IPRO 317

Net Zero Zero Energy Home
1114 W. Roscoe Ave. Chicago, IL

netZERO

Conclusion:

Energy consumption in a building is greatly affected by the amount of energy used by the residents. The residents must be conscious about how much energy they are using because the use of every day appliances makes a large impact on energy consumption.

Secondly, one must consider the site. After extensive site analysis we were able to determine that one cannot simply throw together all the most efficient products and materials and end up with a green home. The orientation, dimensions, and location of a site can greatly affect the area. One must take into consideration the soil composition, water table, north-south facing vs east-west for sun exposure, and height restrictions just to name a few of the issues that arise from having a bad site. After analyzing a site and determining what you can and cannot use there, you need to determine what you should use. This is a complicated and involved step as we learned that with every positive aspect of a design there is a negative one to counteract it and that you must learn to determine when the goods outweigh the bad.

Furthermore, you need to take into consideration the envelope or the shell of the house. The envelope will affect the choices you make for the electrical and heating and ventilation systems. So it is important to chose an optimal material for the house that optimizes your net usage. Designing and optimizing the envelope also depends on the number and placement of windows, minimizing exterior wall area, orientation et cetera. This is why we turned to the energy modeling software.

In order to get started, we found you need to start with a base design for a building. This design doesn't need to be perfect as you will modify the design and through an iterative process of modeling and revising the design you can reach your energy goal. This process also helps in determining the positive and negative effects of certain systems.

Another issue we had to deal with is effective communication between the large amount of people involved. We found that dividing into smaller subgroups and delegating each group a task for coming up with various green solutions of specific categories, you can then do the iterative modeling tests and come up with a final design.

Acknowledgements:

Advisor: Nancy Governale-Hamill
Sponsor: Jimmy Eng
Equest Consultant: Keith Swartz

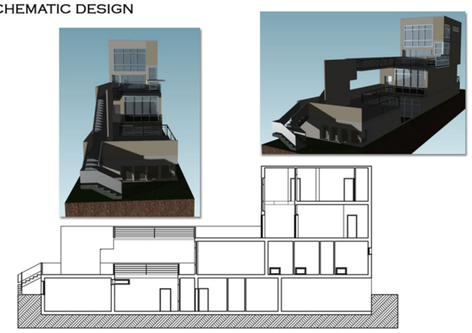
eQUEST
Quick Energy Simulation Tool

Future work:

The Future of This IPRO is to move towards the design-build phase, actually constructing a test structure as designed, and observe the resulting data to compare projected cost and energy savings and realistic energy savings.

Schematic Design

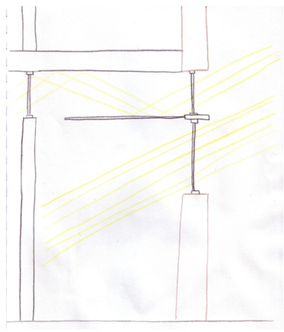
SCHEMATIC DESIGN

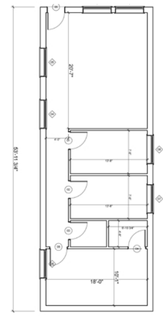


ZONING ANALYSIS — CLASSIFICATION: RT-4

17-2-0103 RT, RESIDENTIAL TWO-FLAT, TOWNHOUSE AND MULTI-UNIT DISTRICTS. THE PRIMARY PURPOSE OF THE RT DISTRICTS IS TO ACCOMMODATE DETACHED HOUSES, TWO- FLATS, TOWNHOUSES AND LOW-DENSITY, MULTI-UNIT RESIDENTIAL BUILDINGS AT A DENSITY AND BUILDING SCALE THAT IS COMPATIBLE WITH RS DISTRICTS. THE DISTRICTS ARE INTENDED TO BE APPLIED IN AREA CHARACTERIZED BY A MIX OF HOUSING TYPES. THE DISTRICTS ARE ALSO INTENDED TO PROVIDE A GRADUAL TRANSITION BETWEEN RS DISTRICTS AND HIGHER DENSITY RM DISTRICTS. THE RT DISTRICTS ARE DIFFERENTIATED PRIMARILY ON THE BASIS OF ALLOWED DENSITY (MINIMUM LOT AREA PER UNIT) AND FLOOR AREA RATIOS. THE RT-4A DESIGNATION IS INTENDED TO ACCOMMODATE AND PROMOTE MULTI-UNIT BUILDINGS CONTAINING ACCESSIBLE DWELLING UNITS

RESIDENTAIL USES ALLOWED:	DETACHED HOUSE, ELDERLY HOUSING, TWO-FLAT, TOWNHOUSE, MULTI-UNIT RESIDENTIAL (3+ UNITS), SINGLE ROOM OCCUPANCY
MINIMUM LOT AREA:	1,650 SQUARE FEET
MINIMUM LOT FRONTAGE STANDARDS :	AVERAGE FRONT YARD DEPTH OF NEAREST TWO PROPERTIES. MINIMUM OF 12' DIMENSION
MINIMUM REAR YARD OPEN SPACE:	65 SQUARE FEET PER DWELLING UNIT OR 6.5% OF LOT, WHICHEVER IS GREATER. MINIMUM OF 12' DIMENSION
MAXIMUM FLOOR AREA RATIO:	1.20
MAXIMUM BUILDING HEIGHT:	38'

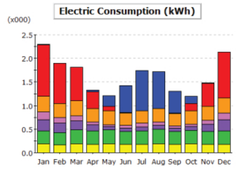


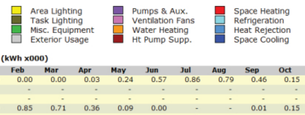


Results:

Zero Energy Green Home

-R50 exterior wall construction
-HVAC: DX Coils with Ground Source Heat Pump
-Energy Efficient Lighting
-Quadruple Low-E Glazing
-Daylighting Controls
-Each unit uses about 550 kWh per month





Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.00	0.00	0.00	0.03	0.24	0.57	0.86	0.79	0.46	0.15	0.01	-	3.11
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	1.10	0.85	0.71	0.36	0.09	0.00	-	-	0.01	0.15	0.49	0.97	4.73
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.33	0.30	0.32	0.29	0.29	0.26	0.26	0.27	0.26	0.29	0.30	0.33	3.50
Vent. Fans	0.16	0.13	0.11	0.06	0.04	0.06	0.08	0.08	0.05	0.04	0.08	0.15	1.02
Pumps & Aux.	0.23	0.20	0.19	0.13	0.08	0.07	0.09	0.08	0.07	0.09	0.16	0.23	1.61
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.28	0.26	0.29	0.28	0.29	0.28	0.28	0.30	0.27	0.29	0.27	0.28	3.39
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.19	0.17	0.19	0.18	0.19	0.17	0.18	0.19	0.17	0.19	0.18	0.18	2.18
Total	2.29	1.90	1.82	1.33	1.21	1.42	1.74	1.72	1.30	1.20	1.48	2.14	19.55

After calculating the energy required for the home to fuction, we plug the number of kilowatt hours needed per month into the solar panel datasheet, which gives us the cost and required roof square footage to supply the residence with enough power.

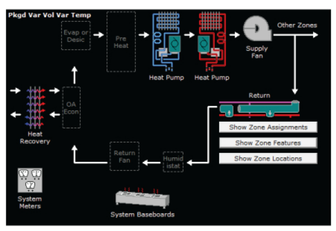
Solar Panels

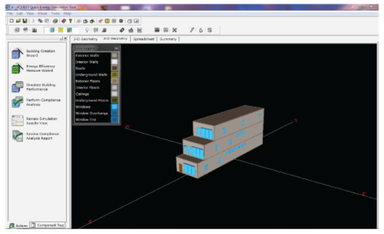
#	Brand	Model #	# of panels	Watts Per Panel	Kwh per Month Per Panel	Total kwh Provided	Panels Needed	Sets needed	Dimensions of 1 panel Length (m)	Width (m)	Area m^2	Total Area m^2	Total Area ft^2	Cost/set	Total Cost
1	Kyocera	210	20	210	23.76	475.23	74	4	1.50	0.99	1.49	110.04	1184.46	$12,600.00	$50,400.00
2	Kyocera	KC40T	1	40	4.53	4.53	387	387	0.53	0.65	0.34	132.83	1429.76	$265.00	$102,555.00
3	Kyocera	205	20	205	23.20	463.92	76	4	1.50	0.99	1.49	113.01	1216.47	$11,890.00	$47,560.00
4	Kyocera	180	20	180	20.37	407.34	86	5	1.34	0.99	1.33	114.25	1229.80	$10,440.00	$52,200.00
5	Applied Solar	4ft	1	48	5.43	5.43	323	323	0.44	1.14	0.51	164.10	1766.41	$0.00	$0.00
6	Applied Solar	3ft	1	34	3.85	3.85	455	455	0.43	0.91	0.39	179.65	1933.75	$0.00	$0.00
7	Applied Solar	STP200	1	200	22.63	22.63	78	78	1.22	1.22	1.49	115.94	1248.00	$0.00	$0.00
8	Applied Solar	STP400	1	400	45.26	45.26	39	39	1.22	2.44	2.97	115.94	1248.00	$0.00	$0.00

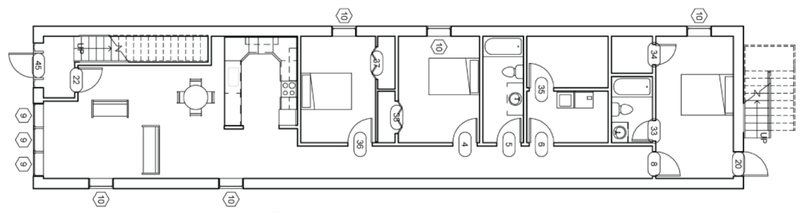
Prices with links are due to different bulk prices than single unit prices

Monthly Energy Needed		Roof Area		
1750	kwh	660 sqft------->	61.32	m^2

Solar Insolation	Unit converter		
	inches to	centimeters to	meters
3.72 hrs/day <-- Average	96	243.84	2.4384

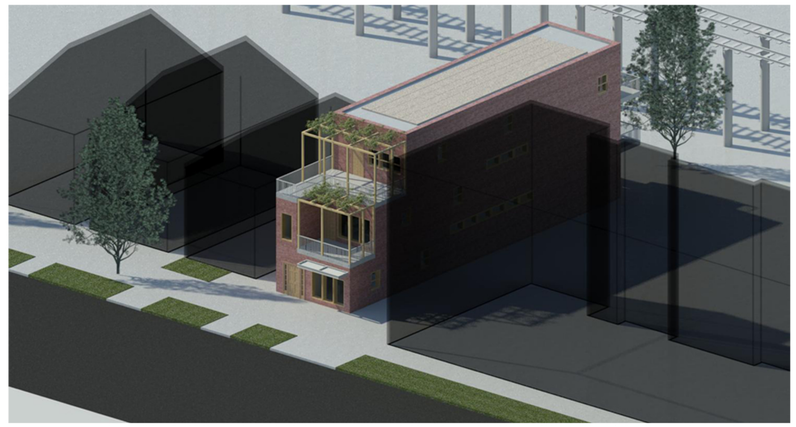


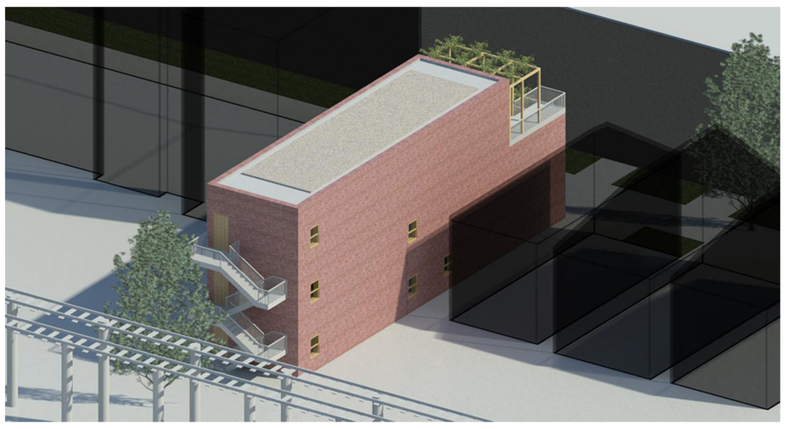




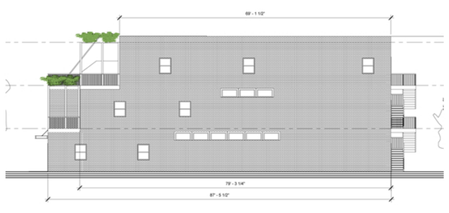
Ground Level Plan

Final Design





South Elevation



East Elevation