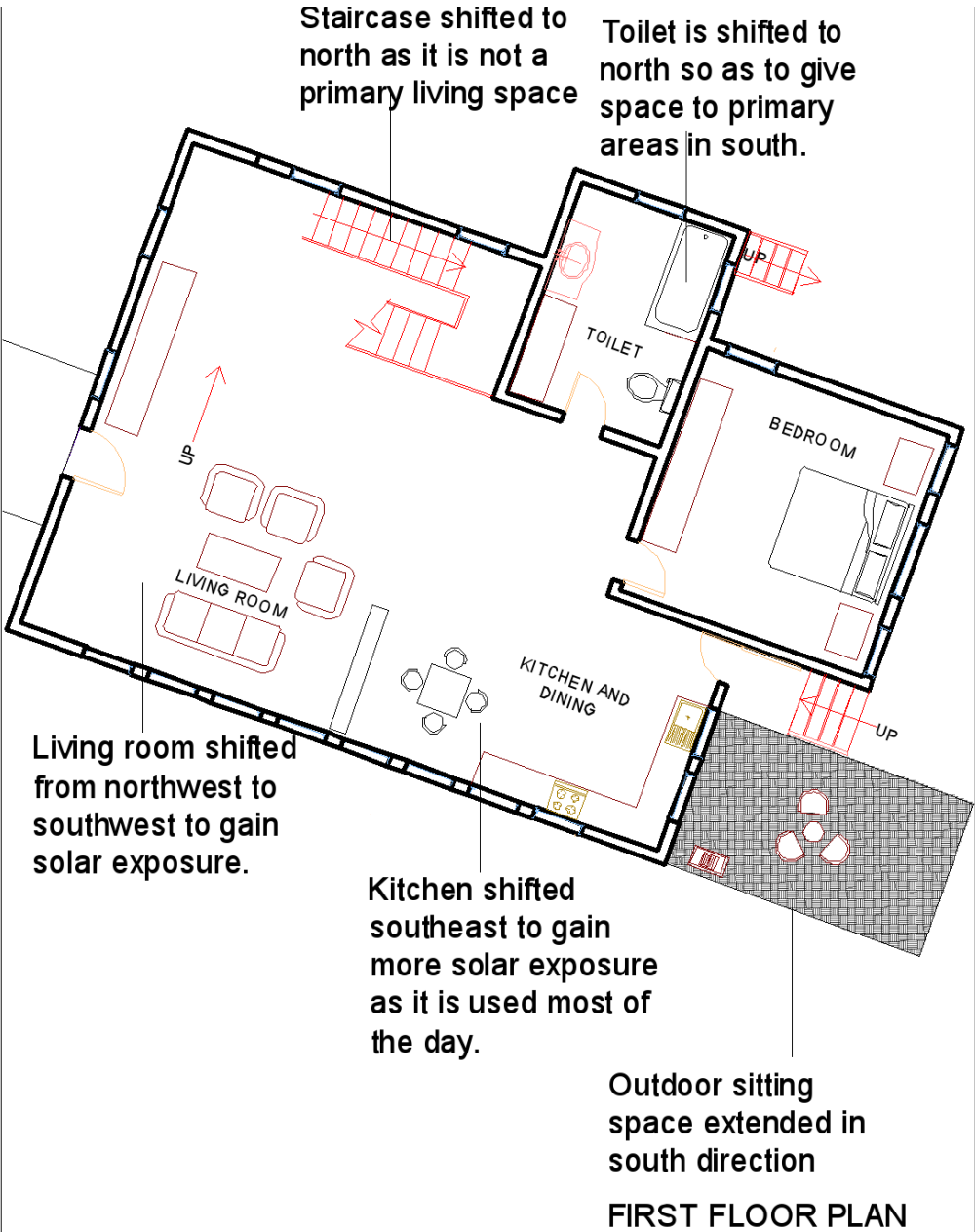
- Third Floor



Environmental Programming Table

Space Title	SquareFoot Range	Living, Circ, Support?	Time in Use	#People MET 1-5	CL O 0-5	Internal Loads L/M/H	Env. Interests: Views/ Access	Htg Clg Vent	S W	S	SE	E	NE	N	N W	W	Space Priority 1, 2, 3
LIVING ROOM	450	LIVING	ALL DAY	P:3 M:1-3	0.5-2	H	Windows with street view and sun light	H+C		X							1
KITCHEN AND DINING	265	LIVING	ALL DAY	P:3 M:1.5-3	1.5-3	H	Window to backyard	H+C +V	X	X	X						1
BEDROOM 1	225	LIVING	DAILY	P:2 M:1	0.5-1.5	H	Window to backyard	H+C +V		X	X	X		X	X		1
BEDROOM2	348	LIVING	DAILY	P:1 M:1	1-2	H	Window with street view	H+C +V		X	X	X					1
GUEST ROOM	180	LIVING	RARE	P:1 M:0.8	0.5-2	M	Window to backyard	H+C +V		X	X	X					3
STORAGE	55	SUPPORT	DAILY	P:1-3 M:1.5	0.5-3	L	Windows for cross ventilation	V	X	X	X	X	X	X	X	X	2
READING AREA	90	SUPPORT	DAILY	P:1-3 M:1	1-3	M	Window with street view	H+C					X	X	X		2
COMMON ROOM	680	LIVING	RARE	P:1-3 M:1.5	2-3	M	Windows for cross ventilation	H+C +V	X	X	X	X	X	X	X	X	2
TOILET (2)	120 EACH	SUPPORT	DAILY	P:1-3 M:1-2	0-1.2	M	-	H+C	X	X	X	X	X	X	X	X	1
OUTDOOR SITTING	100	SUPPORT	DAILY	P:1-3 M:2	2-3	M	Backyard	-	X	X	X						2
STAIRS	120	CIRC	DAILY	P:1-3 M:1.5	0.5-2	L	-	H+C					X	X	X	X	2

Site Redesign – For Sun, Wind



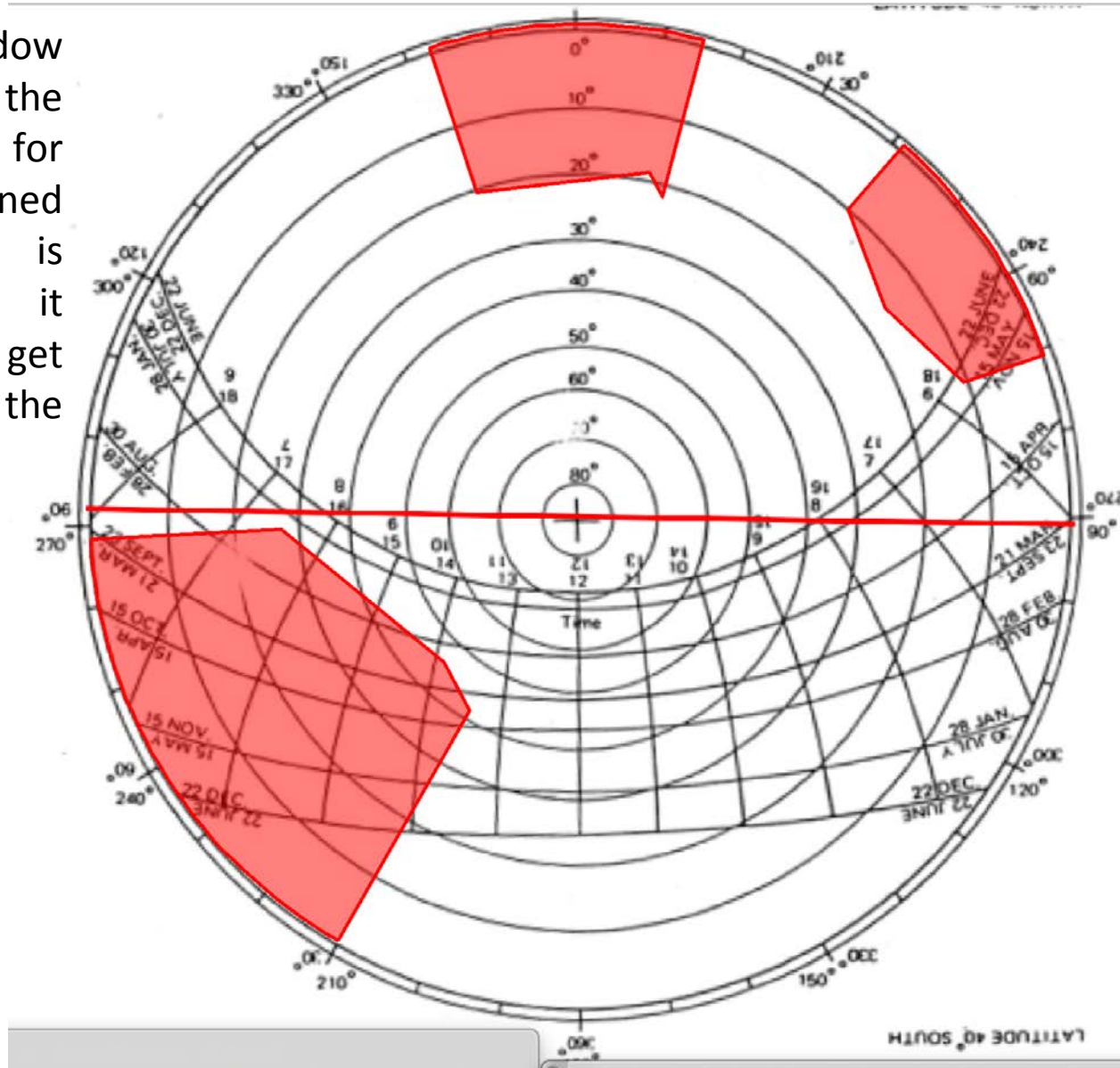
Perspective View

12



Solar Window

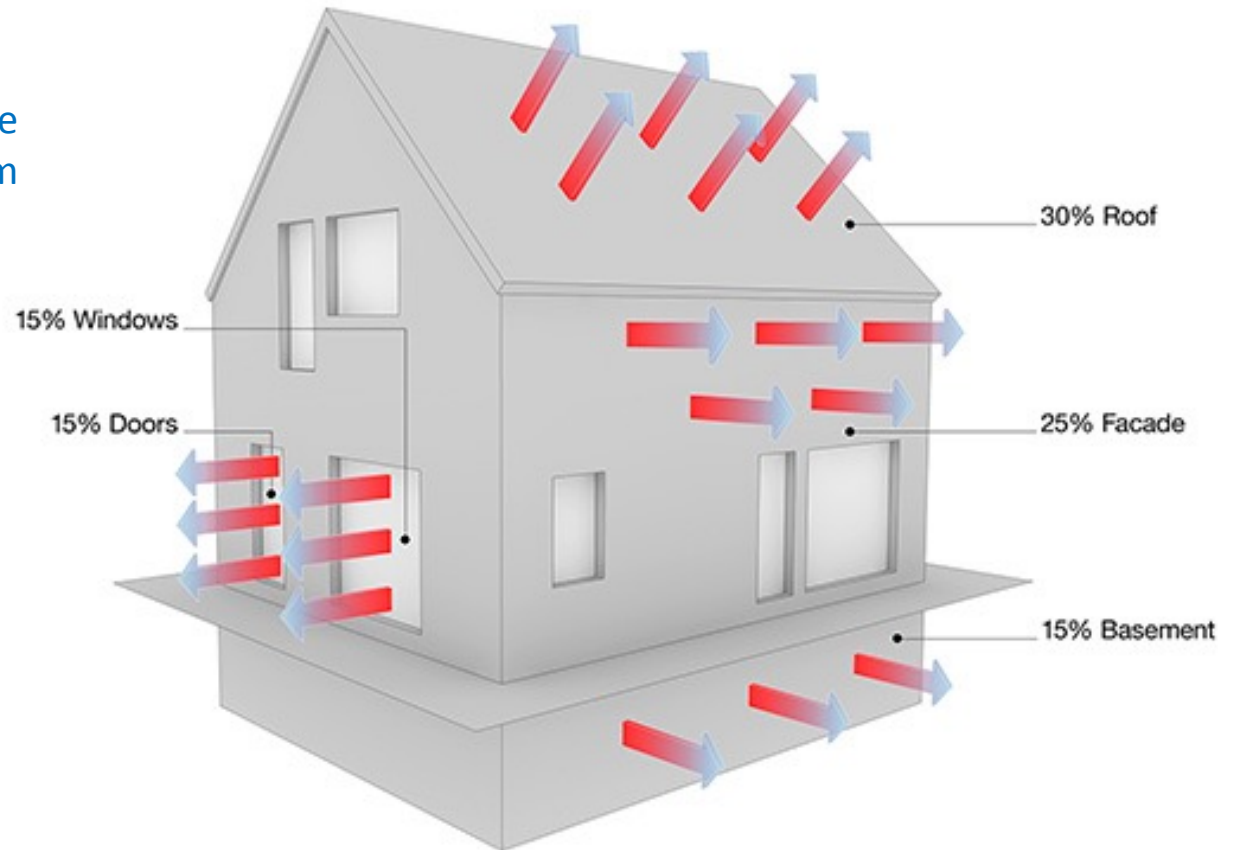
The Solar Window depicts that the location chosen for the redesigned space is appropriate as it does not get shaded by the surroundings.



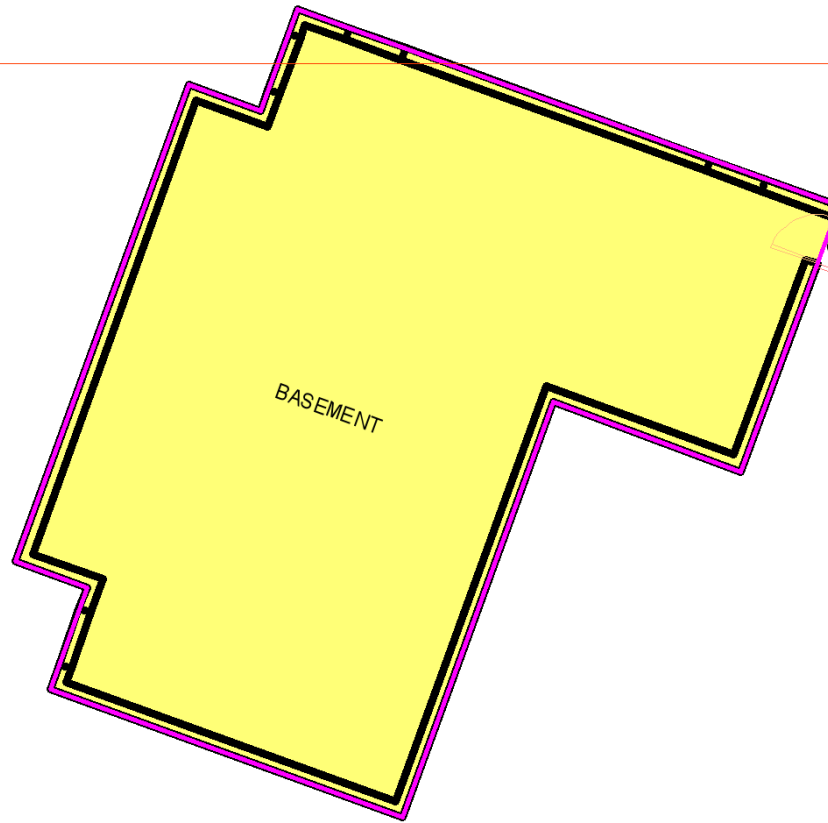
3. HEAT LOSS CALCULATIONS

This section deals with heat losses that are actually occurring due to existing envelope, glazing, door type, basement and floors.

This, in turn gives the peak heat loss and the annual heat loss. It is observed that maximum heat loss occurs due to infiltration.



PLANS



Section 1

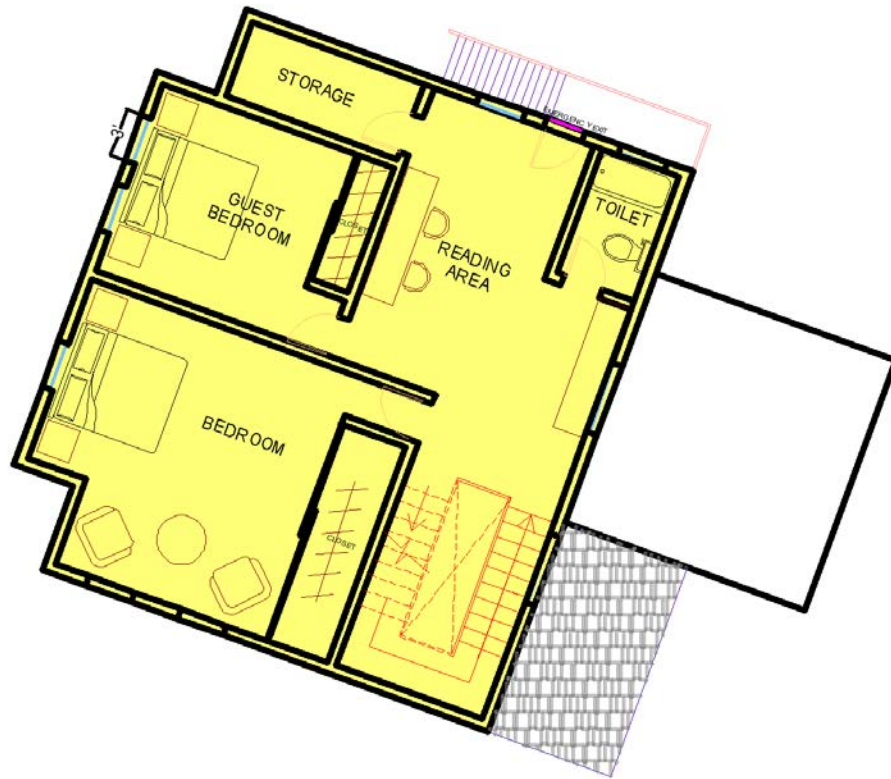


First Floor

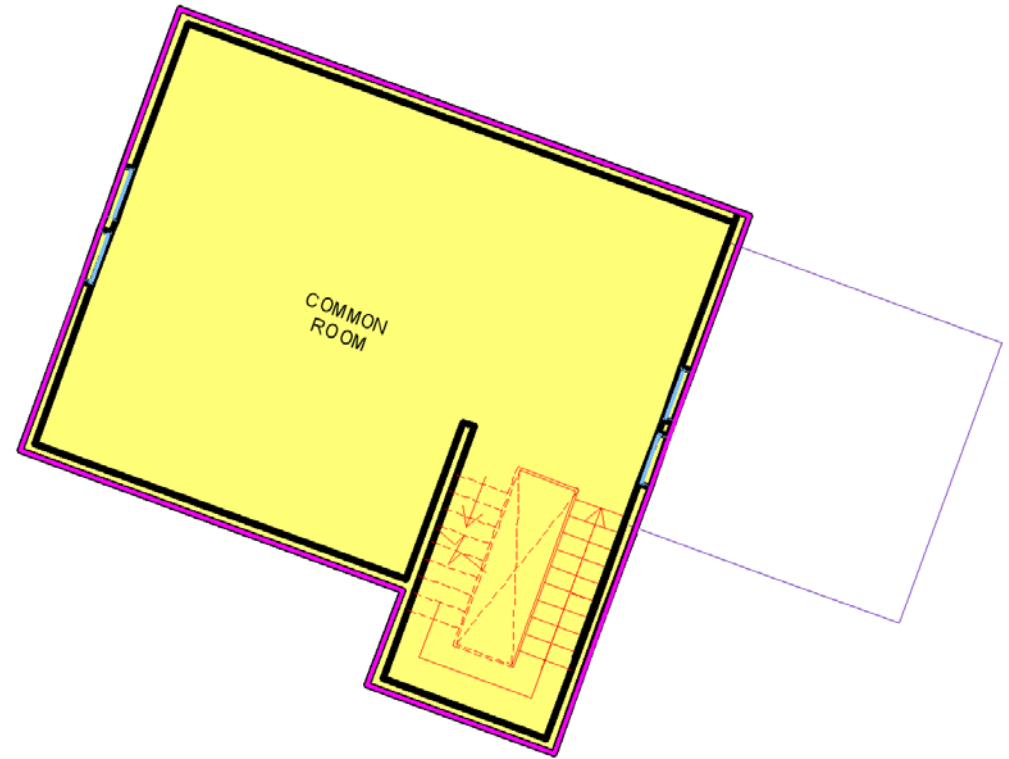
All spaces rendered yellow are the heated spaces.



PLANS



Second Floor

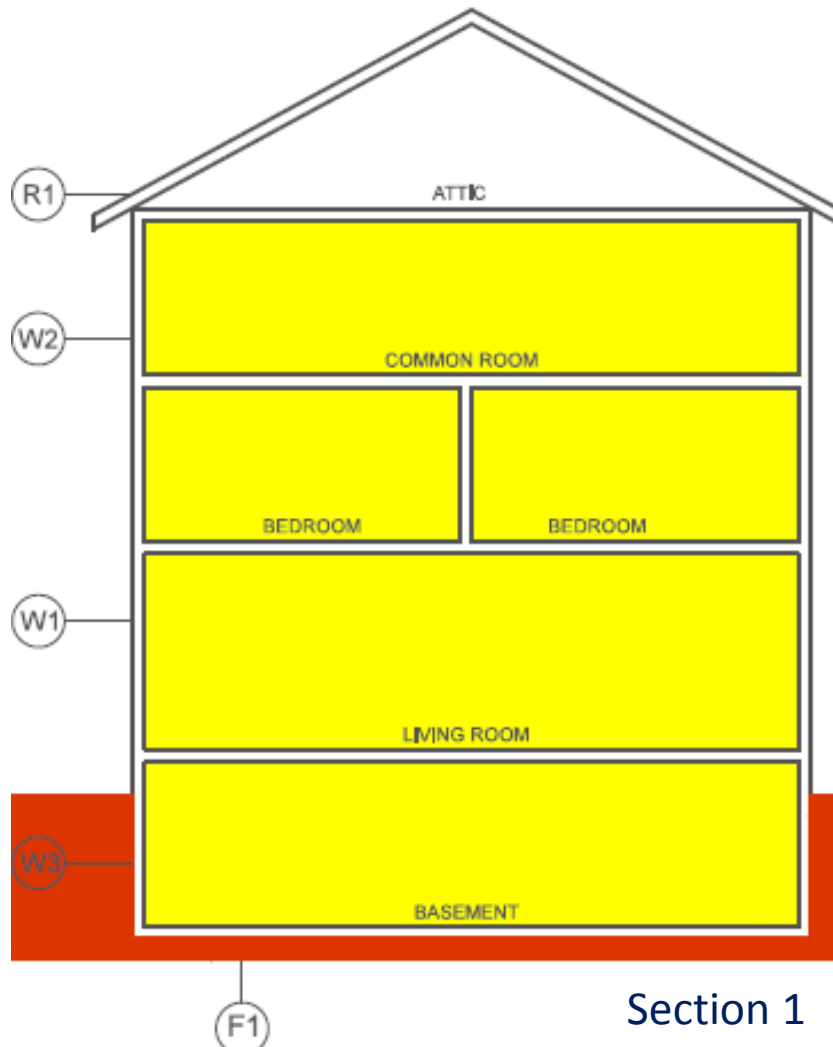


Third Floor

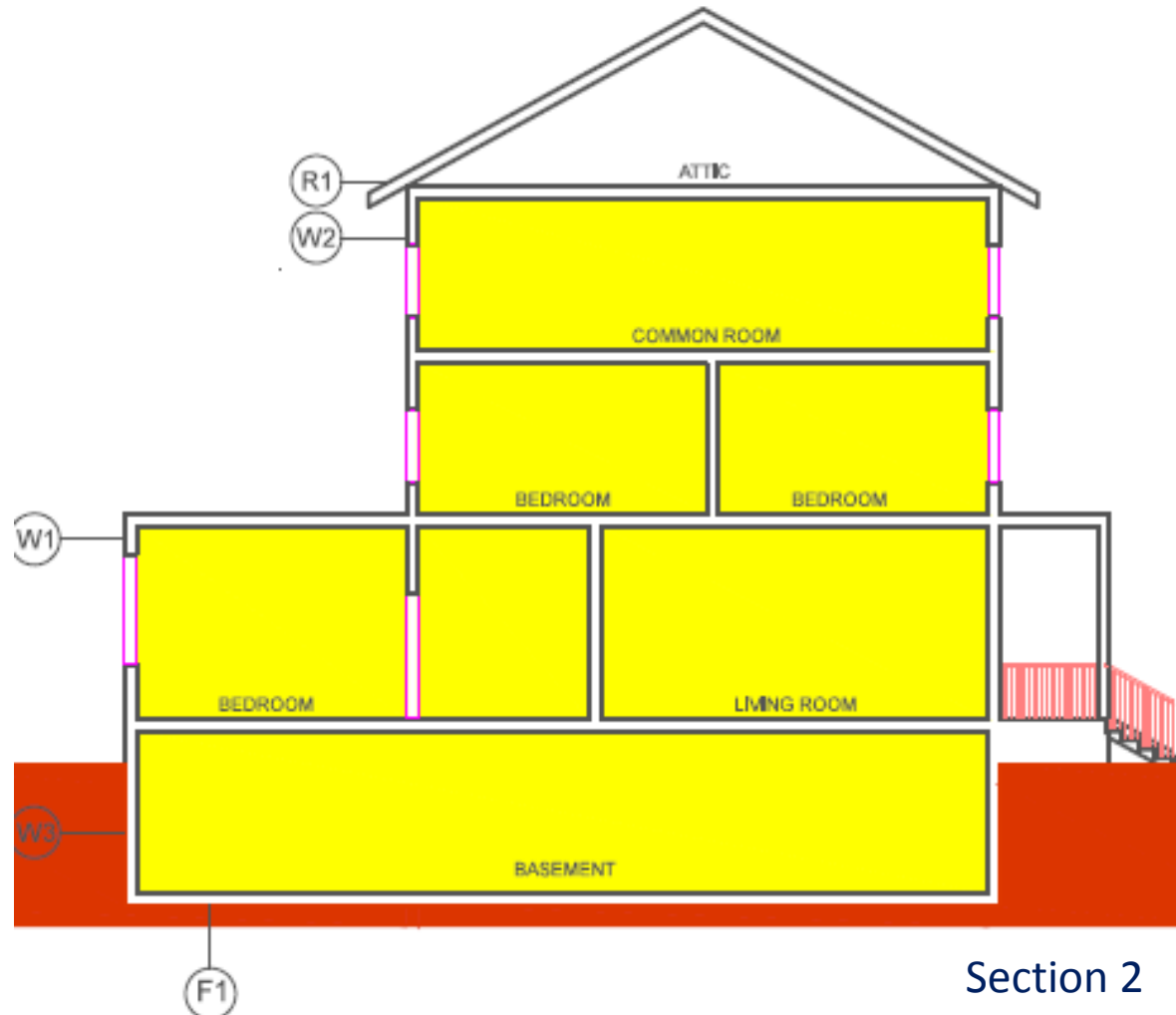
Note : The attic is unheated .



SECTIONS



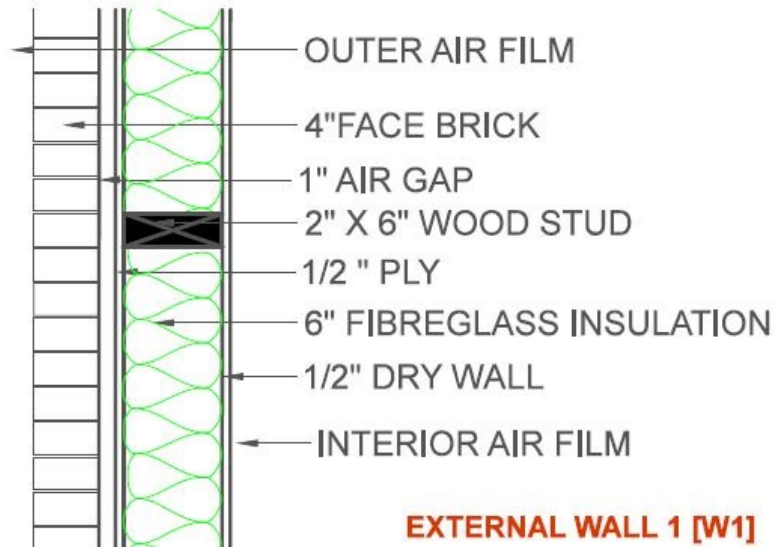
Section 1



Section 2

WALL DETAIL

W1



MATERIALS	R VALUE
<i>Outer Air Film</i>	0.17
4" Face Brick	0.44
1" Air Gap	1
½ " Ply	0.63
6" Fibreglass Insulation	22.20*
½ " Dry Wall	0.32
<i>Interior Air Film</i>	0.68
TOTAL	25.44
U [Btu/h F sft]	0.039

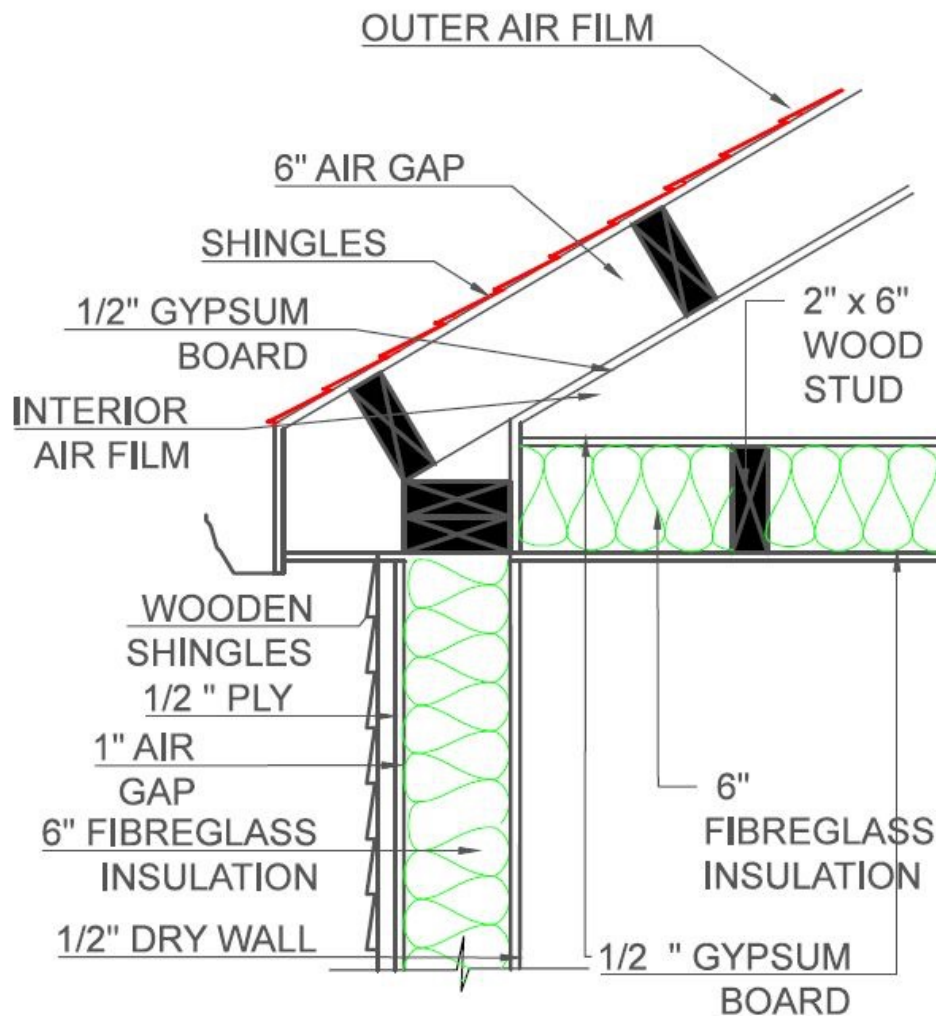
W2



MATERIALS	R VALUE
<i>Outer Air Film</i>	0.17
Wooden Shingles	0.97
1" Air Gap	1
½ " Ply	0.63
6" Fibreglass Insulation	22.20*
½ " Dry Wall	0.32
<i>Interior Air Film</i>	0.68
TOTAL	25.97
U [Btu/h F sft]	0.039

* Value taken from Gerry Mattern's notes

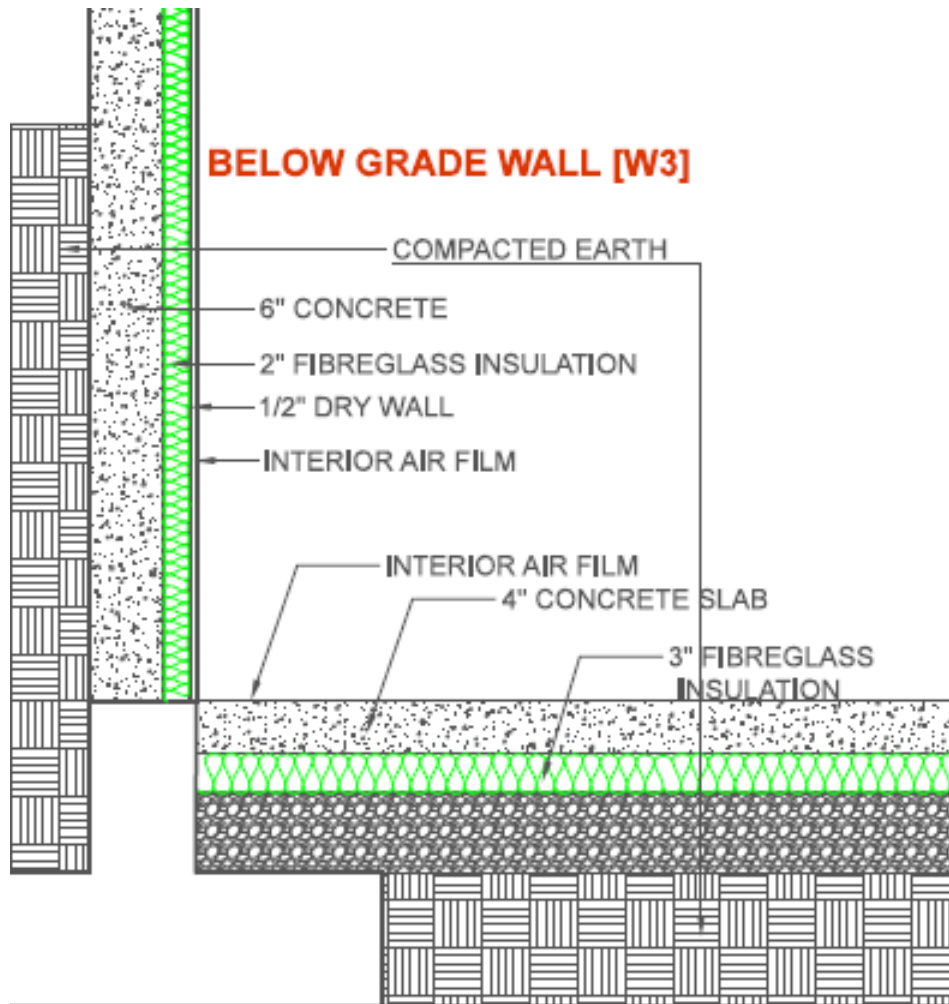
ROOF DETAIL



R1

MATERIALS	R VALUE
<i>Outer Air Film</i>	0.17
<i>Shingles</i>	0.87
<i>Air Gap</i>	1
<i>½ " Gypsum Board</i>	0.44
<i>Inner Air Film</i>	0.68
<i>Air Gap</i>	1
<i>½" Gypsum Board</i>	0.68
<i>6" Fibreglass Insulation</i>	22.20
<i>½" Gypsum Board</i>	0.44
<i>Inner Air Film</i>	0.68
TOTAL	28.16
U [Btu/h F sft]	0.035

BELOW GRADE DETAILS



BELOW GRADE FLOOR [F1]

W3 Heat Loss of Below Grade Insulated Wall
(2" insulation) , 7' depth
Perimeter (ft) = 139 '

F factor = 0.035

F1 Heat Loss of Below Grade Insulated Floor(3"
insulation) , 5' depth
Area (sq ft) = 940 sq ft

F factor = 0.45

I. Sum "F" factor

Depth (ft)	Path Length through Soil (ft)	Insulation		
		Uninsulated	1-in.	2-in.
0-1 (1st)	0.68	0.410	0.152	0.093
1-2 (2nd)	2.27	0.222	0.116	0.079
2-3 (3rd)	3.88	0.155	0.094	0.068
3-4 (4th)	5.52	0.119	0.079	0.060
4-5 (5th)	7.05	0.096	0.069	0.053
5-6 (6th)	8.65	0.079	0.060	0.048
6-7 (7th)	10.28	0.069	0.054	0.044

$$k_{\text{soil}} = 9.6(\text{Btu} \cdot \text{h} / (\text{in} \cdot \text{ft}^2) \cdot (F)); k_{\text{insulation}} = 0.24(\text{Btu} \cdot \text{h} / (\text{in} \cdot \text{ft}^2) \cdot (F)).$$

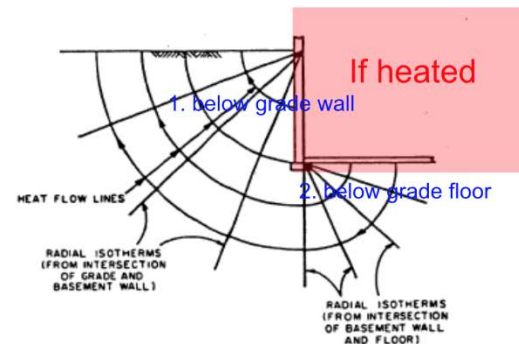


Fig. 1 Heat Flow from Basement

2. Select modified U X area of floor

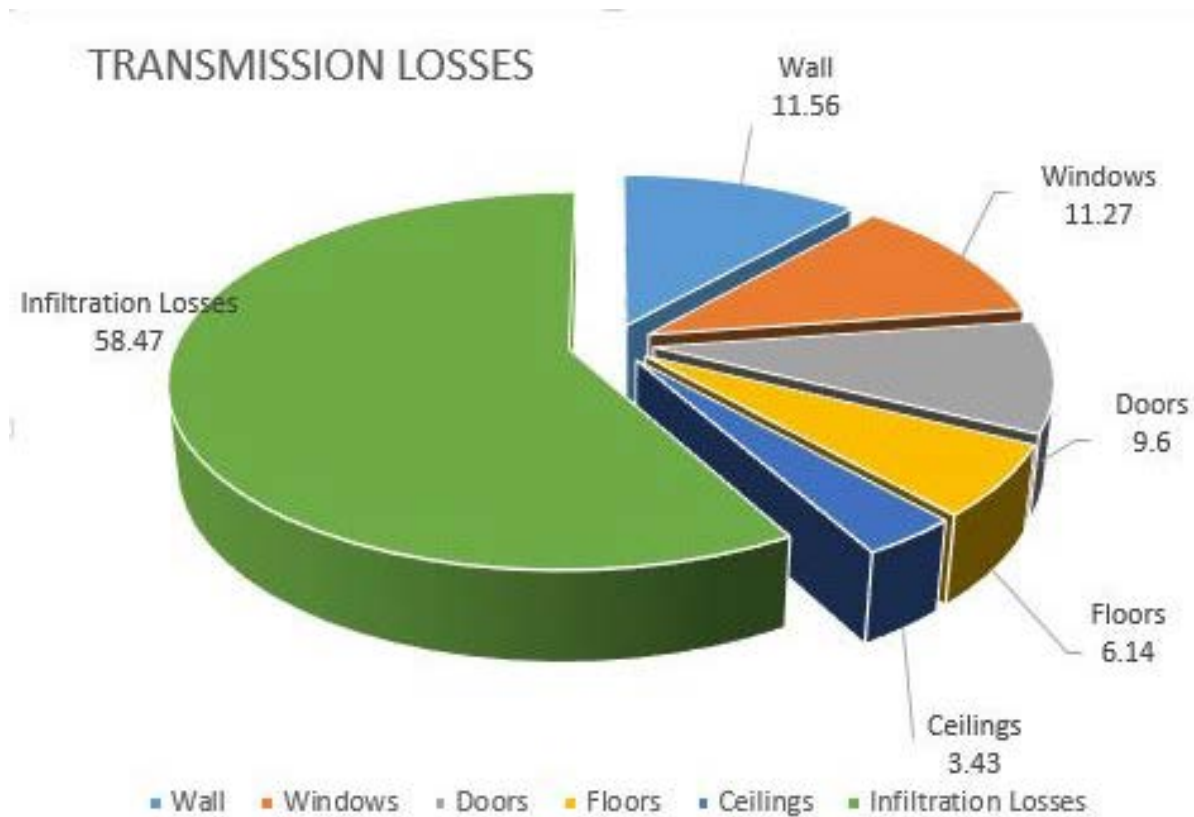
Table 2 Heat Loss through Basement Floors
[Btu/(h)(ft²)(F)]

Depth of Foundation Wall below Grade (ft)	Width of House			
	20 (ft)	24 (ft)	28 (ft)	32 (ft)
5	0.032	0.029	0.026	0.023
6	0.030	0.027	0.025	0.022
7	0.029	0.026	0.023	0.021

HEAT LOSS

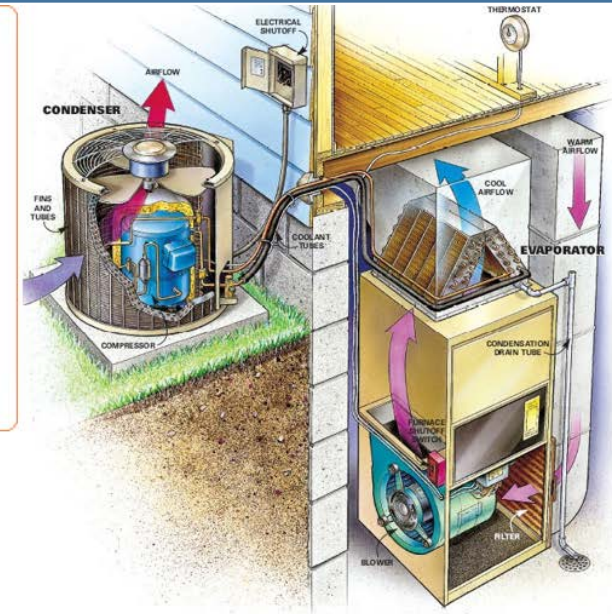
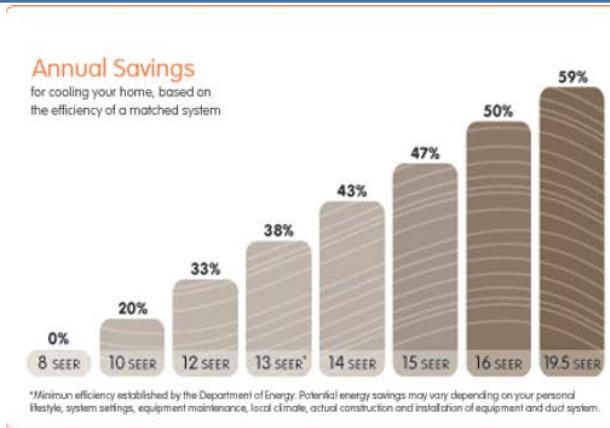
		R-value	U-value	Total area	Heat loss Coefficient
	Detail #	(hrft ² F/Btu)	(Btu/hrft ² F)	ft ²	UA=Btu/hr °F
WALLS	Wall 1 (W1)	25.44	0.039	2553	99.587
	Wall 2 (W2)	25.97	0.038	1104	41.952
WINDOWS	Double pane	2	0.5	278	138
DOORS	Wood with glass	1.25	0.8	147	117.6
ROOFS	Roof 1 (R1)	28.16	0.035	1200	42
	Slab				
BELOW GRADE FLOORS		modified U		ft ²	
	Floor 1 (F1)	0.03		940	30.1
BELOW GRADE WALLS		total F		perimeter ft.	
	Wall 3 (W3)	0.45		139	61.80
INFILTRATION (heated volume of the building x number of air changes x the heat capacity of air .018 Btu ft ³ F					
	#A.C. x .018 x volume cu.ft. = heat loss coefficient				
	1 x 0.018 x 38600 = 695 Btu/hr°F				
	695				
TOTAL HEAT LOSS COEFFICIENT (total UA) Btu/hr°F				100%	1225
	HEAT LOSS SOURCE			UA HEAT LOSS Btu/hr°F	%
Transmission Losses:					
	Walls			141.519	11.56%
	Windows			138	11.27%
	Doors			117.6	9.60%
	Floors			75.2	6.14%
	Ceilings			42	3.43%
	Infiltration Losses			716	58.47%
PEAK HEAT LOSS (BTUh)	=	Total UA	x T (design indoor°F - design outdoor°F)		
	=	1225	x	65	79593 Btu/h
ANNUAL HEAT LOSS (MMBTU)	=	Total UA	x	24hrs	x annual degree days
	=	1225	x	24	x 5987 = 176 MMBtu
Building Energy Performance		Annual Loss	/	Sq.ft heated	= BEPS BTU/sqft x .00315 US/metric
		176 x 10 ⁶	/	4427	= 39760 BTU/sqft = 125 kWh/m ²

TRANSMISSION LOSSES



4.ENERGY CONSUMPTION CALCULATIONS

This section deals with the actual energy consumed in the house due to heating, cooling, domestic hot water, appliances depending on their fuel type (gas or electric). It also shows the cost calculations . These will determine what retrofits are needed and in what way can the costs be controlled.



Water use in the home



12 watt LED



\$200 Lifetime Savings
over an incandescent with the same brightness

Yearly Operating Cost - \$2.58

Energy Usage - 12w

Brightness(Lumens) - 800

Bulb Lifetime- 50,000 Hours+

4everled

Heating

Heating: Building Load Coefficient

1. UA total for house (BTU/h °F) **1225** x 24 = **29400** building load coefficient (BTU/day °F)

(could vary per month if storm windows, night insulation, or zoning is used)

2. DD base 65 °F. Look up monthly DD at that base or calculate (new DD base— ave temp/month) x days month

Heating fuel type 1 **GAS** (choose: gas, oil, electric, other)

3B. heating system efficiency **80** %

4. \$ **5.5**/mmbtu

(total mmbtu from the bills divided by the \$ charged); total costs in 4. may be less than bills if gas is used for DHW, cooking, and drying.

10therm or 10ccf gas = mcf = mmbtu

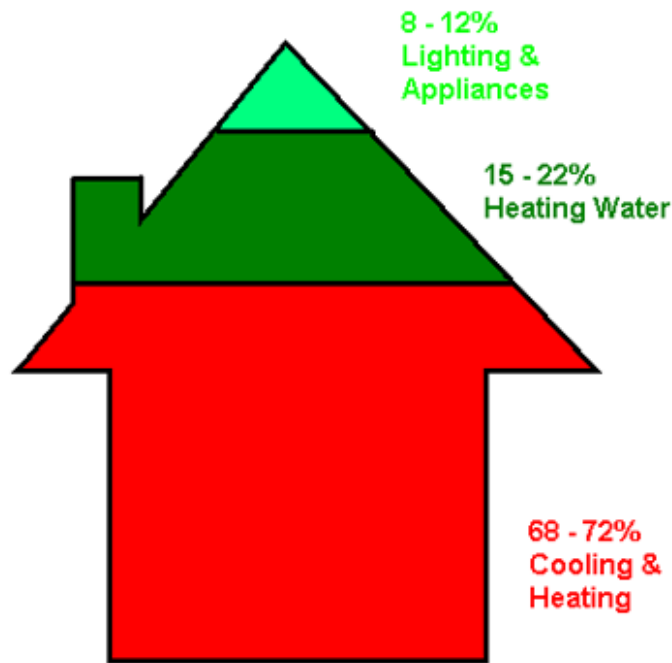
gal oil = 140,000 BTU = .14mmbtu

cord of wood = 20 mmbtu

1 kWh = 3413 btu (mmbtu = btu x 10⁶)

	1. BLC = 24 UA		2. mo. HDD (base 65°)		3. Htg. Load BTU x 10 ⁶ (1. X 2.)	divide by sys- tem eff. (eg. .85 = 85%)	3B. Htg. System Demand (BTU x 10 ⁶)		4. cost/ mmbtu		Total Heating Cost
Jan	29400	x	1221	=	35	0.80	43	x	5.5	=	236.5
Feb	29400	x	1293	=	38	0.80	47	x	5.5	=	258.5
Mar	29400	x	897	=	26	0.80	32	x	5.5	=	176
Apr	29400	x	371	=	10	0.80	13	x	5.5	=	71.5
May	29400	x	118	=	3	0.80	4.3	x	5.5	=	23.65
June	29400	x	43	=	1	0.80	1.5	x	5.5	=	8.25
July	29400	x	15	=	0.4	0.80	0.5	x	5.5	=	2.75
Aug	29400	x	26	=	0.7	0.80	0.9	x	5.5	=	4.95
Sept	29400	x	61	=	1	0.80	2.2	x	5.5	=	12.1
Oct	29400	x	354	=	10	0.80	13	x	5.5	=	71.5
Nov	29400	x	789	=	23	0.80	28	x	5.5	=	154
Dec	29400	x	917	=	26	0.80	33	x	5.5	=	181.5
			6105		174.1		218.4				1201.2
			Total HDD		Heating Load (mmbtu)		System Demand (mmbtu)				Heating Cost \$

Where Your Energy Dollar Goes:



Source: U.S. Department of Energy

What is the heating Btu/ SqFt?

btu/sqft = 49333

What is the heating Btu/ SqFt-HDD value?

btu/sqft-hdd = 8.08

Check the box to show the energy use of your home:

☐ **Passive house** = 1 watt house (per sqmeter and hdd metric) = 0.8 Btu/sqft/hdd

☐ **Best new homes:** 2 Btu/SqFt-HDD

☐ **ENERGY STAR® homes:** 5 Btu/SqFt-HDD

☐ **low usage existing homes:** 7 Btu/SqFt-HDD

☒ **medium usage existing homes:** 11 Btu/ SqFt-HDD

☐ **high usage existing homes:** 15 Btu/ SqFt-HDD

Domestic Hot Water

General Information

7. Monthly CDD or cooling hours/month (variable by month)

Equipment SEER rating 14 BTU/wh (find SEER and capacity on equipment)

Unit Capacity 24000 BTUh (note: 1 ton = 12,000 BTU/hrs) (if window units add all together)

8. Monthly cooling system demand in kwh/CDD 1.7 = unit capacity in BTU/hr divided by (SEER in BTU/wh x 1000 wh/kwh)

9. Electricity cost \$ 0.10 /kwh (from bills)

	5. DHW Load in BTU x 10 ⁶ or Kwh	\$/ mmbtu or \$/kwh	Total Domestic Hot Water Cost
Jan	1.2	5.5	6.6
Feb	1.2	5.5	6.6
Mar	1.2	5.5	6.6
Apr	1.2	5.5	6.6
May	1.8	5.5	9.9
June	1.8	5.5	9.9
July	1.8	5.5	9.9
Aug	1.8	5.5	9.9
Sept	1.8	5.5	9.9
Oct	1.2	5.5	6.6
Nov	1.2	5.5	6.6
Dec	1.2	5.5	6.6
Total?	17.4 DHW load		\$95.7 DHW cost

Domestic Hot Water

Activity	Gallons per use		# of times per month (Winter)		TOTAL (GPM)
Clothes Washing	32	x	4	=	128
Showering	20	x	35	=	700
Bathing	20	x	5	=	100
Automatic Dish-washing	12	x	4	=	48
Preparing Food	5	x	30	=	150
Hand Dishwashin	4	x	15	=	60
Total					1186

Activity	Gallons per use		# of times per month (summer)		TOTAL
Clothes Washing	32	x	4	=	128
Showering	20	x	60	=	700
Bathing	20	x	10	=	100
Automatic Dish-	12	x	4	=	48
Preparing Food	5	x	30	=	150
Hand Dishwashin	4	x	15	=	60
Total					1786

Cooling

General Information

7. Monthly CDD or cooling hours/month (variable by month)

Equipment SEER rating 14 BTU/wh (find SEER and capacity on equipment)

Unit Capacity 24000 BTUh (note: 1 ton = 12,000 BTU/hrs) (if window units add all together)

8. Monthly cooling system demand in kwh/CDD 1.7 = unit capacity in BTU/hr divided by (SEER in BTU/wh x 1000 wh/kwh)

9. Electricity cost \$ 0.10 /kwh (from bills)

	7. Monthly CDD		8. Cooling System Demand factor (kwh/CDD)		Monthly Cooling System Demand (kwh)	9. Electricity cost per kwh		Total Cooling Cost per month
Jan	0	x	1.7	=	0	x <u>0.10</u>	=	0
Feb	0	x	1.7	=	0	x <u>0.10</u>	=	0
Mar	0	x	1.7	=	0	x <u>0.10</u>	=	0
Apr	18	x	1.7	=	30.6	x <u>0.10</u>	=	3.06
May	172	x	1.7	=	292.4	x <u>0.10</u>	=	29.24
June	191	x	1.7	=	324.7	x <u>0.10</u>	=	32.47
July	273	x	1.7	=	464.1	x <u>0.10</u>	=	46.41
Aug	238	x	1.7	=	404.6	x <u>0.10</u>	=	40.46
Sept	185	x	1.7	=	314.5	x <u>0.10</u>	=	31.45
Oct	15	x	1.7	=	25.5	x <u>0.10</u>	=	2.55
Nov	1	x	1.7	=	1.7	x <u>0.10</u>	=	0.17
Dec	0	x	1.7	=	0	x <u>0.10</u>	=	0
Total	1093				1858 Total Cooling Load			\$186 Total Cooling Cost

Lighting

The clients changed all the bulbs last year to LED.

Hence,
 $(60 \text{ bulbs}) \times 12 \text{ W} \times 150 \text{ hrs/ mo} = 108000 \text{ Wh/ mo}$

Total Wh/mo / 1000 = 108 kWh

Electricity Cost = \$0.10/kWh

	10. Monthly Lighting Load KWh		11. Electricity cost \$/kwh		Monthly Lighting Cost
Jan	108	x	0.10	=	10.8
Feb	108	x	0.10	=	10.8
Mar	108	x	0.10	=	10.8
Apr	108	x	0.10	=	10.8
May	108	x	0.10	=	10.8
June	108	x	0.10	=	10.8
July	108	x	0.10	=	10.8
Aug	108	x	0.10	=	10.8
Sept	108	x	0.10	=	10.8
Oct	108	x	0.10	=	10.8
Nov	108	x	0.10	=	10.8
Dec	108	x	0.10	=	10.8
Total	1296 Lighting Load				\$129.6 Total Lighting Cost

As the clients are a middle aged couple, and both of them work , so according to them, they use light on an average 5-6 hours in a day, and that too, not all number of bulbs.

APPLIANCES

Appliance energy use

	quantity in house		average wattage in use****		average hours on/mo		Total (wh/mo)
Refrigerator/Freezer	<u>1</u>	x	<u>700</u>	x	<u>320</u>	=	<u>224000</u>
Dryer	<u>1</u>	x	<u>5000</u>	x	<u>5</u>	=	<u>25000</u>
Washer	<u>1</u>	x	<u>500</u>	x	<u>5</u>	=	<u>2500</u>
Oven/Stove	<u>1</u>	x	<u>1500</u>	x	<u>30</u>	=	<u>45000</u>
Laptop	<u>1</u>	x	<u>200</u>	x	<u>60</u>	=	<u>12000</u>
Standing Lamp	<u>1</u>	x	<u>50</u>	x	<u>10</u>	=	<u>500</u>
Vacuum Cleaner	<u>1</u>	x	<u>1000</u>	x	<u>7</u>	=	<u>7000</u>
TV	<u>1</u>	x	<u>200</u>	x	<u>90</u>	=	<u>18000</u>
Other (small appliances)	<u>5</u>	x	<u>100</u>	x	<u>26</u>	=	<u>13000</u>
Other (large, eg. Spa)	<u>5</u>	x	<u>120</u>	x	<u>80</u>	=	<u>48000</u>
					Total	=	<u>395000</u> wh/mo

12. (total wh/mo)/1000 = 395000 total kwh/mo

12. divide 1000 = 395 kwh/mo

13. Electricity cost \$ 0.10 /kwh

Appliances

	12. Monthly Appliance Load (KWh)		13 Electricity cost \$/kwh		Monthly Appliance Cost
Jan	395	x	0.10	=	39.5
Feb	395	x	0.10	=	39.5
Mar	395	x	0.10	=	39.5
Apr	395	x	0.10	=	39.5
May	395	x	0.10	=	39.5
June	395	x	0.10	=	39.5
July	395	x	0.10	=	39.5
Aug	395	x	0.10	=	39.5
Sept	395	x	0.10	=	39.5
Oct	395	x	0.10	=	39.5
Nov	395	x	0.10	=	39.5
Dec	395	x	0.10	=	39.5
Total	4740 Appliance Load				\$ 474 Total Appliance Cost

Ho

Total Monthly Electric Use

ELECTRIC	S Cooling	S Domestic Hot Water*	S Lighting	S Appliance	S Estimated Total
Jan	0		10.8	39.5	50
Feb	0		10.8	39.5	50
/1/ar	0		10.8	39.5	50
Apr	3.06		10.8	39.5	53
/1/ay	29.24		10.8	39.5	80
June	32.47		10.8	39.5	83
July	46.41		10.8	39.5	97
Aug	40.46		10.8	39.5	91
Sept	31.45		10.8	39.5	82
Oct	2.55		10.8	39.5	53
Nov	0.17		10.8	39.5	51
Dec	0		10.8	39.5	50
Total	\$186		\$129.6	\$ 474	\$790

	Actual Electric Bills
Jan	51
Feb	55
/1/ar	52
Apr	34
/1/ay	37
June	53
July	54
Aug	83
Sept	76
Oct	85
Nov	80
Dec	65
Total	\$725

These should match

Estimated ELECTRIC Annual Total : \$790 Actual ELECTRIC Total : \$725

- If applicable

Total Monthly Gas Use

GAS	S Heating	S Domestic Hot Water•	S Appliance•	Estimated TotalS Gas
Jan	236.5	6.6		243
Feb	258.5	6.6		265
Mar	176	6.6		183
Apr	71.5	6.6		78
/1/ay	23.65	9.9		34
June	8.25	9.9		18
July	2.75	9.9		12
Aug	4.95	9.9		15
Sept	12.1	9.9		22
Oct	71.5	6.6		78
Nov	154	6.6		161
Dec	181.5	6.6		188
Total	\$1201.2	\$95.7		\$1297

	Actual Gas Bills
Jan	193
Feb	220
/1/ar	110
Apr	83
/1/ay	55
June	35
July	33
Aug	55
Sept	58
Oct	83
Nov	110
Dec	165
Total	\$ 1200

• If applicable
 These should match
 Estimated GAS Annual Total \$1297
 Actual GAS Annual Total \$1200

Total Energy Consumption

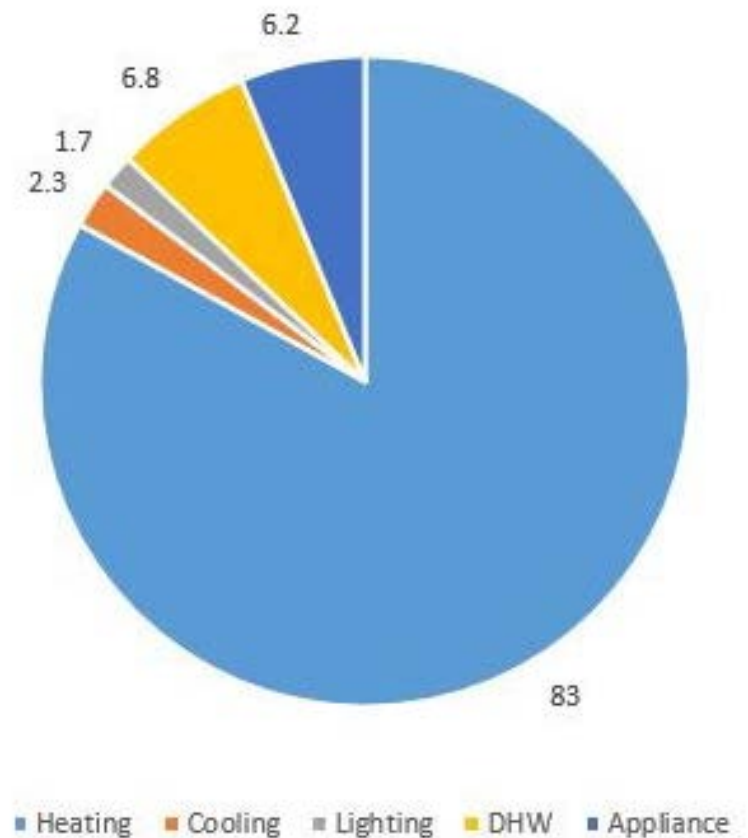
	Heating	Cooling	Lighting	DHW	Appliance	Totals
Annual ELEC in mmbtu equivalent		6	4		16	26
Annual GAS IN mmbtu	218.4			17.4		235.8
Percentage of Total Energy (%)	83	2.3	1.7	6.8	6.2	100%

How does your house compare to US
and International energy standards?

EUI for all fuels

Annual BTU/ft²

59137



Sample of Electric Bill



Customer Name and Service Address:

MUKESH PARIKH
305 S NEGLEY AVE APT 4
PITTSBURGH, PA 15232-1122
BILL ID: 338160488907

Account Number: 3381610000

Rate: RS-Residential Service

Date Prepared: 02/09/15

Meter Reading Usage Information

Next Scheduled Meter Reading Date: March 9, 2015

Meter Read Information for Meter Number: G90006242
Present: Feb 8, 2015 - Actual 2981.7800
Prior: Jan 10, 2015 - Actual 2955.8400
Difference 25.9400

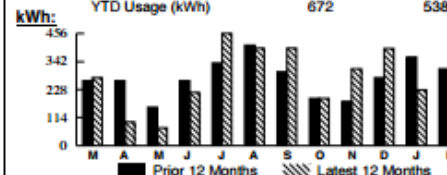
Your Meter Multiplier $\times$ 12
Total kWh Used 311.2800

Electric Usage:

Comparing Your Usage

Feb 14 Feb 15

Avg. kWh Per Day 11 11
Avg. Temperature (F) 25 26
YTD Usage (kWh) 672 538



DAYS IN BILLING PERIOD											
M	A	M	J	J	A	S	O	N	D	J	F
29	32	29	30	32	30	30	31	30	30	33	29
29	31	30	30	32	30	32	30	29	32	33	29

- Average Monthly Usage for the past 12 months is 279 kWh.
- Total Annual Usage for the past 12 months is 3345 kWh.

Estimated Gross Receipts Tax	Estimated PA State Taxes	Late Charge After Mar 2, 2015	Payment Due	Amount Due
\$3.22	\$3.71	1.25%	Mar 2, 2015	\$54.61

DO NOT PAY, ELECTRICCHECK WILL PROCESS YOUR PAYMENT AS LISTED BELOW.

Account Number
3381610000

DO NOT PAY

Amount Enclosed



MUKESH PARIKH
305 S NEGLEY AVE APT 4
PITTSBURGH, PA 15232-1122

DUQUESNE LIGHT COMPANY
PAYMENT PROCESSING CENTER
PO BOX 67
PITTSBURGH, PA 15267-0001



DO NOT PAY, ELECTRICCHECK WILL PROCESS YOUR PAYMENT FOR \$54.61 ON MAR 2, 2015.

Summary

Prior Billing Information

Amount of Last Bill \$40.29
Payment(s) Received as of 02/02/15 -\$40.29
Total Amount Owed From Your Last Bill \$0.00

Current Billing Information

DLC Basic Service Charges (see page 3) \$31.89
Supplier Basic Service Charges (see page 4) \$22.72
TOTAL ACCOUNT BALANCE PAYABLE TO DLC \$54.61

ACTUAL METER READING BILL

For more information see www.duquesnelight.com.

Give to Dollar Energy Fund to help people without heat or light. Make a monthly pledge at www.duquesnelight.com or send a check to Duquesne Light Hardship Fund Donations, 411 Seventh Avenue MD 15-1, Pittsburgh, PA 15219. Your gift is tax deductible.

Understanding Your Bill

Actual Meter Reading -- A reading we take from your meter. We read over 99% of our meters each month.

Basic Service -- The three charges for supply, transmission and distribution that all customers must pay to retain electric service.

Customer Charge -- A monthly charge on your bill that includes our costs for meter reading, customer billing, service equipment, implementation of advanced metering technology and other expenses. We have these expenses even in months that you may not use electricity. The advanced metering technology and related infrastructure will provide, in the next several years, the ability for features such as two-way communication, hourly usage information and electric-price information.

Distribution -- The local wires, transformers, substations and other equipment used to distribute and deliver electricity to end-use consumers from high-voltage transmission lines.

Distribution Charges -- Charges for the use of local wires and other equipment that deliver electricity to consumers and for energy efficiency programs that conserve energy and reduce demand.

Electric Distribution Company (EDC) -- The company that owns the power lines and equipment necessary to deliver purchased electricity to the customer.

Estimated Meter Reading -- Amount of electricity we determine that you may have used during the month, based on your prior electric use and weather conditions. We send you an estimated bill for the months when we have not read your meter.

Kilowatt-Hour (kWh) -- The basic unit of electric energy for which most customers are charged. The amount of electricity used by 10 100-watt light bulbs left on for one hour. Consumers are charged for electricity in cents per kilowatt-hour.

Multiplier -- A number we use to convert the difference between your meter readings to kilowatt-hours and to show your actual electric usage. Most residential meters have a multiplier of 12.

Non-Basic / Special Charges -- Any category of service not related to basic service (supply, transmission and distribution charges).

Supplier (Electricity Supplier) -- A person or corporation, generator, broker, marketer, aggregator or any other entity that sells electricity to customers using the transmission or distribution facilities of an electric distribution company (EDC).

Supply/Generation -- Production of electricity from a power plant.

Supply/Generation Charges -- Charges for production of electricity.

Transmission -- Interconnecting electric lines which move high-voltage electricity from where it is produced to the point of distribution to customers.

Transmission Charges -- Charges for moving high-voltage electricity from a supply facility to the distribution lines of an electric distribution company.

Special Services

Customer Protection Plan -- An injury, illness or vacation could prevent you from reading your mail as you usually would. At your request, we will send a copy of any Duquesne Light past-due notice to a person of your choice.

Employee I.D. Program -- All Duquesne Light employees have a photo-identification card. For your protection, ask to see it!

Customer Assistance Program -- Duquesne Light may be able to help you reduce your bills, arrange an affordable payment or provide information on cash grants, household budgeting or financial counseling. Our goal is to help eligible customers maintain their electric service. If you need help paying your bills, call and speak to a Customer Assistance Program specialist at 412-393-7600.

Billing and Payment Conveniences

e-Bill service -- Our free on-line bill presentment service. Once enrolled, you will no longer receive paper bills. You will receive an e-mail notification that your bill is available to view. You can sign up at www.duquesnelight.com

Automatic Bill Payment (ElectriCheck) -- Our free service to have your bill payment automatically deducted from your bank account on the due date of the bill. You can sign up at www.duquesnelight.com

Schedule an On-line Payment -- A free service to have your payment deducted from your bank account on the date you choose.

Make a One-Time Payment -- Credit card/check services. Go to our website at www.duquesnelight.com or call 1-866-526-0815.

Fees apply.

Budget Payment Plan -- Helps you level out your monthly payments.

U.S. Mail -- Use the payment coupon and envelope we provide to return your payment to us.

How to Reach Us

Visit our Website at: www.duquesnelight.com

Call us for: General information: 1-888-393-7100 or 1-412-393-7100
Credit & Collection: 412-393-7200
Emergencies: 1-888-393-7000 or 1-412-393-7000

Write us at: Customer Care Department
Duquesne Light Company
411 Seventh Avenue, MD 6-1
Pittsburgh, PA 15230-1930

Please call, email or write our business office for a copy of our rate schedules. For questions about your bill, please contact us before the bill due date.

Complete the information at the right to correct your name or mailing address.

For changes or corrections to be processed, check the box on the front the coupon.

PAYMENT MUST BE MAILED

Reason for change:

Name:

Street address:

City:

State:

Phone-home:

Phone-other:

Monthly Pledge to Dollar Energy Fund ☐ \$1.00 ☐ \$2.00 or other \$____.00

If you are moving and need to have your service turned on or off, you must call Customer Care at 412-393-7100.

Sample of Electric Bill



Customer Name and Service Address:
 MUKESH PARIKH
 305 S NEGLEY AVE APT 4
 PITTSBURGH, PA 15232-1122
 BILL ID: 338160489907

Account Number: 3381610000
 Rate: RS-Residential Service
 Date Prepared: 02/09/15

Page 3

Duquesne Light Company Information	Duquesne Light Company Basic Service Charges												
Important Information: \$\$\$ Low Income Home Energy Assistance Program (LIHEAP) funds are available. Please call 1-888-393-7600 for an application today! \$\$\$ Duquesne Light's WATT CHOICES offers energy efficiency programs to help customers save money by conserving energy and reducing demand. To participate or to learn more about these programs, visit www.wattchoices.com or call 1-888-WATTLEY. Need to reach us? Call (412) 393-7100 or on the web @ www.duquesnelight.com You can join our Budget Plan by calling us at (412) 393-7100. If eligible, the Budget Plan will begin with your next bill. For this bill, please pay the Amount Due shown.	<table> <tr> <td>Current Charges</td><td></td></tr> <tr> <td>Customer Charge</td><td>14.69</td></tr> <tr> <td>Distribution 311.2800 kWh@ 5.529200¢</td><td>17.21</td></tr> <tr> <td>Pennsylvania Tax Adjustment</td><td>-0.01</td></tr> <tr> <td>Total Current Charges</td><td>\$31.89</td></tr> <tr> <td>DLC Basic Service Charges</td><td>\$31.89</td></tr> </table>	Current Charges		Customer Charge	14.69	Distribution 311.2800 kWh@ 5.529200¢	17.21	Pennsylvania Tax Adjustment	-0.01	Total Current Charges	\$31.89	DLC Basic Service Charges	\$31.89
Current Charges													
Customer Charge	14.69												
Distribution 311.2800 kWh@ 5.529200¢	17.21												
Pennsylvania Tax Adjustment	-0.01												
Total Current Charges	\$31.89												
DLC Basic Service Charges	\$31.89												
The Price to Compare for your rate class is 8.09 cents/kWh. It will change every June and December. For more information & supplier offers visit www.PAPowerSwitch.com and www.oca.state.pa.us.													



Customer Name and Service Address:
 MUKESH PARIKH
 305 S NEGLEY AVE APT 4
 PITTSBURGH, PA 15232-1122
 BILL ID: 338160489907

Account Number: 3381610000
 Rate: RS-Residential Service
 Date Prepared: 02/09/15

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Supplier Basic Service Charges	General & Supplier Information
Current Charges Generation-Trans 311.2800kWh@ 7.300¢ <u>22.72</u> Total Current Charges	

5.RETROFIT RECOMMENDATIONS

This section deals with the suggested retrofit measures that can help in improvising the energy consumption as well as the cost savings due to their implementation.

These measures can be widely described as :

- Reducing the infiltration losses
- Using Setback Thermostats
- Zoning the house
- Night Insulation on windows
- Replacing appliances
- Using surge strip to prevent vampire loads
- Use of low flow fixtures
- Also, the clients are requested to follow some sustainable practices like switching off appliances when not needed, Avoiding infiltration by tightly shutting down all the possible junctions from where air can enter, Avoid frequent opening of doors etc.



A. CAULKING

Caulking should be done in order to resist the infiltration of air through cracks and minor air gaps-junctions where there are cables going across the window, door jambs etc. Hence, caulking is done or sealing such gaps.

Product Name : Silicone II 10.1-oz White Caulk

Rate : \$5.92

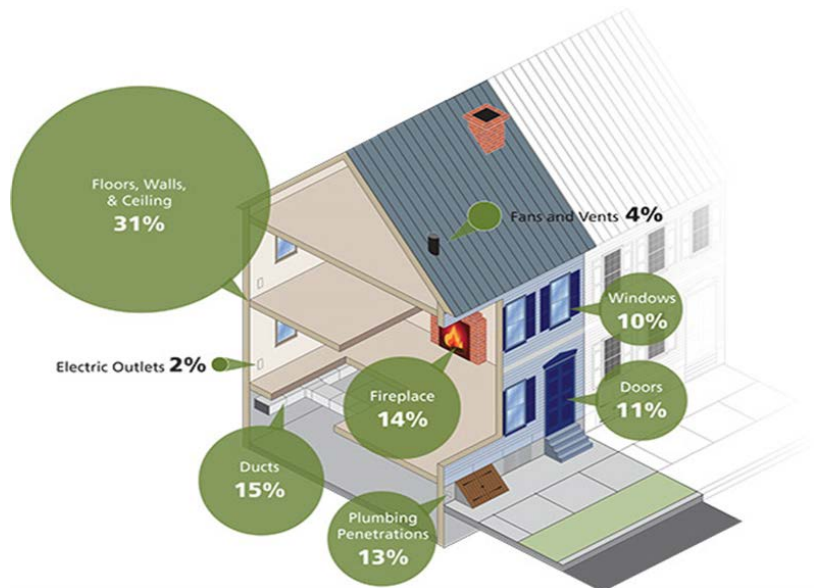
Type : Silicone

Product Name : Dripless 10 oz Cradle Hex Rod Caulk Gun

Rate : \$5.78

Installation Instructions:

- Surface should be dry,
- Caulking gun should be at an angle of 45° on the cracks,
- It should be continuously applied without stopping.



Cartridge



Caulk Gun

Cost Calculations:

Total Running Footage of windows and doors : 636 (approx.)

Total number of cartridges required

$$636 / 55 = 1.5 \sim 12 \text{ nos.}$$

$$\begin{aligned} \text{Total Cost : } &(\$5.92 \times 12) \\ &= \$71 \end{aligned}$$

(1 Tube cartridge = Typical Coverage of 55ft)

It is used around :

windows, doors, siding, trim, moulding, baseboards, vents, around wires/pipes and other attic/ basement application

B. WEATHERSTRIPPING

Weatherstripping should be done in order to seal the air leaks around the openable building components – doors and windows.

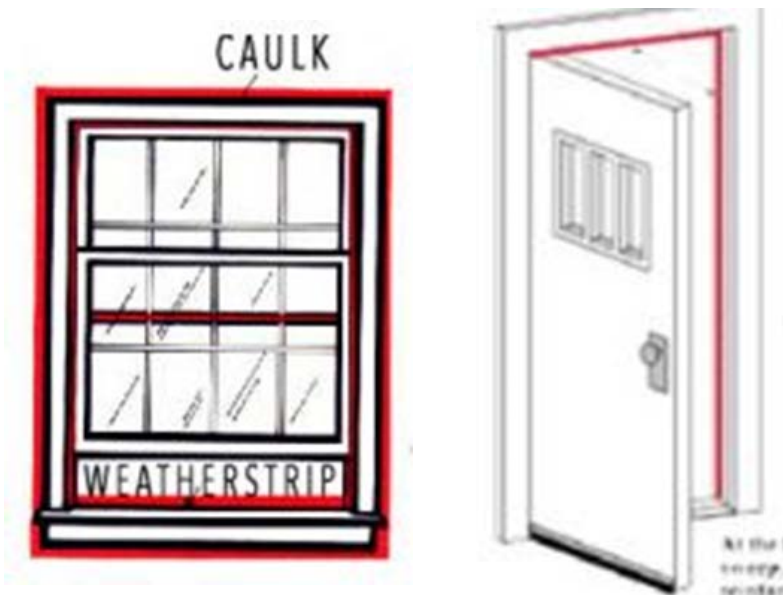
Product Name : V- STRIP – durable

Rate : \$3.97 per 17 ft

Dimension : 7/8 in. x 17 ft

Installation Instructions:

- Surface should be dry,
- Apply snugly against both surfaces
- Weatherstrip the entire door jamb
- It should meet tightly at the corners
- For air sealing windows, apply weatherstripping between the sash and the frame. The weatherstripping shouldn't interfere with the operation of the window.



Cost Calculations:

Total Running Footage of windows and doors : 636 (approx.)

Total number of cartridges required

$$636 / 17 = 37.4 \sim 38 \text{ no. of strips}$$

$$\begin{aligned} \text{Total Cost : } & (\$3.97 \times 38) \\ & = \$150.86 \end{aligned}$$



Reduction in infiltration losses due to caulking and weatherstripping

Product Name : Frost King E/O 1-3/4 in. x 36 in. Universal

Drip Cap Door Bottom (Model # UDB36BR)

Rate : \$7.77

Dimension : 1.75 wide x 1.5 ht

The energy loss through constant movement of the door can be minimized by providing door bottoms and smooth top thresholds. Also, when the doors are closed, there is very minimal chance of air infiltration through tiniest of gaps.

Infiltration rate reduction : 30%

New infiltration rate : 857 Btu/h F

Cost Calculations :

Door Bottom = $\$7.77 \times 7 = \54.39

Payback and Energy Saving

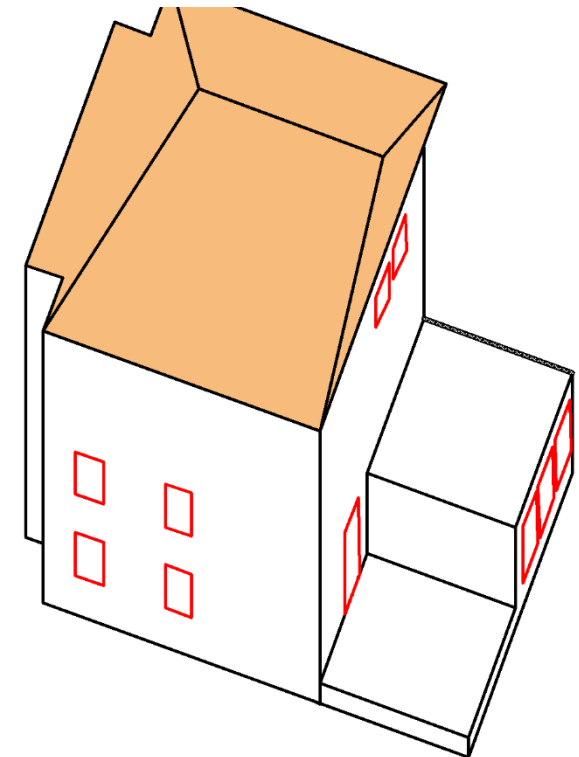
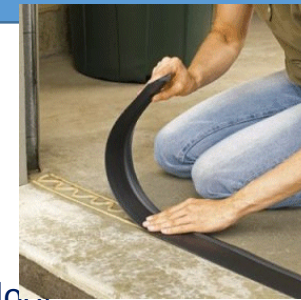
Including the caulking, weatherstripping and door bottoms,

Total cost = $\$71 + \$150.86 + \$54.39$
= 276.25

Annual Energy Savings = 45 mmBtu

Annual Cost Saving = \$247.5

Payback period = 1 year



C. SET BACK THERMOSTAT

Thermostat will have more than one settings according to the occupancy schedule of the residents. It helps to maintain the HVAC settings and has a significant impact on degree days.

Product Name : NEST Learning Thermostat, 2nd Generation

Rate : \$199

Features:

- Auto- Schedule
- Energy History
- Auto Tune
- System Match
- Auto Away

Payback and Energy Savings :

Current Heating Degree Days at 65F = 6105

New Heating Degree days at 55F = 3710

Considering the setpoint at 65 F for 12 hours in a day and at 55F for other 12 hours of the day,

Heat Load Without NEST : $29400 \times 6105 = 179 \text{ mmBtu}$

Heat Load With NEST : $29400 \times 3710 = 109 \text{ mmBtu}$

Hence,

Annual Energy Savings : 35 mmBtu

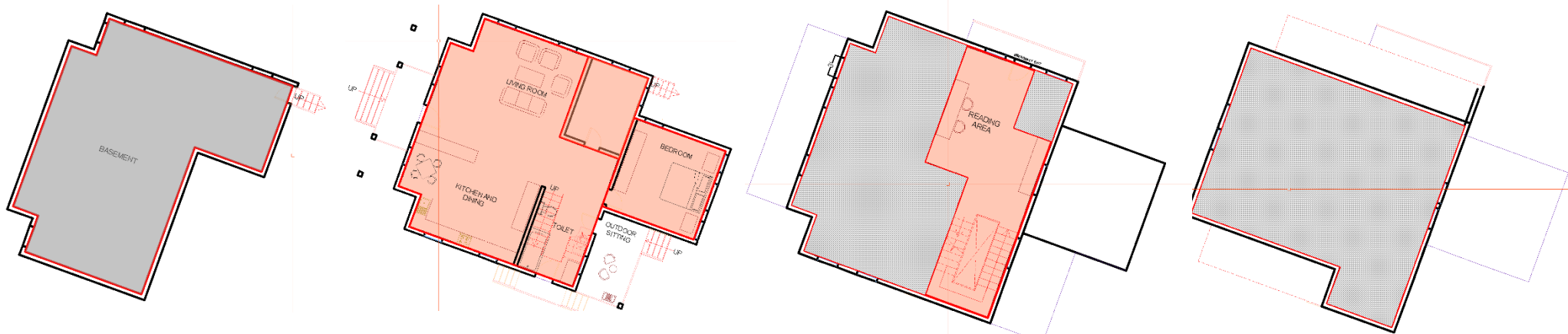
Annual Cost Savings : $[179 - (109/2) + (179/2)] = 35 \text{ mmBtu} \times \5.5
= \$ 192.5

Payback period: $199/192.5 \times 12 \sim 1 \text{ year}$



D . HOUSE ZONING

The house should be zoned as there are only two occupants so most of the spaces are not used daily. Hence, the zoning should be done as extensively used spaces and rarely used spaces.



The design temperature for normally conditioned space when the spaces are occupied for 12 hrs (65 F) and for another 12 hrs (55 F) is
$$= (12 \text{ hrs} \times 65 \text{ F} + 12 \text{ HRS} \times 55 \text{ F}) / 2 = 60 \text{ F}$$

New HDD for 60 F = 4691

Design Temperature for unused spaces = 50 F

New HDD FOR 50 F = 2861

Total square footage of space used extensively throughout the day : 1909 sf (~40 % of total area)

Total square footage of unused space : 2518 sf

Now,

$\text{HDD}@60 \times 40\% \times 29400 = 55 \text{ mmBtu}$

$\text{HDD}@50 \times 60\% \times 29400 = 50 \text{ mmBtu}$

Total Heat Loss = 105 mmBtu

Now $\text{HDD}@65 \times \text{BLC} = 179$

Annual Energy Savings = $179 - 105 = 74 \text{ mmBtu}$

Annual Cost Savings = \$ 407

Payback period: 1.2 months



**Product Name : HONEYWELL RTH2510B 7
DAY PROGRAMMED THERMOSTAT**

Rate : \$160

E .NIGHT INSULATION ON WINDOWS

These shades should be installed in order to mitigate the losses due to infiltration.

Product Name : Blindster Super VALUE Blackout Triple Cell Shade

Rate : \$98

R-Value : 5

Width: 16"-72"

Height: 12"-84"

Headrail dimensions: 1 7/8" (depth) x 1 3/4" (height)

R Value of existing double pane windows : 2

R Value of existing double pane windows with recommended cellular shades: 7

$$\begin{aligned}\text{Effective U value of the window} &= (U \text{ closed} \times 12\text{hrs}) + (U \text{ open} \times 12) / 24 \\ &= (0.11 \times 12) + (0.2 \times 12) / 24 \\ &= (1.32) + (2.4) / 24 \\ &= 4.08 / 24 \\ &= 0.15\end{aligned}$$

Previous annual Heat Loss = 176 mmBtu

New Heat Loss = 162 mmBtu

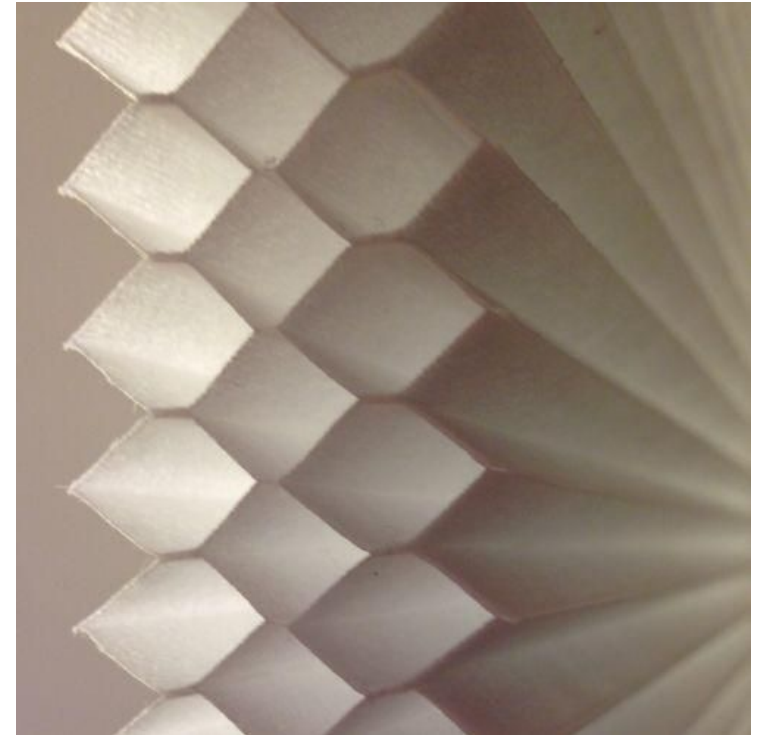
So. Reduction in heat loss is 14 mmBtu

Annual Heating Energy Cost Saving = \$61.60

Cost for 1 = \$98

Total cost = 23 x \$61.60 = \$1417

Payback period: = 23 years



F .REFRIGERATOR

Among all the appliances, highest electrical load is due to refrigerator. Hence, replacing it may have a large effect on electrical energy savings.

Product Name : Fisher & Paykel, RF201A

Rate : \$2299

Features:

- Capacity : 20.2 cu ft
- Freezer Type : Bottom
- Energy Consumption : 448 kWh/year
- Annual Operating Cost : \$47
- Energy Savings : 16 %

Annual appliance energy consumption = $192 \text{ kWh/mo} \times 0.10 \times 12 =$
\$230.40

Modified appliance energy consumption = $448 \times 0.10 = \$44.80$

Savings = \$185.60

Payback period: = $2299/185.60 = 12.4 \text{ years}$



G .SURGE STRIP

In order to get rid of the vampire loads, surge strip is a great intervention in order to prevent unnecessary expenditure.

Product Name: APC P8GT 8 Outlets 120V Power-Saving Home/Office Surge Arrest with Phone Protection

Rate : \$22.95

Installation : Plug into wall outlet

- 8 outlets, 8 outlets- 3 always on, 1 master control, 4 switchable
- 6 feet power cord
- Peak Current Common Mode: 144 kAmps
- Phone/fax/modem line protection



Annual Energy Saving : 253 kWh

Annual energy cost saving : $253 \times 0.10 = \$25.32$

Payback period : $\$22.95 / \$25.32 = 9$ months

Appliances	Watt (When switched off)	Hours not used per month	Total (Wh/ mo)	Total (kWh/ mo)
Television	24.35	650	15827.5	15
Computer	4.55	650	2957.5	3
Microwave	3.15	715	2249.1	2.2
Coffee Maker	1.35	712	961.2	0.9
(Other 4 switchable)	--	--	--	--

H .LOW FLOW FIXTURES

Most part of the DHW is used in showering. Hence, efficient showerheads can contribute in saving energy.

Product Name : High Sierra 1.5 GPM High Efficiency Low Flow

Shower Head, Polished Chrome

Rate : \$35

No. of showers : 2

- Flow Rate : 1.5 gpm
- Saves 40% or more and the energy to heat water
- Meets EPA criteria
- Dimension : 2.5 x 1 x 1 inches



Existing Water Heating Load (shower) = 1400 Gallons/year = 1.4 mmBtu/ month

Existing hot water cost for showering = $1.4 \times 5.5 \times 12 = \92.4

New DHW Load for showering in mmBtu = 560 gallons $\times 0.001$ mmbtu/gallon = 0.56 mmBtu/ month

Total annual domestic hot water cost for showering after retrofit = \$36.96

Annual Savings = \$55.44

Payback Period = $(2 \times \$35) / \$55.4 = 1.2$ years

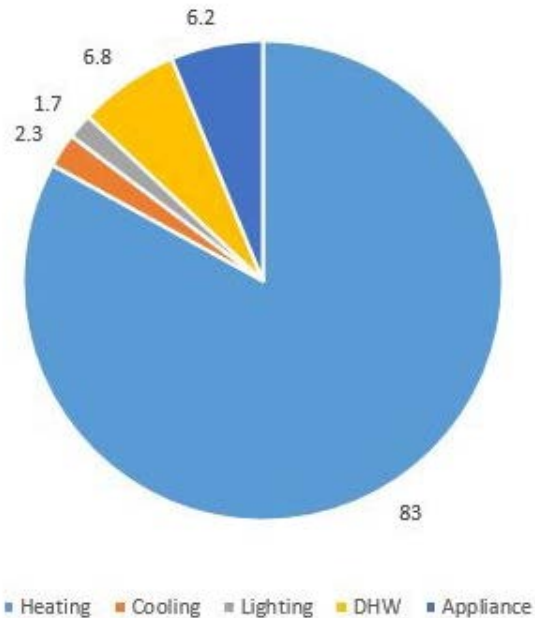
ENERGY CHANGES AFTER RETROFITS

		R-value	U-value	Total area	Heat loss Coefficient
		(hrft2°F/Btu)	(Btu/hrft2°F)	ft2	UA=Btu/hr °F
WALLS	Wall 1 (W1)	25.44	0.039	2553	99.567
	Wall 2 (W2)	25.97	0.038	1104	41.952
WINDOWS	Double pane	2	0.15	276	41.4
DOORS	Wood with glass	1.25	0.8	147	117.6
FLOORS	Roof 1 (R1)	28.16	0.035	1200	42
	Slab				
BELOW GRADE FLOORS		modified U		ft2	
	Floor 1 (F1)	0.08		940	75.2
BELOW GRADE WALLS		total F		perimeter ft.	
	Wall 3 (W3)	0.26		139	36.14
INFILTRATION (heated volume of the building x number of air changes x the heat capacity of air .018 Btu ft3°F					
	#A.C. x .018 x volume cu.ft. = heat loss coefficient				
	1 x 0.018 x 39800 = 570.6 Btu/hr°F				
	570				
TOTAL HEAT LOSS COEFFICIENT (total UA) Btu/hr°F				100%	982
HEAT LOSS SOURCE					
				UA HEAT LOSS Btu/hr°F	%
Transmission Losses:					
	Walls			141.519	14.41%
	Windows			41.4	4.22%
	Doors			117.6	11.98%
	Floors			75.2	7.66%
	Ceilings			42	4.28%
	Infiltration Losses			570	58.05%
PEAK HEAT LOSS (BTU/h)		=	Total UA	x T (design indoor°F - design outdoor°F)	
		=	982	x	65 63824 Btu/h
ANNUAL HEAT LOSS (MMBTU)		=	Total UA	x 24hrs x annual degree days	
		=	982	x	24 x 2652 62496417
Building Energy performance		Annual Loss	/ Sq.ft heated	= BEPS BTU/sqft x .00315 US/metric	
		176 x 10 ⁶	/	4427	= 39760 BTU/sqft = 125 kWh/m ²

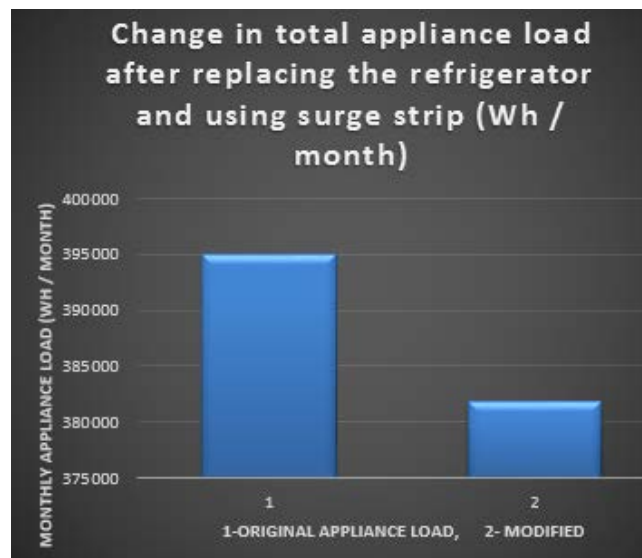
COMPARISON OF ENERGY SAVINGS

ENERGY CONSUMPTION IN %

ORIGINAL

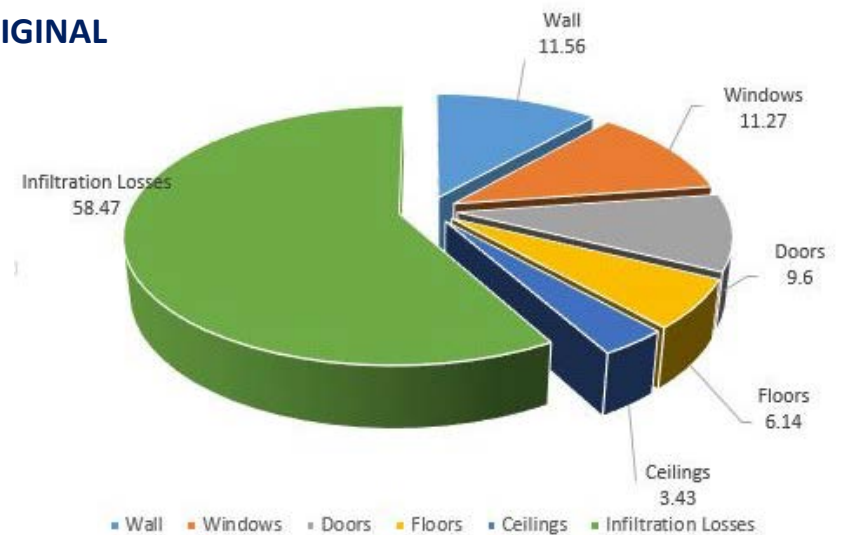


AFTER RETROFIT (Appliance load had to be minimized)

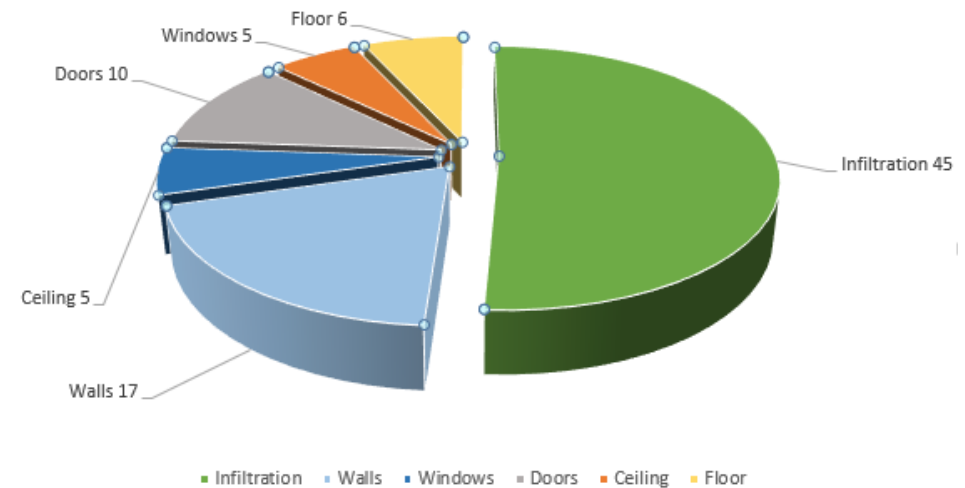


TRANSMISSION LOSSES IN %

ORIGINAL



AFTER RETROFIT



6.PASSIVE SOLAR STRATEGIES

Aim: To find out the total area of glass required to make up for the heat loss that is taking place on a typical January day

Suntempering:

Glass area calculation

$$[UA_h + U_g A_g + U_{sw}(A_{tw} - A_g)] (t_i - t_o) = I_s A_g$$

$$UA_h = 940 \text{ Btu/hr}^\circ\text{F}$$

$$U_g = 0.15 \text{ Btu/hrft}^2^\circ\text{F}$$

$$A_g = x$$

$$U_{sw} = 0.03 \text{ Btu/hrft}^2^\circ\text{F}$$

$$A_{tw} = 1215 \text{ sq.ft.}$$

$$T_i = 65 \text{ degrees F}$$

$$T_o = 28 \text{ degrees F}$$

Calculating the I_s by adding the morning SE and the afternoon SW totals.

$$\text{Solar Heat Gain Factor} = 934 + 273 = 1207 \text{ Btu/hr.sqft}$$

$$S_{\text{global}} = 740 \text{ Btu/sq.ft./day}$$

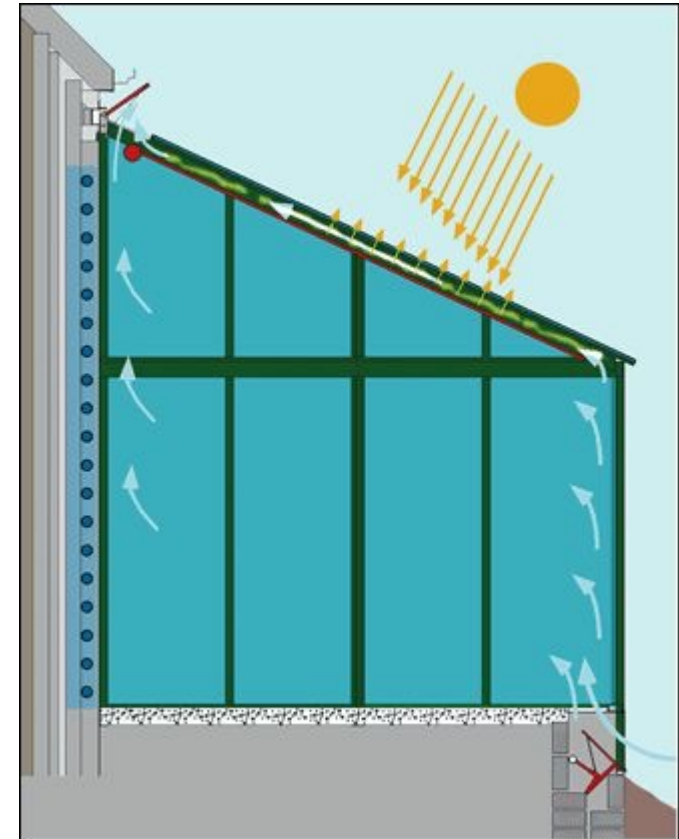
$$\text{Percentage} = 254/1207 = 21.04\%$$

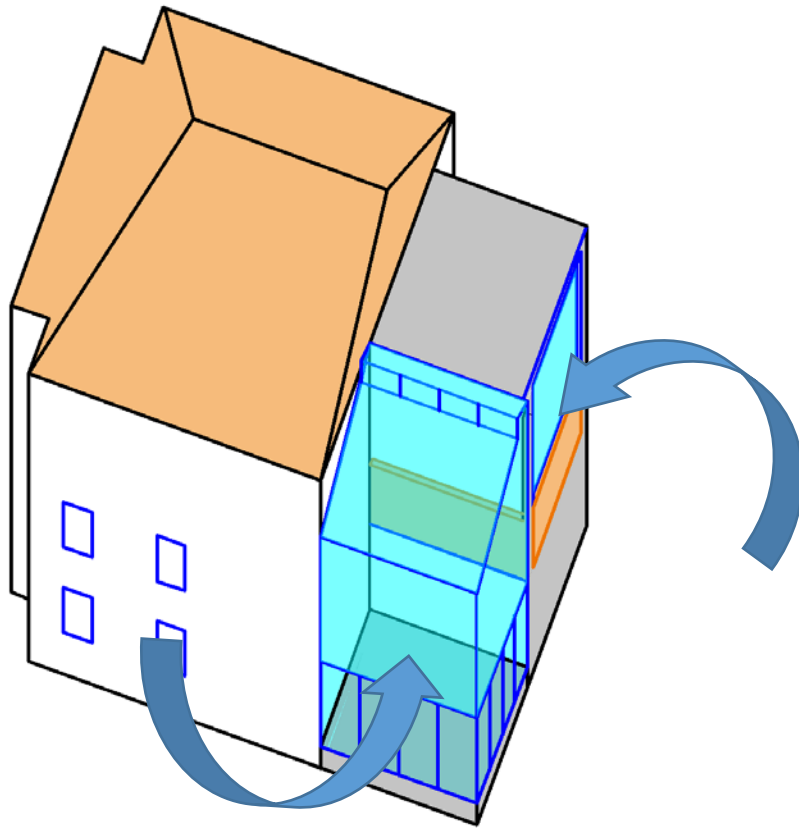
$$\begin{aligned} \text{Calculating } I_s &= 21\% \text{ of } 740 \times 0.55 \\ &= 85.63 \end{aligned}$$

$$[UA_h + U_g A_g + U_{sw}(A_{tw} - A_g)] (t_i - t_o) = I_s A_g$$

$$(940) + (0.15 * A_g) + 0.03 (1215 - A_g)] (65 - 28) = 85.63 A_g$$

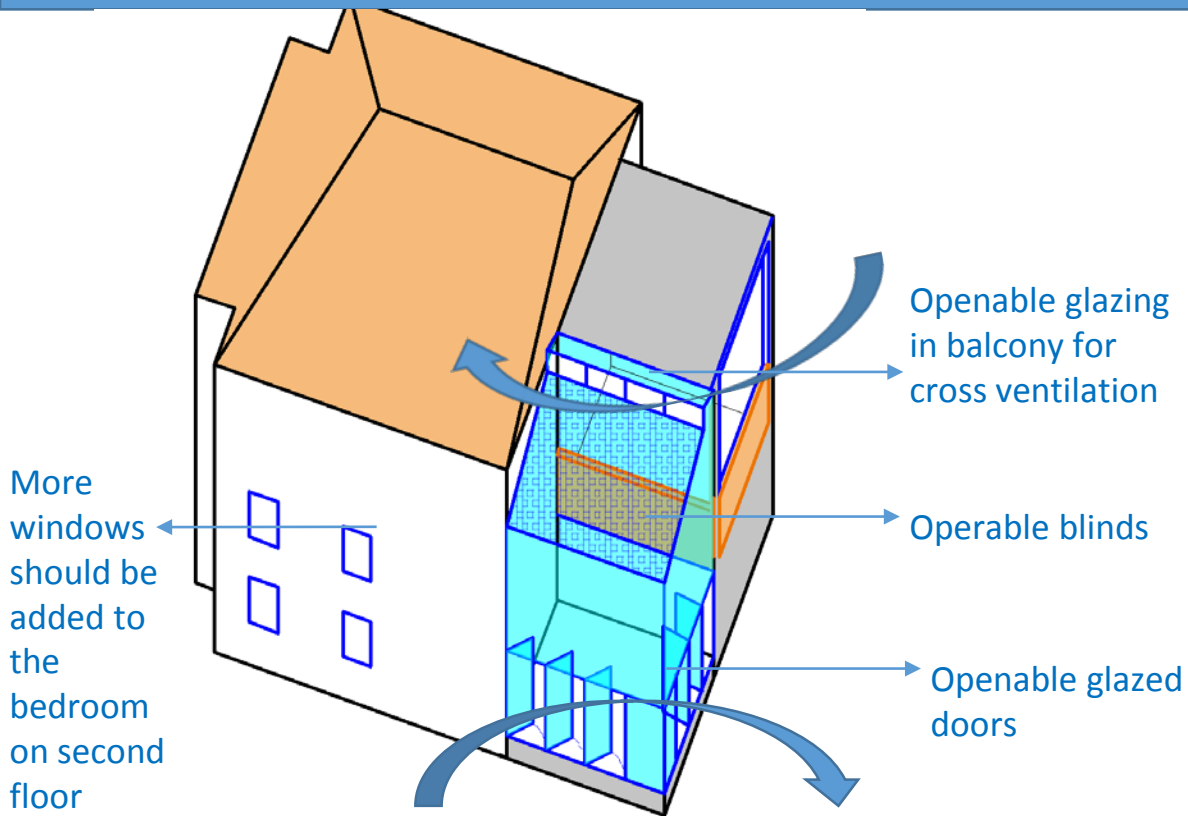
$$A_g = \mathbf{445 \text{ sqft}}$$



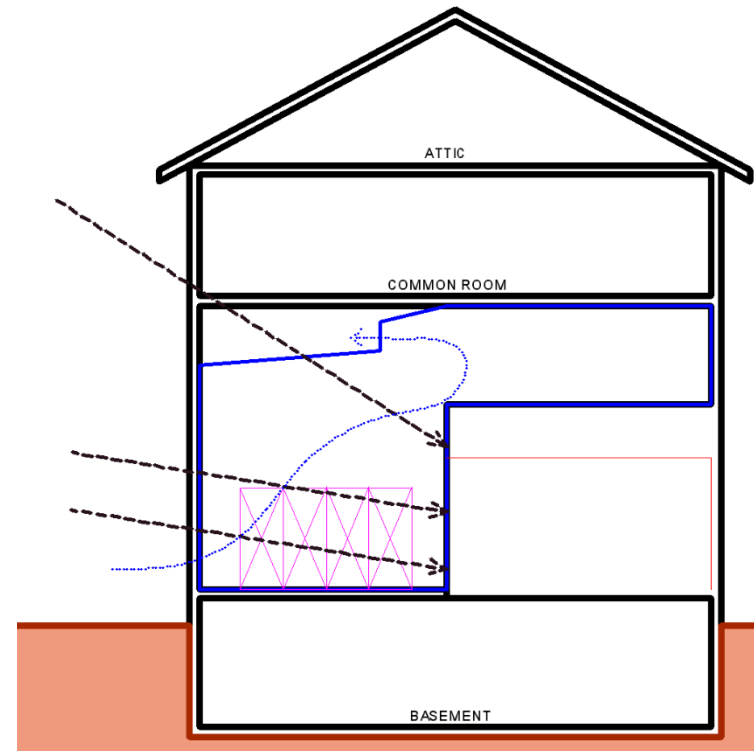


Winter Scenario

- The south-west façade is selected to add up a sunspace in order to get a maximum advantage of the incident solar radiation.
- The deck as a sitting space. The area on second floor, that lies above the first floor bedroom is converted into a semicovered balcony.
- This has openable glazed windows, which can be used for solar storage in winter as well as for cross ventilation in summer.
- A series of clerestorey windows is also added in the south – east façade so as to ensure proper circulation of air, when opened.
- Out of 445 sq ft of glazing, 80 % will be used for sun space while 20 % will be used to add windows to the bedroom on second floor.
- The sunspace allows the distribution of heat from kitchen to living room, when all the internal openings are open.
- The solar deck above ensures heat gain on the second floor as well, redirecting it to the bedroom soaces.
- The bedroom with added windows shall be more thermally comfortable as the glass used has lower U value, hence it gains heat but reflects the sunlight.



Summer Scenario



- The sunspace on the deck has movable glazing, so during summer, to avoid excessive heat gain, They can be opened in order to ensure circulation of air. The clerestory windows can be opened for that purpose as well.
- The balcony on the floor above overlooks the deck and its openings also serve the same purpose.
- The wall on which the sunlight is incident directly, is colored dark, so as to increase the heat gain. It also heats the adjacent living spaces.
- The folding doors are added to kitchen area, so when they are opened, the heat can be distributed evenly all along the floor.
- The operable blinds are needed to avoid overheating in summer.