IPRO 358: GreenLEAF Community Project Report

Project Work

Appendices

Project Work

Project Introduction

Project Objectives

In Fall 2009 IPRO 323 designed net-zero energy housing but focused primarily on the concept without considering the marketing and funding necessary to make it a reality. The next fall, IPRO 358 took the ideas from that work and used it to develop a plan for a specific site in Evanston. This spring, IPRO 358's work is continued by implementing some of the ideas and proposals they discovered during that semester but did not have time to explore.

The focus of the project is to design homes that have very low energy use and are desirable to buyers. Net-zero, or no energy use at all is considered a goal, but one that may need to be compromised to meet the twin goal of marketability. Specific objectives for this revision of the IPRO are to explore the potential of home automation systems for reducing energy use and to develop a site plan that is an improvement over typical dense layouts.

Proposed Site

The City of Evanston identified a lot on the corner of Dodge and Greenleaf streets that they considered appropriate for residential redevelopment. The site currently contains commercial buildings but has residential areas to the east and south. Directly to the north is a large shopping center containing a grocery store and several other retail outlets. Public transportation is available via buses on Dodge and a Metra station a few blocks away. Public schools are also nearby and Northwestern University is within biking distance.

Design Method

Three criteria were considered for design decisions in this IPRO. One was the energy use of the project, and the second was attractiveness to potential buyers. The third was that the proposed design encourage the community aspect of the project, so that site was one cohesive unit rather than a grouping of unrelated structures.

To evaluate the energy use of the designs, their performance was simulated using eQuest computer models and compared to previous semesters and values for typical housing to identify the impact. Buyer interest was gauged both by talking to realtors familiar with the area and conducting a informal survey about some of the key design elements outside of the neighborhood grocery store. These factors were combined with design theory to yield the final proposals.

Team Organization

The IPRO team was divided into three main groups: architecture, technical, and marketing.

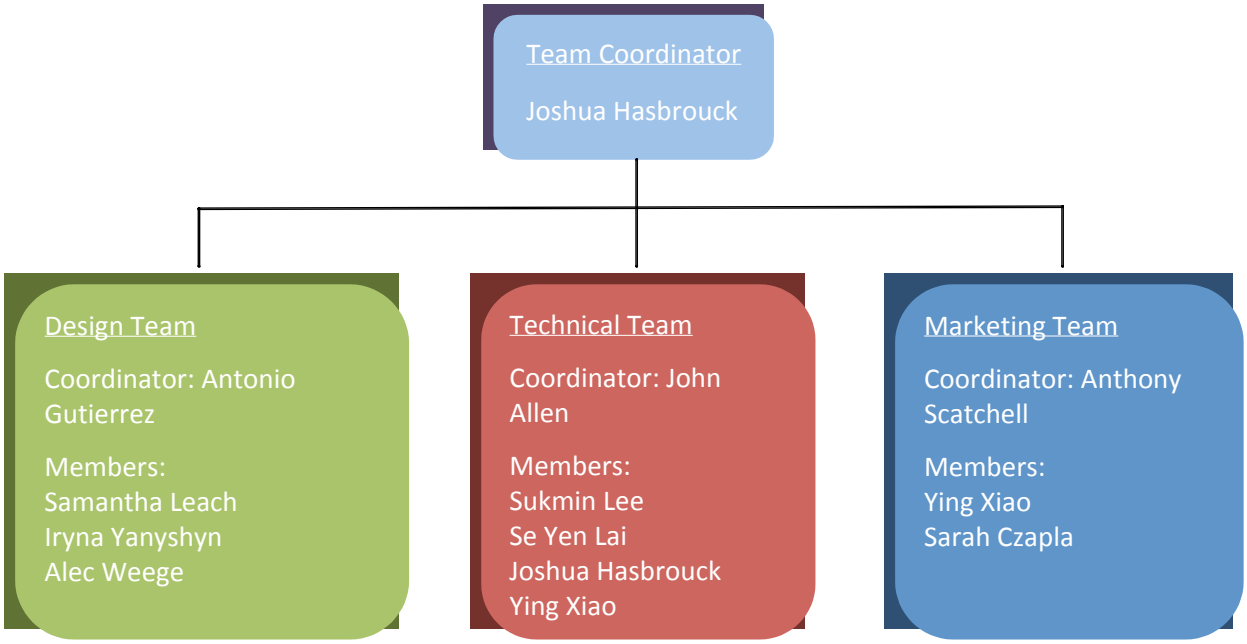

Figure 1: Team organization

Market Research

Target Market

Research was done on the market in Evanston to help identify who we are selling to, and try and assume what their general desires might be. Based on data obtained from the U.S. 2010 census through census.gov, we determined the following about the Evanston market. First of all, a great majority of home owners in Evanston are white, as indicated clearly by Figure 2.

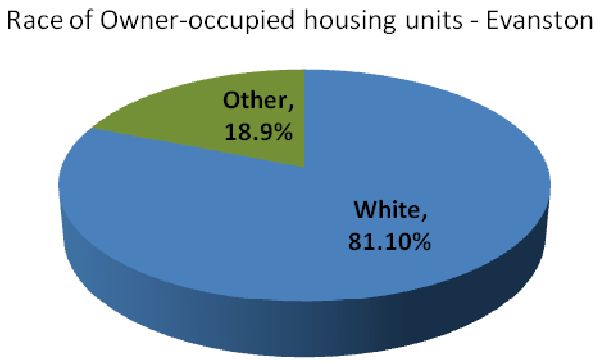

Figure 2: Race of owner-occupied housing units in Evanston[1]

We also found that the housing market in Evanston was relatively young. Figure 3 shows that 61.5% of the occupied housing units in Evanston are occupied by individuals younger than 54 years old. That means only 38.5% of the market is older than that. The younger than 54 years portion of the graph can then be broken down into three more specific age brackets. When this is done, we find the largest amount of individuals occupying housing units in Evanston are less than 35 years old, with 22.6% of the Evanston housing market falling into this category. This is a particularly young market; especially keeping in mind we are talking about home owners, who generally tend to be older.

[1] http://www.census.gov/

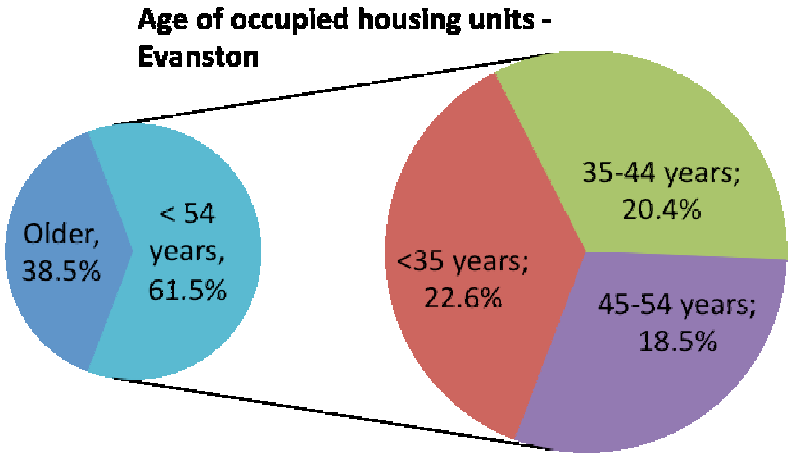

Figure 3: Age of occupied housing units in Evanston[2]

We also found a few more interesting things about the market in Evanston. Over 66% of home owners in this area have a bachelor's degree or higher, and this is by far the largest group in Evanston, so most people are well educated. We also find the mean income in Evanston to be over $100,000, and over 50% of families owning homes in Evanston make more than $100,000 a year—indicating this market has relatively high income.

We suggest that all of these variables, the race of the home owners, their youth, their relatively high education and their high income, add up to indicate this particular target market will be have especially high environmental concern, and very likely will be much more interested than average in purchasing environmentally friendly products and housing units. This is, of course, a positive signal for a project like this which has a focus on selling environmentally friendly homes.

We also find that, although the U.S. continues to experience a poor economic environment in 2011, eco-friendly products are surprisingly unaffected by the effects of the recession. A 2008 Reuters press release suggested "people are especially looking for eco-friendliness when shopping for household paper products (66%), food (57%) and energy efficient appliances (48%)" indicating there is still a strong focus, even in 2008 in the midst of one of the greatest recessions the U.S. has ever known, to spend a little extra money purchasing products in an effort to be environmentally friendly.

Additionally, in a 2008 study by Mintel, it was noted that "the number of Americans who say they almost always or regularly buy green products remained unchanged since [2007], at 36%. This comes after tripling the previous year (from 12% in 2006 to 36% in 2007)."[3] It is very interesting

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[2] http://www.census.gov/

[3] http://www.reuters.com/article/2008/04/09/idUS174412+09-Apr-2008+BW20080409

that this trend remained static, instead of declining like you might expect in the midst of a recession. This indicates that consumers are willing to spend a little more money on eco-friendly products even though they essentially have less money in their pockets in 2008 due to a poor economy. This is a strong indication of an increase in environmental concern even during these financially difficult times, which suggests that people, especially in an area composed of a target market like Evanston's, will be interested in purchasing environmentally friendly housing.

Statistically, most units occupied in Evanston are occupied by 2 people (33.5% of all owner-occupied units are such.) Given the other aspects of our target market, we believe that this could indicate relatively young, highly educated, and financially capable individuals who are living together in a house and looking to expand their families. We also found that a huge majority of people in Evanston, 99.1%, currently live in houses with 1 or less occupants per room – also indicating that they may be looking to expand their families.[4]

The desire for 1 or less occupants per room may also indicate simply that people in this area are looking for particularly big houses that have many rooms. This was also validated by conversations with real estate agents who mentioned to us that at this price, and in this area, people are looking for bigger houses, bigger bathrooms, and more closet space. Additionally, we fielded a survey where many consumers told us one of their most critical buying decisions was the size of the house and the number of rooms. The design of the units for this project was changed after obtaining this information to make the house a little larger and expand bathrooms and closets.

We also found that most home-owners in Evanston are living in 2 or 3 bedroom houses, over 68% of occupied housing units in Evanston being 2 or 3 bedroom houses. Real estate agents also suggested to us that 3 bedroom houses in Evanston were trending upward in sales recently.

Survey

As mentioned earlier, we fielded a survey in Evanston to find out what the consumers were looking for in the area. We went a few blocks away from the site and asked questions to several people – the results of this survey were quantified, and are given in Appendix A. Some key points we discovered during this survey were:

- Many people felt a garage was very important, and that it should be close to their house. This idea was so popular, it prompted us to add a garage to our final design.
- The central park was a big focus of this project from the beginning, but through the survey we found it was even more popular than we had expected, many people loved the idea. So, we put more focus on the central park and brought in a landscaping architect to help give us some ideas on its design and functionality.
- Several people mentioned the importance of a garden, and the landscape architect mentioned it would be a good touch, so we decided to add one to the final design of the central park.

[4] http://www.census.gov/

- The survey prompted us to rethink the home control system idea, and we started focusing more on money saved through energy savings, because people wanted to know the payback times and were only interested in this type of system if it could help with their energy savings.

Industry Information

It cannot be denied that the housing market is currently poor – housing prices peaked in early 2006 and then the bubble burst in the U.S., and although Evanston wasn't particularly vulnerable to the housing disaster, they certainly weren't immune. As Figure 4 indicates, detailing the median sales price and number of sales in Evanston over the past 5 years, the market is not doing as good as it once was and we are dealing with price sensitive consumers.

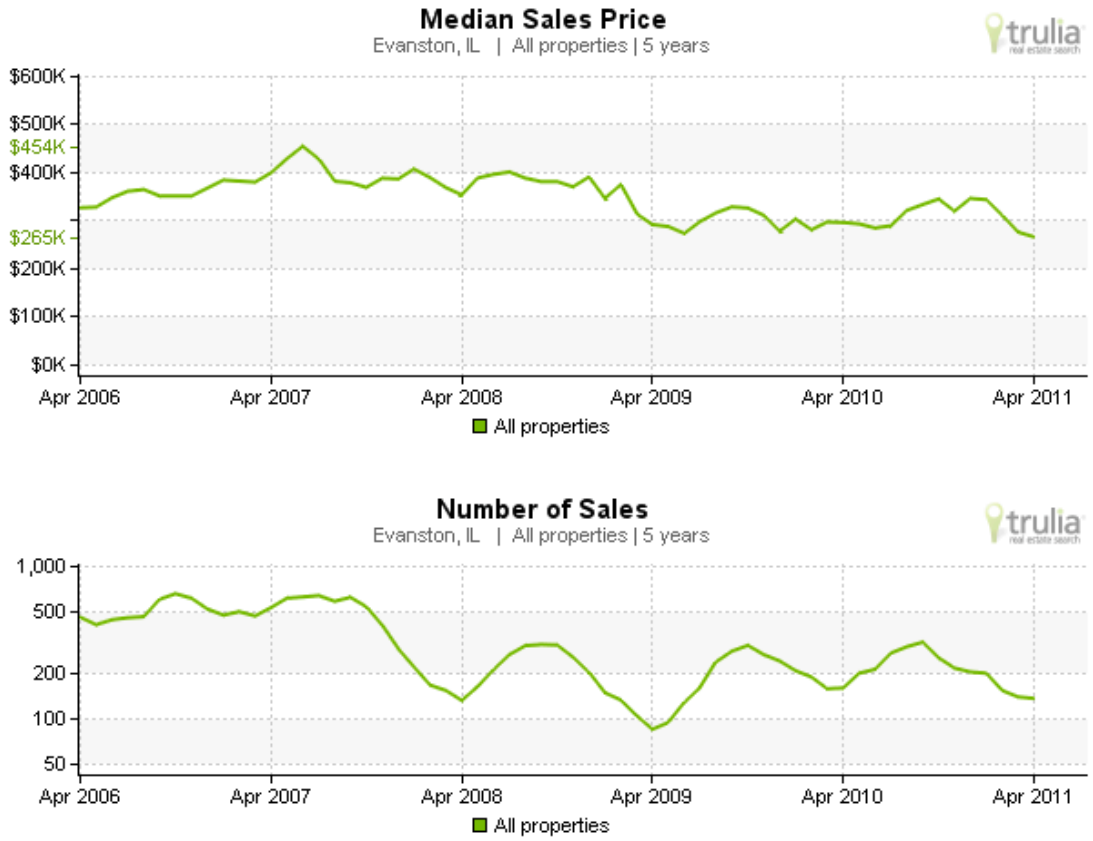

Figure 4: Evanston housing market data[5]

Although the consumers are likely very price sensitive in this type of market, we found that the average listing price of a 3 bedroom house in Evanston is $428,768. This indicated to us that, even in the poor economic environment, consumers are still willing to pay considerable money for a house that they really like, and has the features they want.

[5] http://www.trulia.com/

Architecture

Site Design

The design team first approached the project by researching the context of the site we were given, local zoning codes, and discussing our aspirations for the development. The site borders a very busy street in Evanston to the east, and a shopping center alley to the north, both of which were major design concerns. To the south are townhomes, and to the east are single family homes. It is located in a neighborhood which is currently not very well off, making security and appeal and issue. However, the neighborhood appears to be on the rise, so it was important to make a community which could also fit in with the surroundings.

After reading the zoning codes, we laid out property lines for individual buildings, which were then manipulated to form a central park area that stayed true to the zoning code requirements for setback, parking restrictions, and allowable building footprint and height. The site is 67,000 square feet and includes 6 buildings with 2 units each. The buildings are arranged in such a way that the southern facades will never be in shadow from the neighboring buildings, even during the winter solstice. The 4 buildings on the west and east end of the site are pushed together, creating a more dynamic park area as well as a visual barrier between the park and the busy street. Fences are also run the length of the west and east property lines, creating a physical barrier which provides security and peace of mind for parents and their children. 6 guest parking spots are on the north, following Evanston zoning codes, as well as evergreen trees to visually block the shopping center just to the north. This creates a more welcoming neighborhood, and increases the appeal of the 6 units adjacent to the shopping center's alley. Deciduous trees are used throughout the rest of the site to control passive solar gain in the winter and summer months.

The central park was a primary focus of our design from the beginning of the project until the very end. It is an area which encourages use of the outdoors and therefore decrease the amount of energy used while time is spent in the home. It is a welcoming and safe area, persuading neighbors to engage with one another and create a strong community. To the far west is a community vegetable and flower garden. It is large enough to be divided into individual plots, or it could be used as a collaborative garden. The central garden also includes a pond, leisurely walkways, a tot lot and nearby covered pavilion, and a field. Next to the buildings are semi-private patios that transition from the public park into the private home.

Buildings

In the design of the homes, the design team felt it was important to place emphasis on the park, and organized the indoor spaces accordingly. The first floor, which sits at ground level, has the public spaces: living, dining, kitchen, and half bath. It is laid out to direct attention to the park, with the sliding doors and the patio being a main entrance, and the garage a secondary entrance. The addition of a garage to the design was discussed at length by all of the teams, and the decision to add one came after the marketing team conducted its survey in Evanston and found that most residents wanted one in their home. The second floor contains private spaces: a master bed and

bath, 2 children's rooms which can double as a work space for a couple with one or no children, and a children's bath. On both floors, the majority of the windows look out onto the park, giving both a pleasant view and a line of site to draw people outdoors. In order to give the bedrooms more space and create a more intriguing façade, the second floor overhangs the first by a few feet on either side. The basement level, which is fully underground, has an unfinished mechanical room, storage, and laundry, as well as a finished secondary living space.

The façade of the building is made of aluminum panels which are painted bronze and gold. They create a running bond pattern, a pattern which is typically seen in brick buildings and mimics the style of the surrounding buildings. The color palette was also chosen to match common colors in the neighborhood and blend in.

Technical Systems

Building Envelope and Materials

Continuing in the footsteps of IPRO 358 (Fall 2010), we decided to used advanced framing techniques and low-e gas filled windows. We found this system to truly compliment our goals as a team since we sought to increase efficiency and affordability for potential homeowners as two of our main goals. Advanced framing utilizes less material than traditional stick framing, induces lower labor costs and is much tighter fitting, which prevents unwanted air infiltration that would increase heating or cooling loads. Using advanced framing with 2x6 studs also enabled us to increase our insulation at less cost than methods such as Structural Insulation Panels.

The 2x6 stud walls are filled with blown cellulose insulation that provides an excellent cost to heat loss ratio. Since the gaps in cavity insulation caused by the wall studs are a significant source of heat loss in typical construction, we added 2 in. XPS insulating board on the outside of the wall to reduce the thermal bridging effect. This exterior insulation also adds to the overall insulation value of the wall. The result was an insulation value of R-28 for the whole wall.

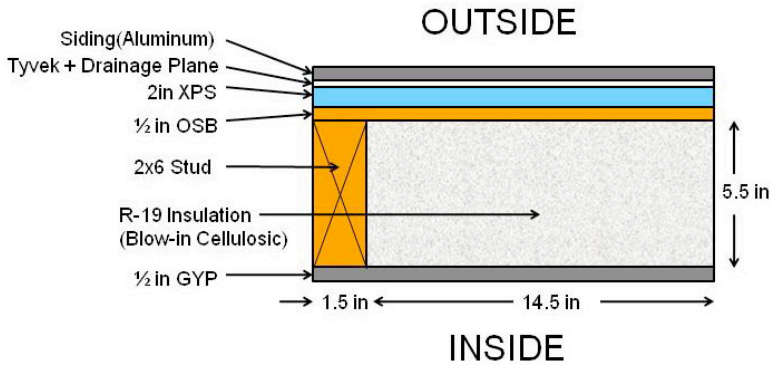

Figure 5: Exterior wall construction detail

The built-up flat roof is a standard construction that provides excellent waterproofing and low maintenance. Using blown cellulose in the ceiling cavity and 2 in. XPS as in the walls, the total roof insulation value is R-54.

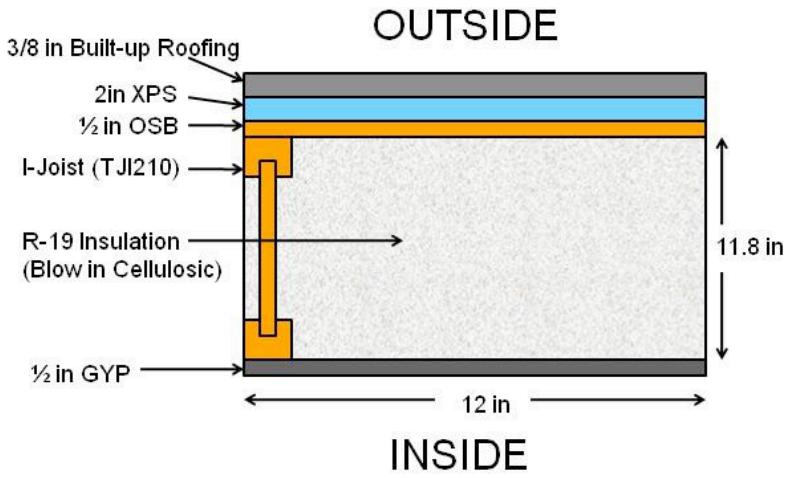

Figure 6: Roof construction detail

Ventilation

Most homes rely on leaks in the walls to provide fresh air. Energy is lost through these leaks, however, so part of the purpose of the added insulation and tighter construction of the building envelope is to reduce the air leaks. Instead, fresh air is controlled and drawn in through an Energy Recovery Ventilator that transfers the heat from the outgoing air to the incoming air. The ERV also helps control the amount of humidity in the air and can be set up with a filter to remove dust and pollen if the homeowners have allergies, two things that are difficult when the the ventilation is not controlled.

Light Control

The homes are designed so that the windows provide sunlight during the day to decrease the amount of artificial light needed. By combining this with CFL bulbs, the lighting loads can drop to a quarter of what they would be typically.[6] During summer months, the large windows could let in too much sunlight and heat, so this is offset by the placement of deciduous trees that shade only during the summer and light-blocking window shades. Additional cost and energy savings are available through the home automation system that can adjust lights and shades to the optimum levels.

Climate Control

A geothermal heat pump provides both the heating and cooling needs of the house. The geothermal system uses 25% - 50% less electricity than conventional heating and/or cooling systems and according to the EPA, geothermal heat pumps can reduce energy consumption—and corresponding emissions—up to 72% compared to electric resistance heating with standard air-conditioning equipment. Due to the relatively constant temperature of the ground (45°F to 75°F) such technology enables the system to exchange heat with the earth through a ground heat exchanger. As with any heat pump, geothermal and water-source heat pumps are able to provide

[6] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=LB

sufficient amount of heating and cooling as well as hot water if needed. Even though the installation price of a geothermal system can be several times that of an air-source system of the same heating and cooling capacity, the additional costs are returned to you in energy savings in 5–10 years. System life is estimated at 25 years for the inside components and 50+ years for the ground loop. There are approximately 50,000 geothermal heat pumps installed in the United States each year.[7]

The type of GHP we are planning to use is the WaterFurnace Synergy 3D GHP which is a 2-ton dual-capacity heat pump. This heat pump delivers five units of energy for every one unit of electrical energy used, which means it can save up to 70% in heating, cooling and hot water. Apart from that, this system provides precise distribution of comfortable air all year long, eliminating hot spots and cold spots. WaterFurnace units are designed and constructed for "whisper quiet" operation, similar to your refrigerator. Unlike air conditioners and heat pumps, geothermal units are installed indoors (like your refrigerator), so they are not subject to wear and tear caused by rain, snow, ice, debris, extreme temperatures, or vandalism. According to the Department of Energy and the EPA, geothermal systems are the most environmentally friendly way to heat and cool your home, since they emit no carbon dioxide, carbon monoxide, or other greenhouse gasses which are considered to be major contributors to environmental air pollution.

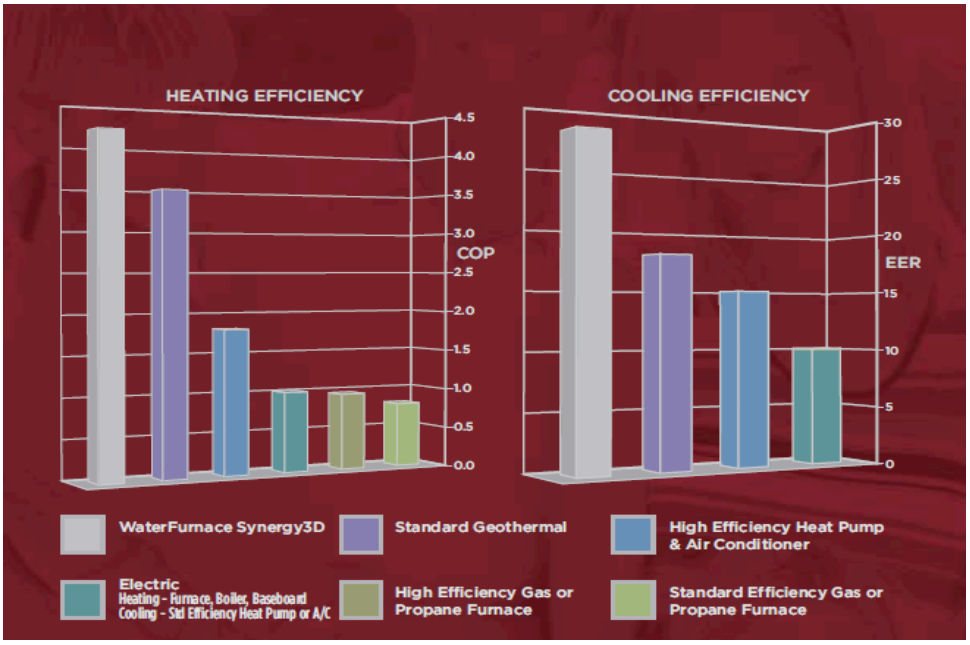

Figure 7: Comparison of WaterFurnace Synergy 3D to other heat pumps.[8]

For our geothermal system, we will be using a Closed-Vertical Loop which not only uses less land than other closed loop system, it also uses smaller amounts of pipe and pumping energy. Apart

7 http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

8 http://www.waterfurnace.com/products.aspx?prd=Synergy3D

from that, it is also the most efficient performance of a closed-loop systems. One ~550 ft. loop will be shared by 3 units for the highest efficiency.

Our initial inquiries to find estimates included requests for costs of other HVAC systems to determine whether or not a Ground Source Heat Pump would be a viable option for our project. We contacted two companies (Comfort Masters and Ardmore) for prices that included purchase of equipment and installation costs. We finally came to the conclusion that a GSHP was a viable option with the estimate given by Ridgeway Precision Mechanical, Inc. Tax credits are also available for installing GSHP systems: units installed from 2009 through 2016 can take advantage of the full credit or 30% tax credit.[9]

Home Automation

Normally, all the building systems would operate independently and need a person to oversee them and make sure they were turned on and off at the right times. But by using a home automation system, all this work is done automatically. Rather than someone walking around and adjusting all the window shades and lights manually, the system can detect the amount of sunlight and the temperature and without interrupting anyone automatically adjust everything to compensate.

The home automation system also gives feedback about how energy is being used, enabling the homeowner to adjust their habits for even more energy efficiency. If there are appliances or activities that are causing large increases in energy use, real-time feedback can show that and help the homeowner make better informed decisions. Through automatic adjustments and feedback, a home automation system can save around 10% of the total energy used according to our eQuest model.

Energy Usage

Our primary objective was to create an energy model that would most accurately represent the building loads with all design implementations considered. We achieved this to the best of our ability using eQuest 3.64, an energy modeling software provided by the IIT computer labs (also available for free download). In creating a model of energy consumption, we were able to compare numbers with the two previous IPRO projects, thus we already had a benchmark for design. IPRO 323 (Zero Communiity) began this project by creating a model for energy consumption of homes with typical construction materials and techniques. Consequently, IPRO 358 (Green Class Community) and our current ENPRO decided to continue with that benchmark for energy calculations and cost savings.

In comparison to previous IPROs, 323 used 15,300 kWh/year of electricity. IPRO 358 used 14,310 kWh/year of electricity and 12.630 therm/year of gas. ENPRO 358 was lower than both of them at 11,430 kWh/year.

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9 http://www.rpmechanical.com/geo.htm

Business Plan

Financing

With any construction project, a huge factor is how it will be financed. Any person who puts money into this project wants to see a sizable return on their investment so we had to make sure that our project was profitable. We decided that the best business plan would be to have the project funded 40% by investors, and the other 60% through a bank loan.

Sales

At the end of construction, half of the units will be sold immediately to reduce our interest payments on the loan and give better investor return. The other half of the units will be sold in a rent to buy scheme. We thought this would help to draw in uncertain customers who were not quite willing to make the commitment of such a large purchase without trying the house out first, and customers who are not yet financially ready to pay for a home but intend to be in the near future. They can rent for 3 years, and 20% of their rent each month will go towards the down payment for purchase of the unit, allowing them to buy it at a reduced price at the end of 3 years.

Profitability

During the three years, the investors will be making a steady monthly profit from the rent money. If renters decide at the end of three years not to buy the unit, the down payment will go directly to the investors, giving them an even larger return. Our Proforma indicated that we can offer our investors an 18% return. We took into account all of the costs associated with constructing this community, from construction and labor costs to legal costs and interest on the business loan. Our profit comes from the sale of the units and the profit from rent over the following three years. We priced the homes at $400,000 based on our research of the Evanston real estate market. We also feel that the unique nature of these homes allows us to price the rent for them slightly higher than the average price for the same square footage.

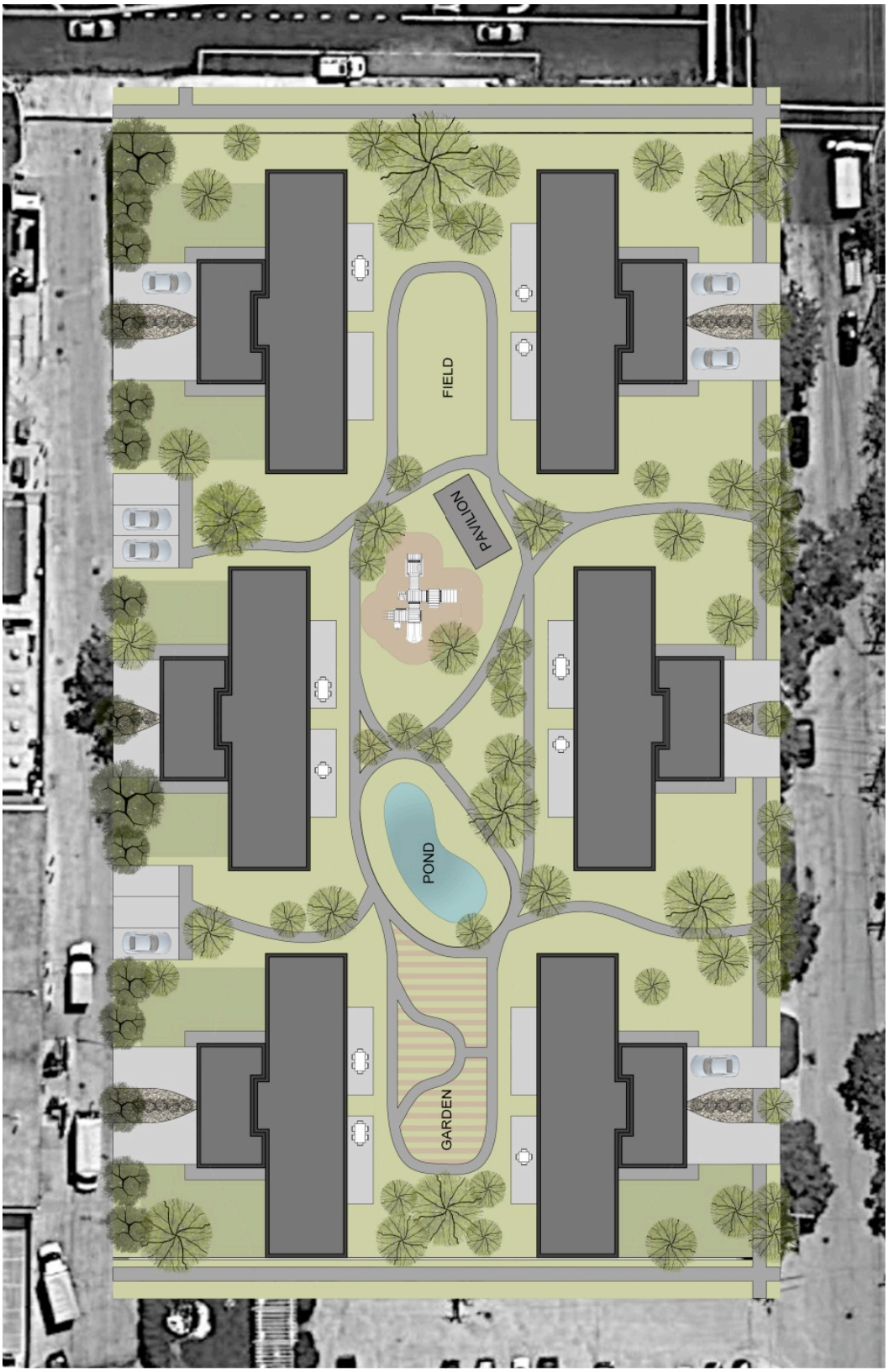
Appendices

Appendix A: Evanston Survey

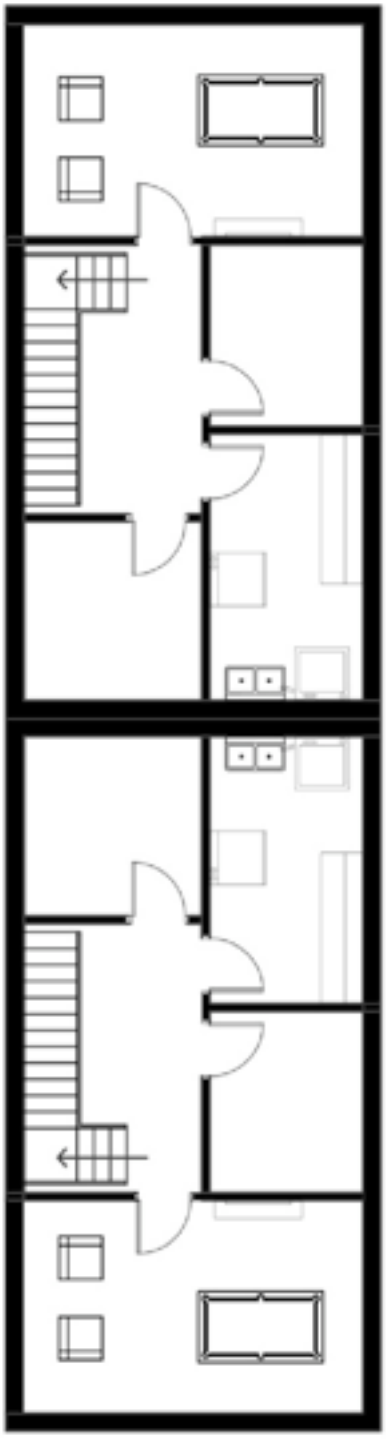
Who	Most important thing you look for in home	How important is garage?	Do you like the idea of a Central Private Park	Should the park be fenced off or just separated by landscaping	How important is a Garden in the park	Simple floor plan or more visually striking	Is a Home Control System/Energy Reporting important?	Extra
28 year old female	Open concept with design	Very important - should be very close to house	Great idea	landscaping better than fence, not worried about security	Not important	Basic floor plan is fine	Only if inexpensive	
		1	1	1	0	1	0	
Male, >30	Location	Attached garage is important	Good idea	Private fence important for security	Important	n/a	Only if inexpensive	
		1	1	2	1	n/a	0	
Female, ~30 years old	Size, # of rooms, and location	Garage is important, but walking some distance to it is OK	Likes it	Landscaping	Garden "definitely" important	Visually striking	Only if it saves money in the long run, payback period can be up to 15 years	Prefers some more private outdoor section connected to house
		1	1	1	1	2	1	
Female, ~30 years old. Current homeowner in Evanston	Price	Important - detached garage is OK	Good idea	Fence better	Loves gardens	Visually striking	Only if inexpensive	
		1	1	2	1	2	0	
Female, <30, 1 child, Current homeowner in Evanston	Location, Finance rate (price)	Important, should be very close	Loves the idea	Landscaping	n/a	Basic	Only if it saves money in the long run, payback period can be up to 15 years. She said "people have homes forever"	
		1	1	1	n/a	1	1	
Female, > 40, has two children, current homeowner in Evanston	Design, size, somewhat concerned with cost, water heating system must be efficient	Important, but a minute or two walk would be OK	Loves the idea	Fence for security, with bushes near the fence so it doesn't stand out	n/a	Floor plan doesn't matter, but interior design is especially important	Only if it saves money in the long run, payback period can be up to 15 years	
		1	1	2	n/a	0	1	
Female, > 40, has two children, current homeowner in Evanston	Number of rooms, especially bathrooms	Garage is important, especially in winter	Great idea	Landscaping	Garden important, but would also be fine if it offered more space for kids	Visually striking	Payback should be less than 15 years	
		1	1	1	0	2	1	

Appendix B: Floor and Site Plans

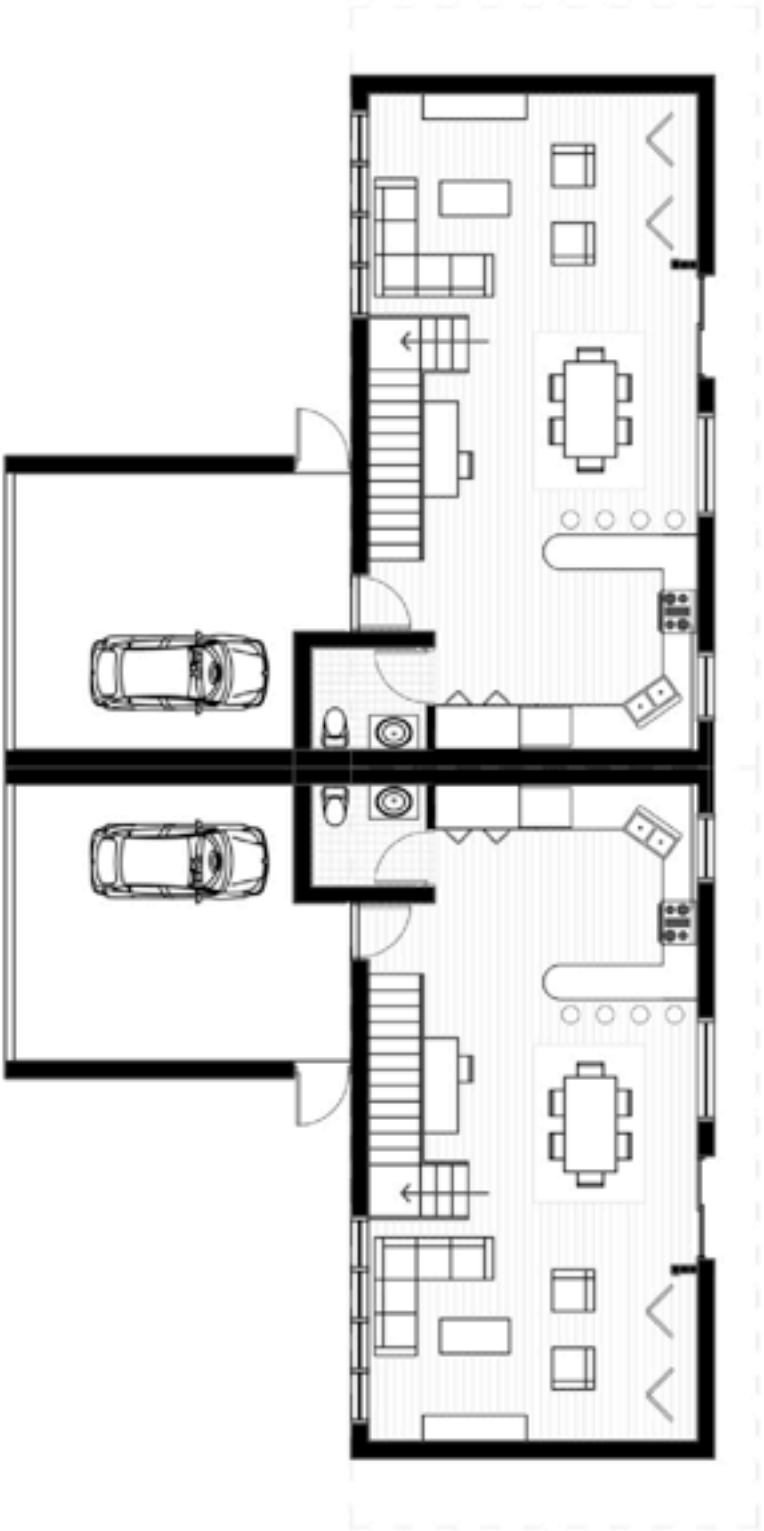
Site Plan



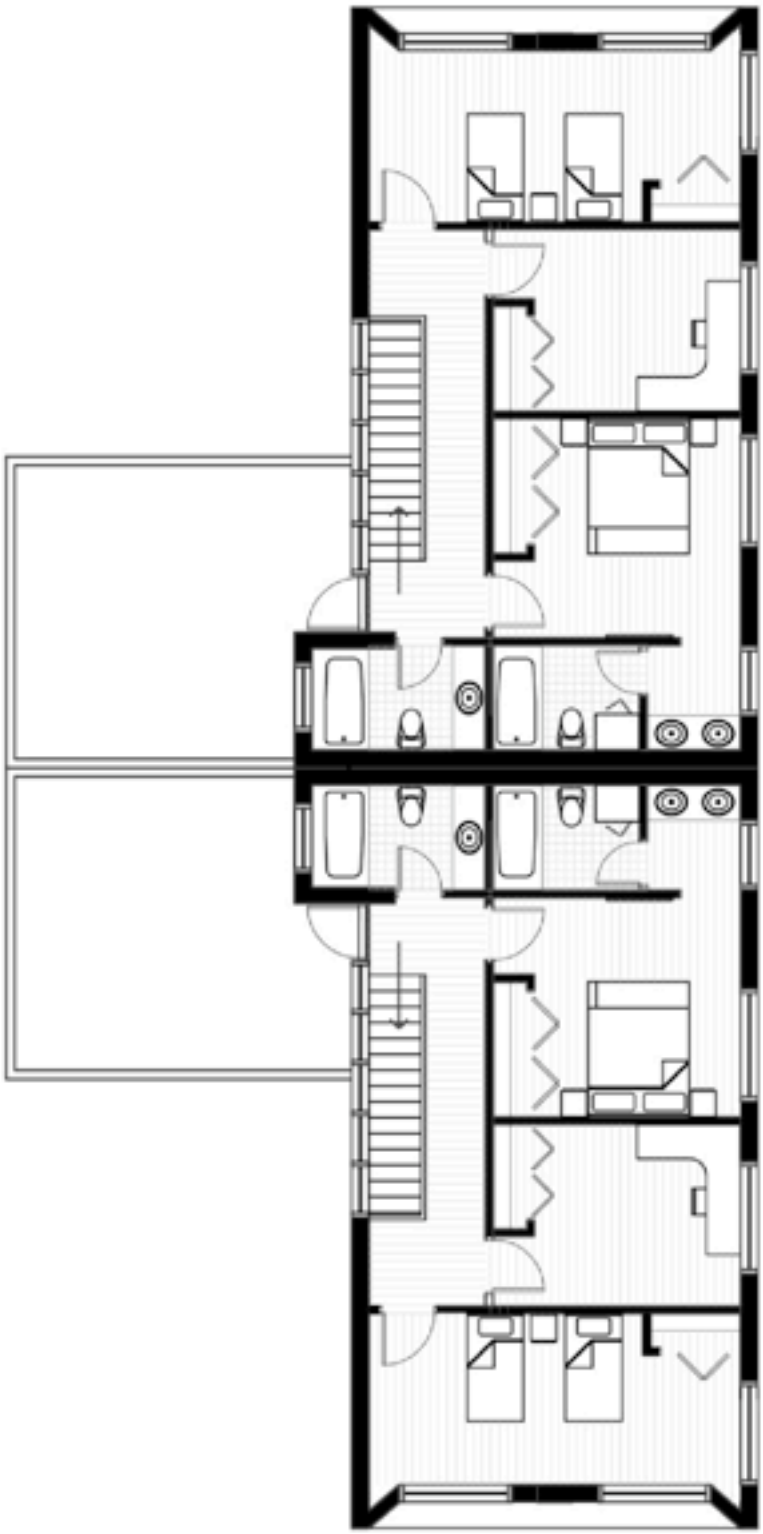
Basement Floor Plan



1st Floor Plan



2nd Floor Plan



Appendix C: Renderings

West End of Park

Center of Park

1st Floor, Looking from Living Room

1st Floor, Looking from Back Entrance

Aerial View of Site from South

Appendix D: Structural Calculations

ASCE Loads:

Occupancy Category II

Load Combinations: $D + (L \text{ or } L_R \text{ or } R)$
$D + 0.75W + 0.75L + 0.75(L_R \text{ or } S \text{ or } R)$

Uniform Live Load = 40 psf

Snow load:

$p_f = 0.7C_eC_tI_sp_g = 0.7 \cdot (1.0)(1.0)(1.0)(25\ psf) = 17.5\ psf$ on the main roof

$p_f = 0.7C_eC_tI_sp_g = 0.7 \cdot (1.0)(1.2)(1.0)(25\ psf) = 21\ psf$ on the garage roof with additional triangular drift 30 psf at house wall and 6 ft length

Roof live load = 20 psf for the main roof and 40 psf over the garage

Floor dead load:

Hardwood flooring	4.0 psf
1" plywood	3.0 psf
I-joist @ 24" O.C.	2.0 psf
½" drywall ceiling	2.5 psf
Partitions	20 psf
Total	31.5 psf

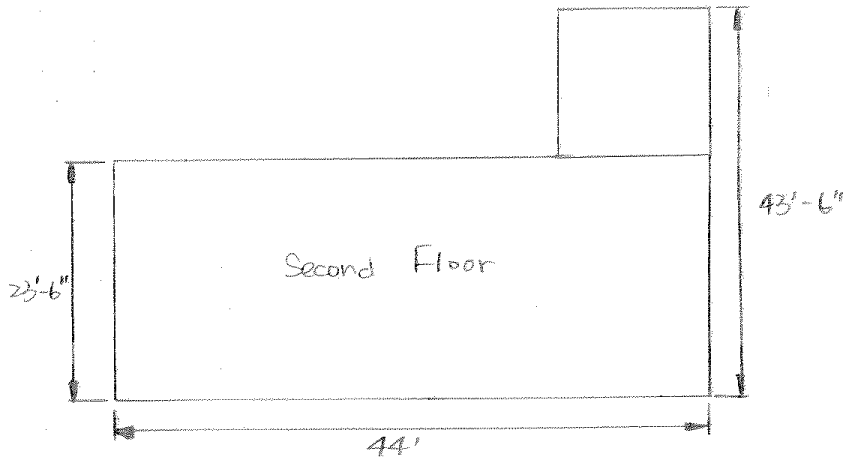
Roof dead load:

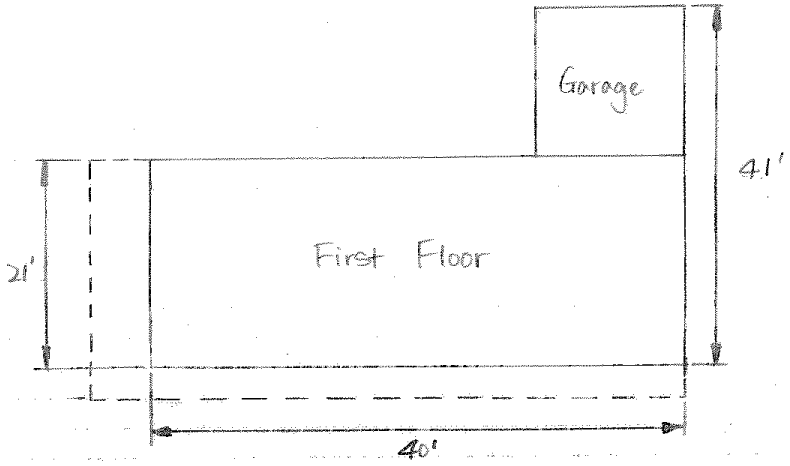
5-ply w/ gravel	6.5 psf
Reroofing	2.5 psf
¾" plywood	2.25 psf
I-joist @ 24" O.C.	2.0 psf
Loose fill insulation	6 psf
½" drywall ceiling	2.5 psf
Total	21.75 psf

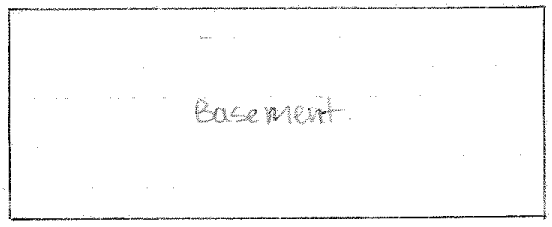
Wall dead loads: (multiply by wall height to get linear distributed load)

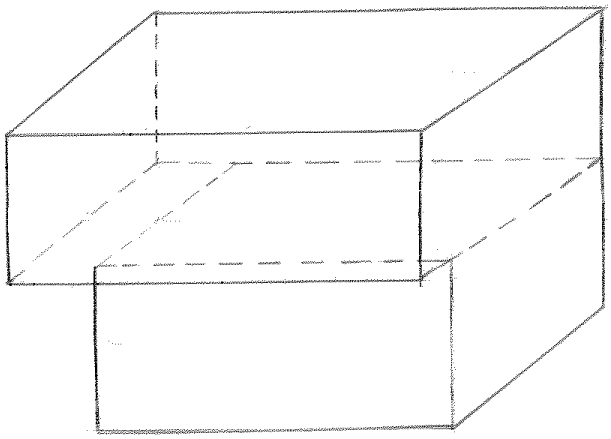
2x6 framing @ 24" O.C.	1.0 psf
Loose fill insulation	3.0 psf
Rigid board insulation	0.4 psf
Plywood sheathing	1.5 psf
Aluminum siding	1.2 psf
½" drywall	2.5 psf
Total	9.6 psf

IPRO | Structural Design | I-joist / Beam | Ying Xiao | 4/9









Occupancy Category II

Load Combinations: D + (L or Lr or R)

D + 0.75W + 0.75L + 0.75(Lr or S or R)

Live load = 40psf

Snow Load = $P_{f_1} = 0.7\, C_e C_t I_s P_g$

$= 0.7(1.0)(1.0)(1.0)(25\,psf) = 17.5\,psf$

(on the main roof)

$P_{f_2} = 0.7\, C_e C_t I_s P_g$

$= 0.7(1.0)(1.2)(1.0)(25\,psf) = 21\,psf$

(on the garage roof)

Roof live load = L_{r1} = 20 psf (main roof)

L_{r2} = 40 psf (garage)

Floor dead load:

Hardwood Floor	4.0
1" plywood	3.0
I-joist @ 24 o.c	2.0
½" dryWall ceiling	2.5
Partitions	20

=> total = 31.5psf

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Roof dead load:

5-ply w/ gravel	6.5
Reroofing	2.5
3/4" plywood	2.25
I-joist @ 24" o.c	2.0
Loose fill installation	6.0
1/2" drywall ceiling	2.5

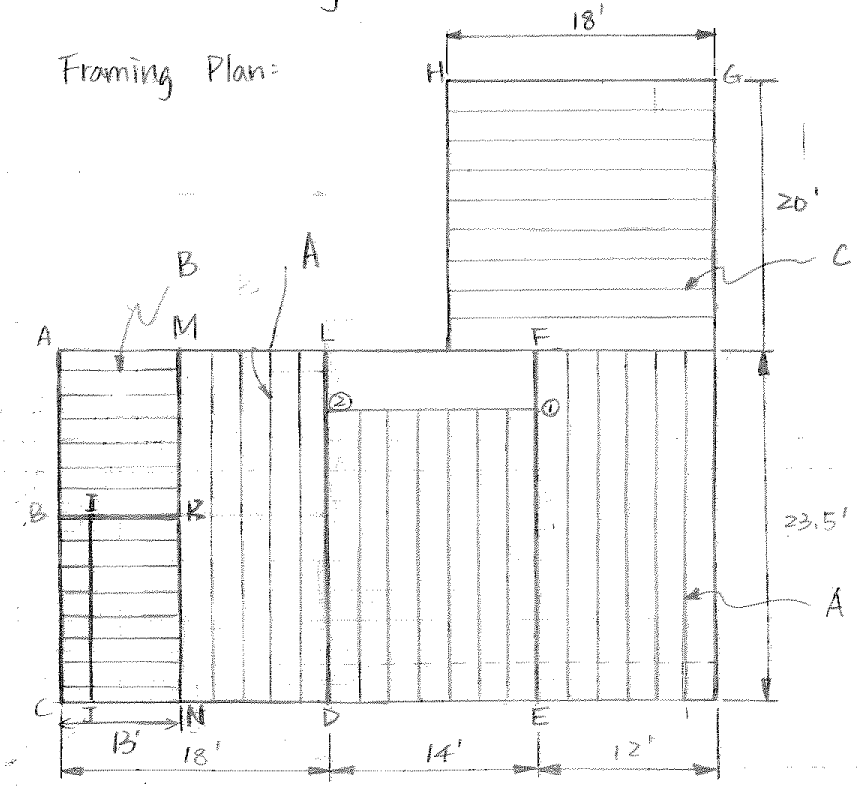
⇒ Total = 21.75 psf

Wall dead load:

2×6 framing @ 24" o.c.	1.0
Loose fill insulation	3.0
Rigid board insulation	0.4
Plywood sheathing	1.5
Aluminum siding	1.2
1/2" drywall	2.5

⇒ Total = 9.6 psf

Framing Plan:



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Main Roof Load:

$D + L = 21.75 + 20 = 41.75$ psf

$W_{R1} = 41.75 \times \frac{23.5}{2} = 490.6$ lb/ft

Garage Roof Load:

$D + L = 21.75 + 40 = 61.75$ psf

$W_{R2} = 61.75 \times 2 = 123.5$ lb/ft (Spacing 2')

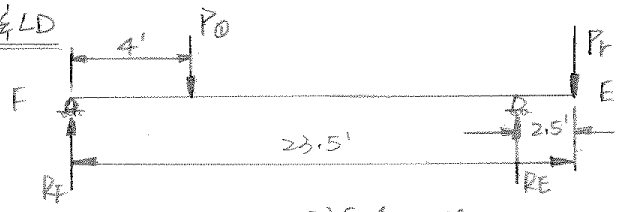
2nd Floor Load:

$D + 0.75L + 0.75L_R = 31.5 + 0.75(40) + 0.75(20)$

$= 76.5$ psf

Beam Design: $F_b = 1600$ psi

Beam EF & LD



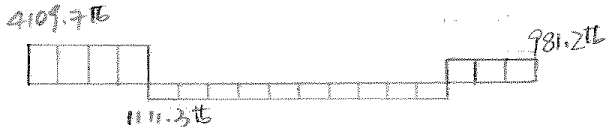
$P_D = 76.5\left(\frac{23.5-4}{2}\right)\left(\frac{14}{2}\right) = 5221$ lb

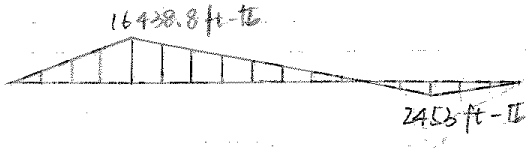
$P_R = W_{R1} \times 2 = 490.6 \times 2 = 981.2$ lb

$\Sigma M_F = 0 = -4(5221) + 21(R_E) - 23.5(981.2)$

$\Rightarrow R_E = 2092.5$ lb

$R_F = 5221 + 981.2 - 2092.5 = 4109.7$ lb





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Choose F_b = 1600 psi lumber with F_v = 170 psi

$$\Rightarrow S = \frac{M}{F_b} = \frac{16438.8(12)}{1600} = 123\ in^3$$

Choose 4×16 with $S = 135.7\ in^3$ $b = 3.5$ in, $d = 13.25$ in.

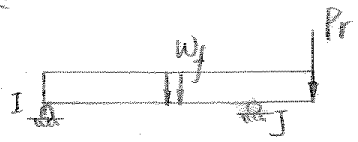
Shear:

$$f_v = \frac{3V}{2bd} = \frac{3(4109.7)}{2(3.5)(13.25)} = 133\ psi$$

$\therefore f_v < F_v$ O.K.

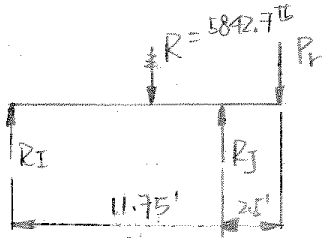
$\therefore$ Beam EF is Timber (selected structural) 4×16

Beam IJ:



$w_f = 76.5(2+4.5) = 497.25$ lb/ft

$P_r = w_{rl} \times (2+4.5) = 490.6(6.5) = 3188.9$ lb



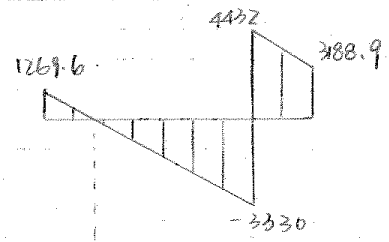
$R = w_f L = 497.25\left(\frac{23.5}{2}\right)$

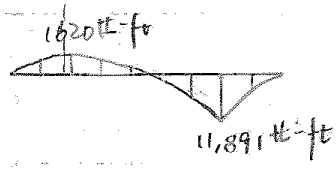
$= 5842.7$ lb/ft

$\Sigma M_I = 0 = -5842.7(5.875) - 3188.9(11.75) + R_J(11.75 - 2.5)$

$\Rightarrow R_J = 7762$ lb

$R_I = 5842.7 + 3188.9 - 7762 = 1269.6$ lb





$\therefore S = \frac{M_{max}}{F_b}$

$= \frac{11891(12)}{1600}$

$= 89\ in^3$

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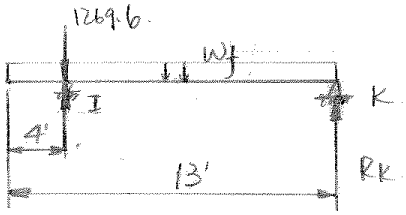
Choose 8×10 with $S = 112.8\ in^3$ $b = 7.5\ in$, $Fv = 170\ psi$
$d = 9.5\ in$

Shear: $f_v = \frac{3V}{2bd} = \frac{3 \times 4432}{2(7.5)(9.5)} = 93.3\ psi$

$\therefore f_v < F_v$ O.K.

$\therefore$ Beam IJ is Timber 8×10"

Beam BK:



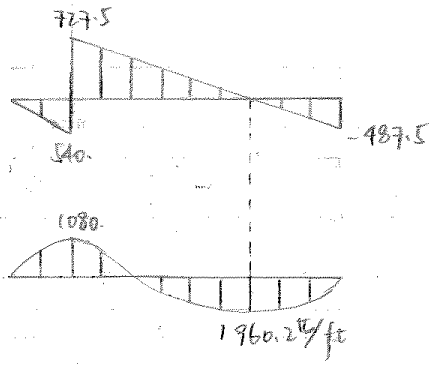
Spacing = 2 ft

$W_f = 67.5(2) = 135\ lb/ft$ $R = 135(13) = 1755\ lb$

$\Sigma M_I = 0 = -1755(\frac{13}{2} - 4) + (13-4)R_K$

$R_K = 487.5$

$R_I = 1269.6 + 1755 - 487.5 = 2537.1\ lb$



$S = \frac{M}{F_b} = \frac{1960.2(12)}{1600} = 14.7\ in^3$

Choose 3×8 ; $S = 21.9\ in^3$ $b = 2.5$
$d = 7.25$

$f_v = \frac{3V}{2bd} = \frac{3(727.5)}{2(2.5)(7.25)} = 20.0\ psi$ O.K.

$\therefore$ Beam BK is Timber 3×8"

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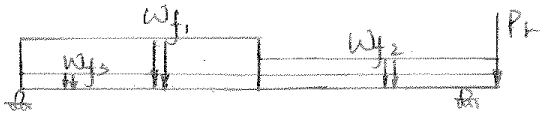
Beam MN:



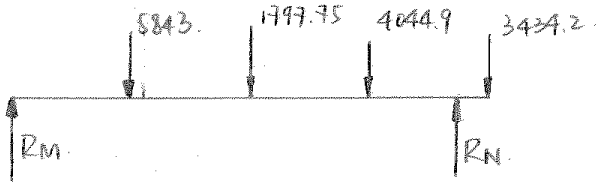
$W_{f_1} = \frac{13}{2} \times 76.5 = 497.25$ lb/ft

$W_{f_2} = \frac{9}{2} \times 76.5 = 344.25$ lb/ft

$W_{f_3} = 1 \times 76.5 = 76.5$ lb/ft

$P_r = W_{r_1}\left(\frac{9}{2} + 2.5\right) = 490.6(4.5+2.5)$

$= 3434.2$ lb

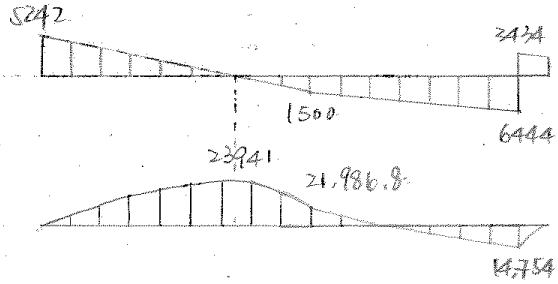


$\Sigma M_N = 0 = -5848(5.875) - 1797.75(11.75) - 4044.9(17.623)$

$+ 21R_N - 3434.2(23.5)$

$\Rightarrow R_N = 9878$ lb

$R_M = 5242$ lb



$S = \frac{M}{F_b} = \frac{23941(12)}{1600} = 179.6\ in^3$

Choose 10x12 with $S = 209.4\ in^3$. $b = 9.5$, $d = 11.5$

$f_v = \frac{3V}{2bd} = \frac{3(6444)}{2(9.5)(11.5)} = 88.5$ psi O.K.

Beam MN is Timber 10x12

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I-joist Design:

I-joist design for A: Spacing = 2'

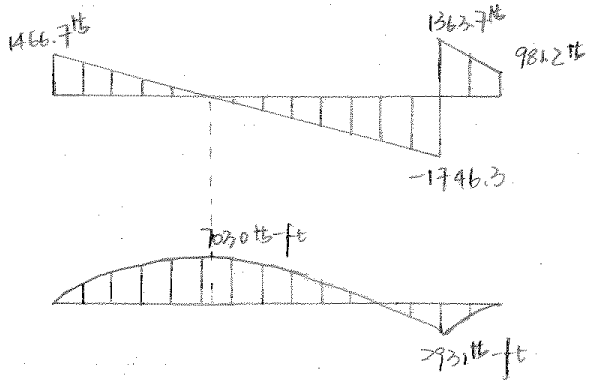
$W_j = 76.5(2) = 153\ lb/ft$

$P_r = W_r(2) = 490.6(2) = 981.2\ lb$

$\Sigma M_1 = 0 = -153(23.5)\left(\frac{23.5}{2}\right) - 981.2(23.5) + 21R_2$

$\Rightarrow R_2 = 3110\ lb$

$R_1 = 153(23.5) + 981.2 - 3110 = 1466.7\ lb$

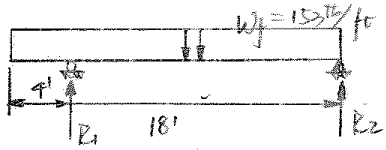


Choose TJI 560 : $M_c = 9500\ lb\text{-}ft$ O.K.

$F_c = 2050\ lb$ O.K.

∴ For area A = TJI 560 @ 24" o.c.

I joist Design for B: spacing 2'



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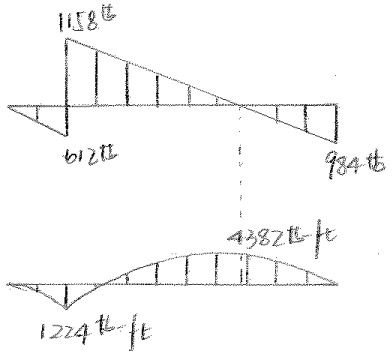
$\Sigma M_1 = 0 = -153(18)(5) + R_2(18-4)$

$\Rightarrow R_2 = 984$ lb

$\therefore R_1 = 153(18) - 984 = 1770$ lb.

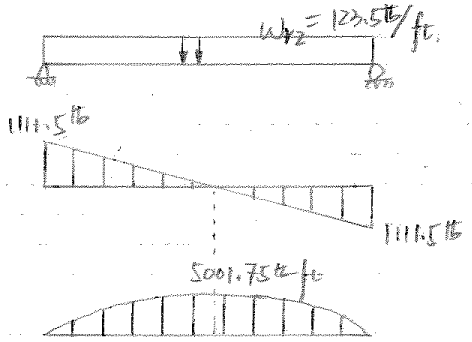


Choose TJI 360 $M_c = 6,180$ lb-ft O.K.

$F_c = 1,705$ lb O.K.

$\therefore$ For area B: TJI 360 @ 24" O.C.

I joist design for C: spacing = 2'



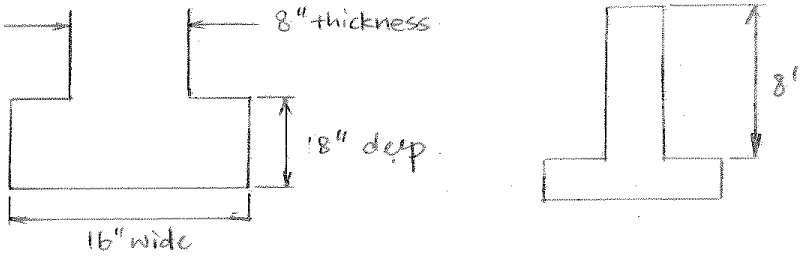
Choose TJI 360. $M_c = 6,180$ lb-ft O.K.

$F_c = 1,705$ lb O.K.

$\therefore$ For garage C: TJI 360 @ 24" O.C.

IPRO | Foundation Design | Ying Xiao | 1/

Continous Footing:



Load = roof = $(21.75+20)(23.5\times44)/(21\times2+40\times2)$

$= 353.8\ lb/ft$

2nd Floor load = $76.5(21\times40)/(21\times2+40\times2)$

$= 526.7\ lb/ft$

Weight = $\left(8\times\frac{8}{12}+\frac{16}{12}\times\frac{8}{12}\right)\times150 = 933\ lb/ft$

$\therefore$ $P = 353.8+526.7 = 880.5\ lb/ft$

$W_f = 933\ lb/ft$

Assume $u_0 = 0$.

$$q = \frac{P/b + W_f/b}{B} = \frac{880.5+933}{16/12} = 1360.5\ lb/ft^2.$$

$$q_{ult} = c'N_c + \bar{\sigma}'_{zD}N_q + 0.5\gamma'BN_\gamma$$

Stud Wall Capacity — IPRO 358 — Joshua Hasbrouck 1 of 2

2×6 dimension lumber @ 24" O.C.

$F_c = 1300$ psi
$E_{min} = 440,000$ psi } for standard grade fir

Top floor:

$\ell_e = 9$ ft
$d = 5.5$ in

$\frac{\ell_e}{d} = \frac{9(12)}{5.5} = 19.6$

$F_{cE} = \frac{0.822 E_{min}}{(\ell_e/d)^2} = \frac{0.822(440,000)}{19.6^2} = 942$ psi

$F_c^* = F_c C_D = 1300(1.15) = 1495$ psi

$\frac{F_{cE}}{F_c^*} = \frac{942}{1495} = 0.6301$

$\frac{1+F_{cE}/F_c^*}{2c} = \frac{1+0.6301}{2(0.8)} = 1.019$

$C_P = \frac{1+F_{cE}/F_c^*}{2c} - \sqrt{\left(\frac{1+F_{cE}/F_c^*}{2c}\right)^2 - \frac{F_{cE}/F_c^*}{c}} = 1.019 - \sqrt{1.019^2 - 0.6301/0.8} = 0.518$

$F_c' = F_c C_D C_P = 1300(1.15)(0.518) = 774$ psi

$P_{max} = F_c' A = 774(8.25) = \boxed{6386 \text{ lb per stud}}$

$w_{max} = \frac{P}{S} = \frac{6386}{2} = \boxed{3193 \text{ plf}}$

Ground floor:

$\ell_e = 10$ ft
$d = 5.5$ in } $\frac{\ell_e}{d} = \frac{12(10)}{5.5} = 21.8$

$F_{cE} = \frac{0.822(440,000)}{21.8^2} = 761$ psi

$F_c^* = 1300(1.15) = 1495$ psi

$\frac{F_{cE}}{F_c^*} = \frac{761}{1495} = 0.509$

$\frac{1+F_{cE}/F_c^*}{2c} = \frac{1+0.509}{2(0.8)} = 0.943$

$C_P = 0.943 - \sqrt{0.943^2 - 0.509/0.8} = 0.440$

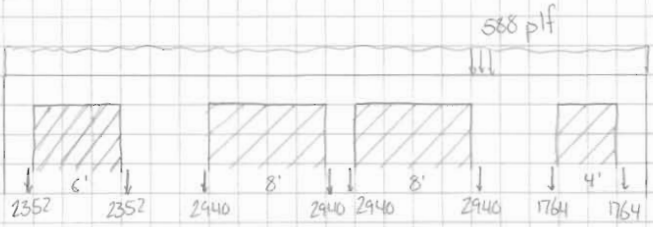
$F_c' = 1300(1.15)(0.440) = 658$ psi

$P_{max} = 658(8.25) = \boxed{5429 \text{ lb per stud}}$

$w_{max} = \frac{5429}{2} = \boxed{2714 \text{ plf}}$

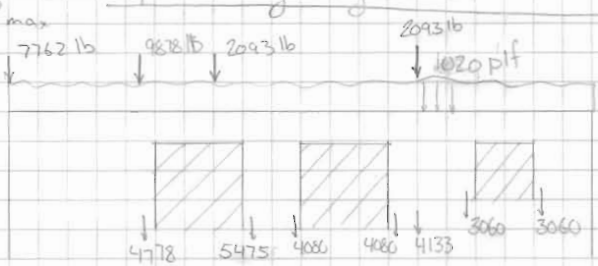
Load Paths

Joshua Hasbrouck 2 of 2



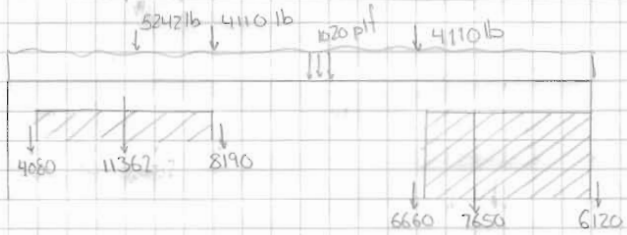
$w < w_{max}$

$P < P_{max}$ Top floor okay using 2×6 @ 24" o.c. framing



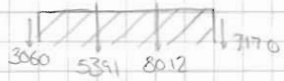
$w < w_{max}$

$P < P_{max}$ except for corner and under 9878 lb load which need two studs each



$w < w_{max}$

$P > P_{max}$ doubled studs needed at all openings except outside end of clerestory window and pillar three studs needed at center of clerestory or should divided clerestory into thirds



Shear Wall Loading — Joshua Hasbrouck 1 of 2

90 mph wind

horizontal pressures:			Vertical pressures:		
	A	12.8		E	-15.4
	B	-6.7		F	-8.8
	C	8.5		G	-10.7
	D	-4.0		H	-6.8

overhangs: E_{OH} -21.6
G_{OH} -16.9

λ = 1.00 B
1.35 C
1.61 D
} for 25' mean height

$a = 0.4(22) = 8.8$ or $0.1(88) = 8.8$

$2a = 17.6$

end wall:

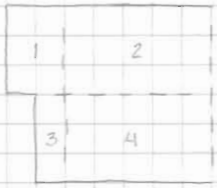
End zone: $p_s = \lambda I p_{z30} = 1.00(1.0)(12.8) = 12.8$ psf

Interior zone: $p_s = (1.00)(1.0)(8.5) = 8.5$ psf

$A_1 = 93.45$ ft^2 $A_2 = 184.8$ ft^2
$A_3 = 61.95$ ft^2 $A_4 = 202.4$ ft^2

$F_{top} = 8.5(93.45) + 12.8(184.8) = 3160$ lb
$F_{bot} = 8.5(6185) + 12.8(202.4) = 3167$ lb
$F_{tot} = 6327$ lb

side wall:



End zone: $p_s = 12.8$ psf

Interior zone: $p_s = 8.5$ psf

$A_1 = 184.8$ ft^2 $A_2 = 277.2$ ft^2
$A_3 = 202.4$ ft^2 $A_4 = 257.6$ ft^2

$F_{top} = 8.5(277.2) + 12.8(184.8) = 4722$ lb
$F_{bot} = 8.5(257.6) + 12.8(202.4) = 4780$ lb
$F_{tot} = 9502$ lb

Shear Wall Capacity — Joshua Hasbrouck 2 of 2

end walls:

$V_{top} = 4722$ lb

$v_{gyp} = 110$ plf for ½" gypsum board unblocked and fasteners 4" O.C.

$V_{gyp} = (110\text{ plf})(20.5\text{ ft}) = 2255$ lb

$V_{shared} = 4722 - 2255 = 2467$ lb

$v_{sha} = \frac{2467\text{ lb}}{26.5\text{ ft}} = 93$ plf < 110 plf

Gypsum board on the long bedroom wall and shared wall is sufficient to restrain shear for the top floor. Choice of ½" is conservative and the shear strength will likely be even higher since 5/8" may be needed for fire code.

$V_{tot} = 9502$ lb

$v = \frac{9502\text{ lb}}{24+21\text{ ft}} = 211.2$ plf

Use ½" OSD with 8d nails @ 4" spacing

long walls:

$V_{top} = 3160$ lb

$v = \frac{3160\text{ lb}}{44\text{ ft}} = 72$ plf

Use 3/8" OSB with 6d nails @6"

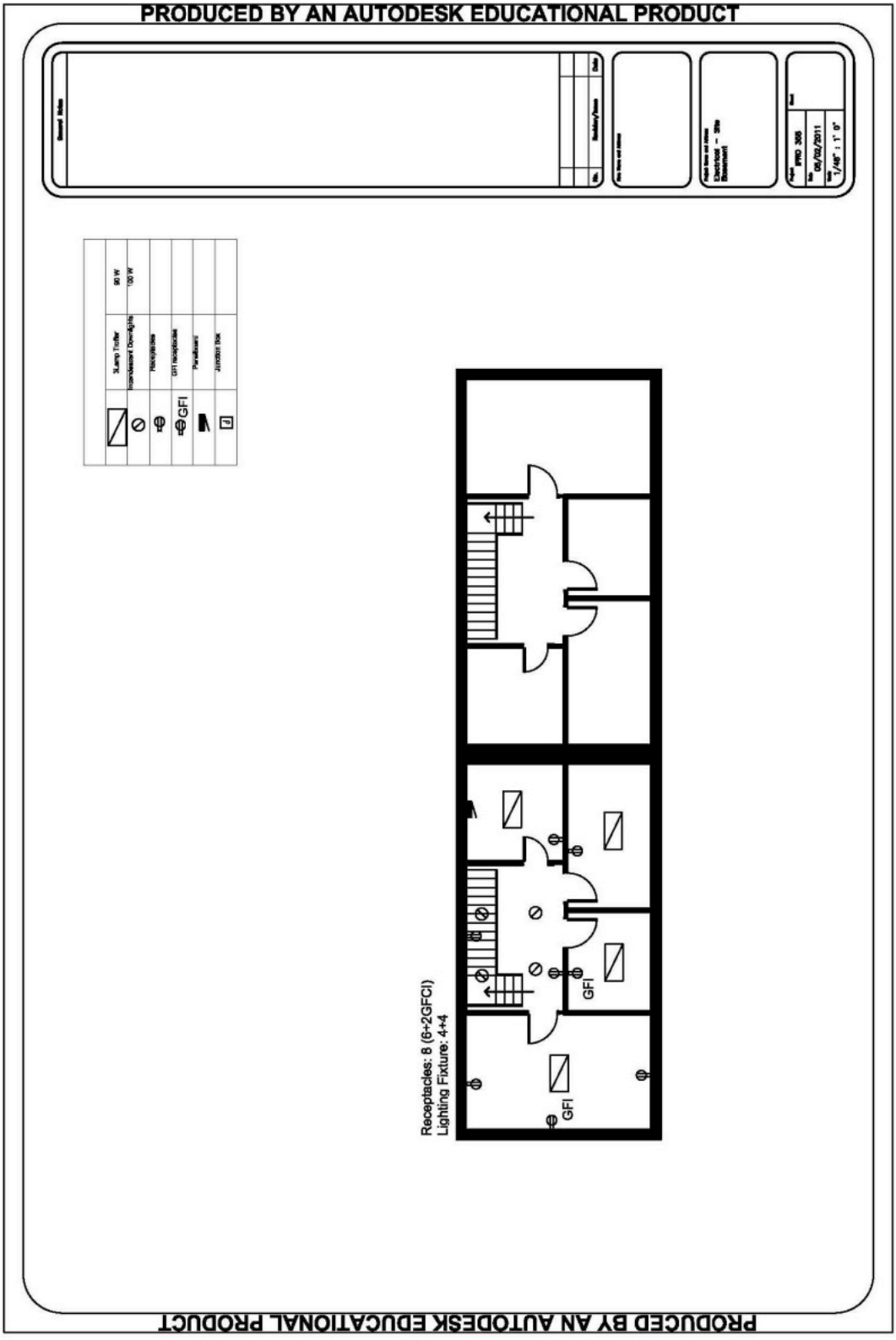
$V_{tot} = 6327$ lb

$v = \frac{6327\text{ lb}}{44+12\text{ ft}} = 113$ plf

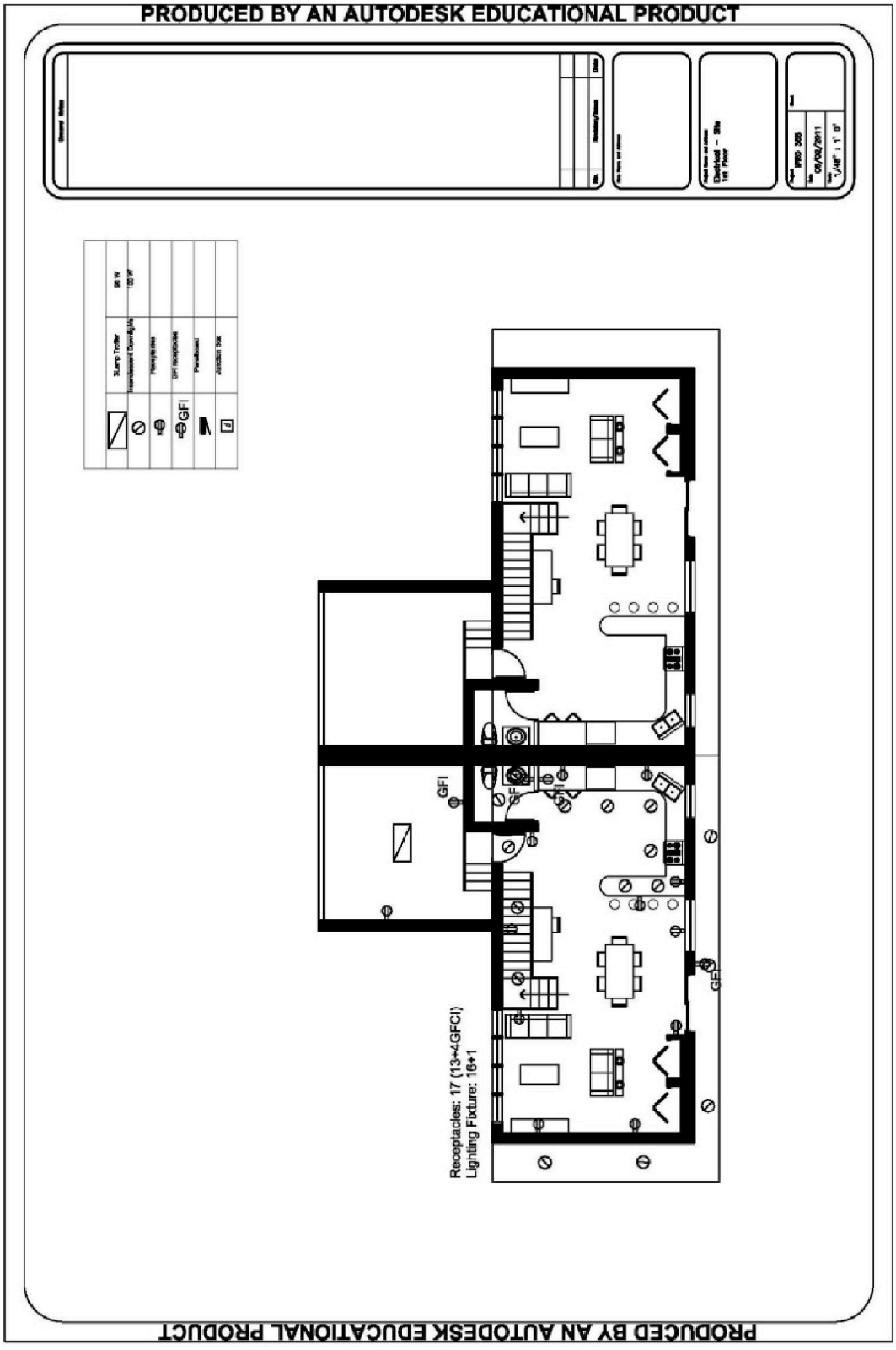
Use 3/8" OSB with 6d nails @6"

Appendix E: MEP Plans

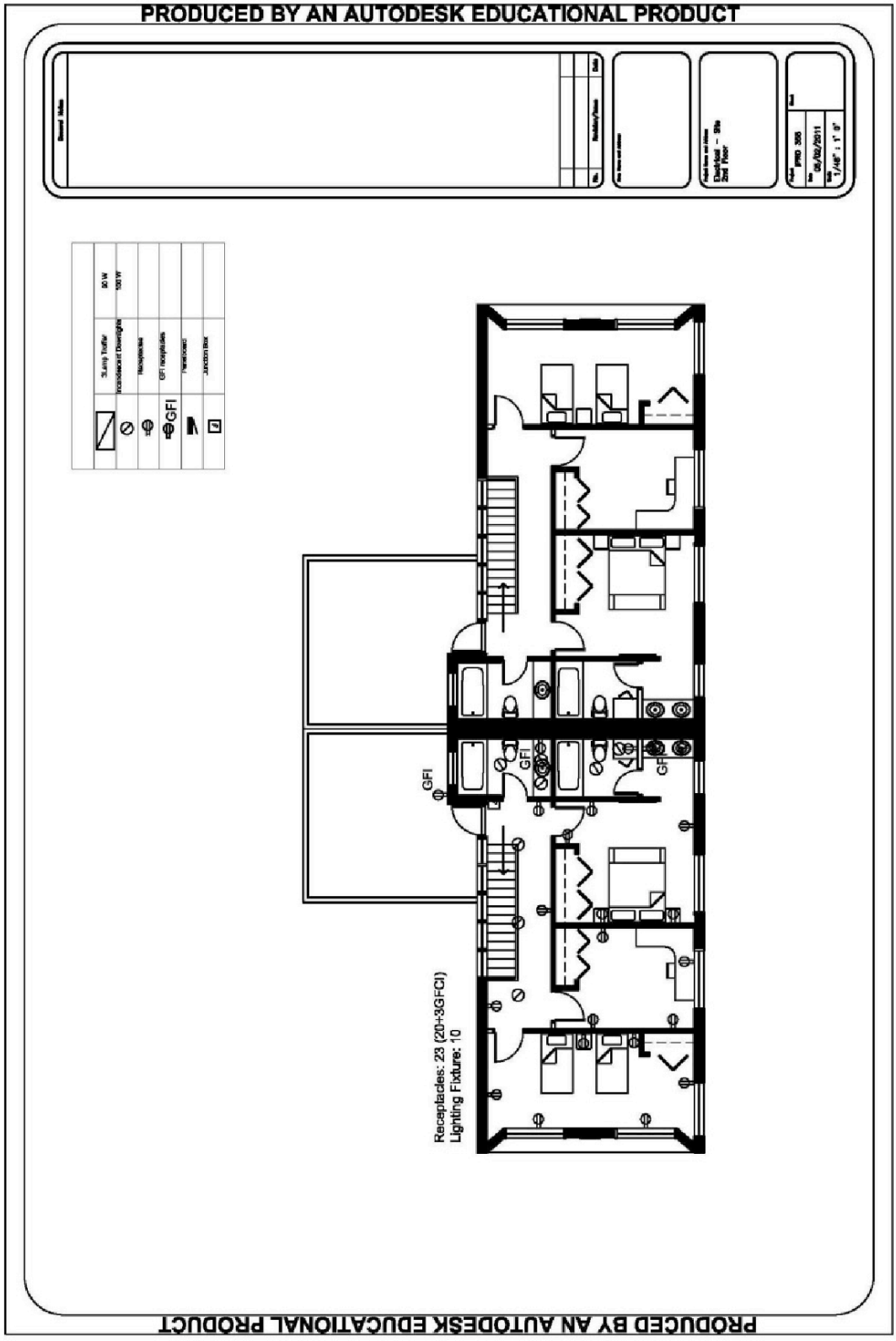
Basement Electric Plan



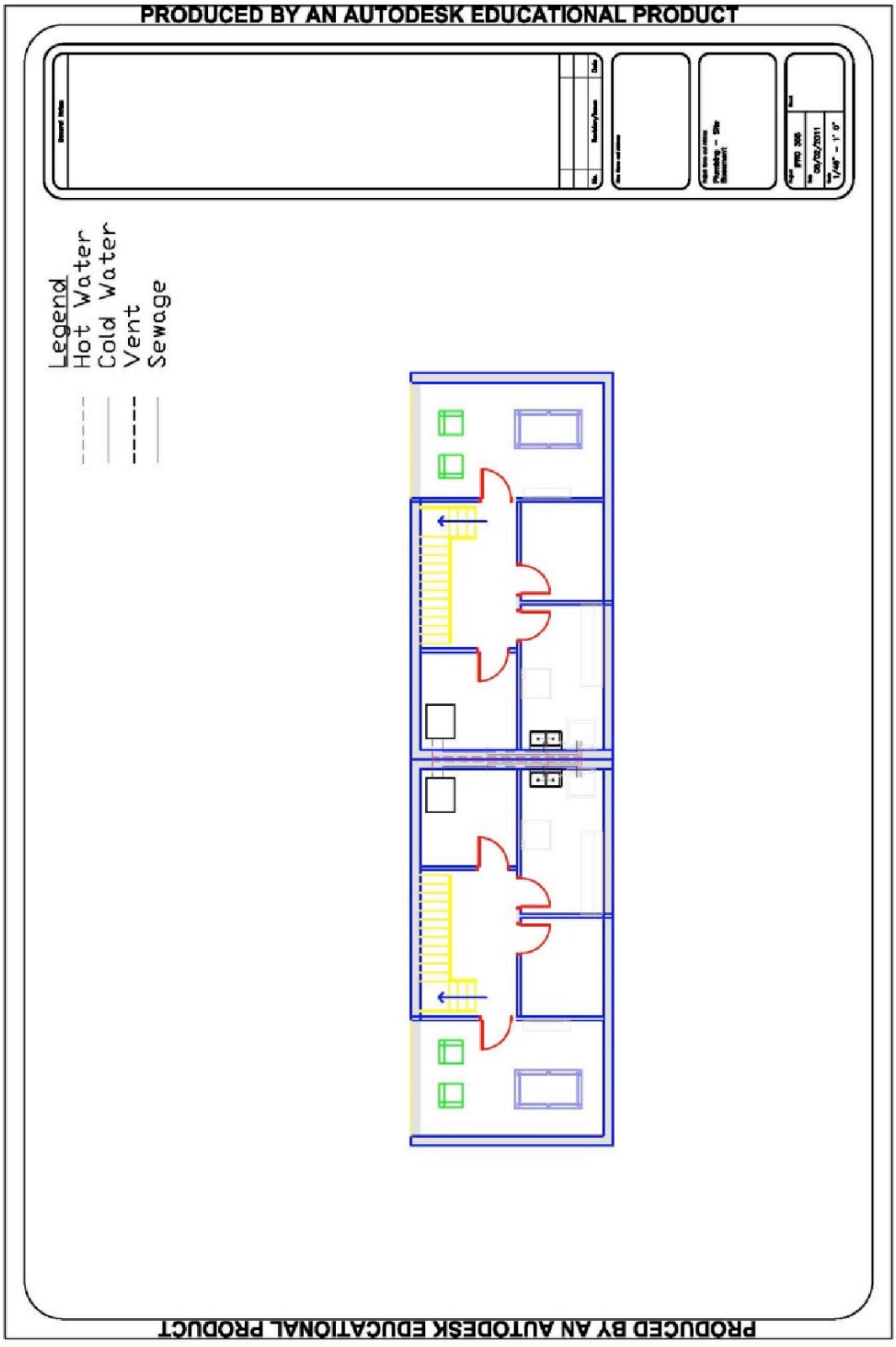
1st Floor Electric Plan



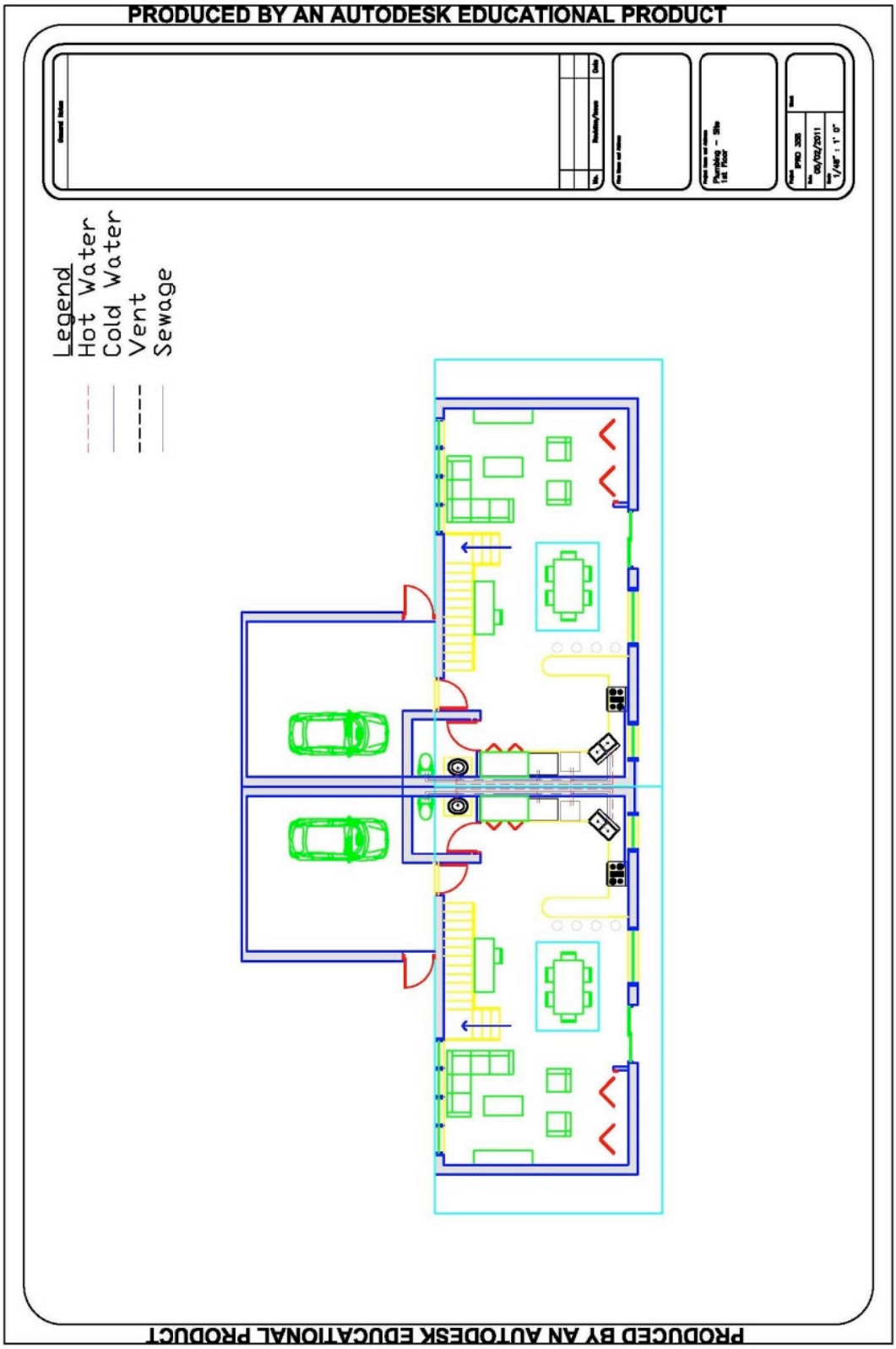
2nd Floor Electric Plan



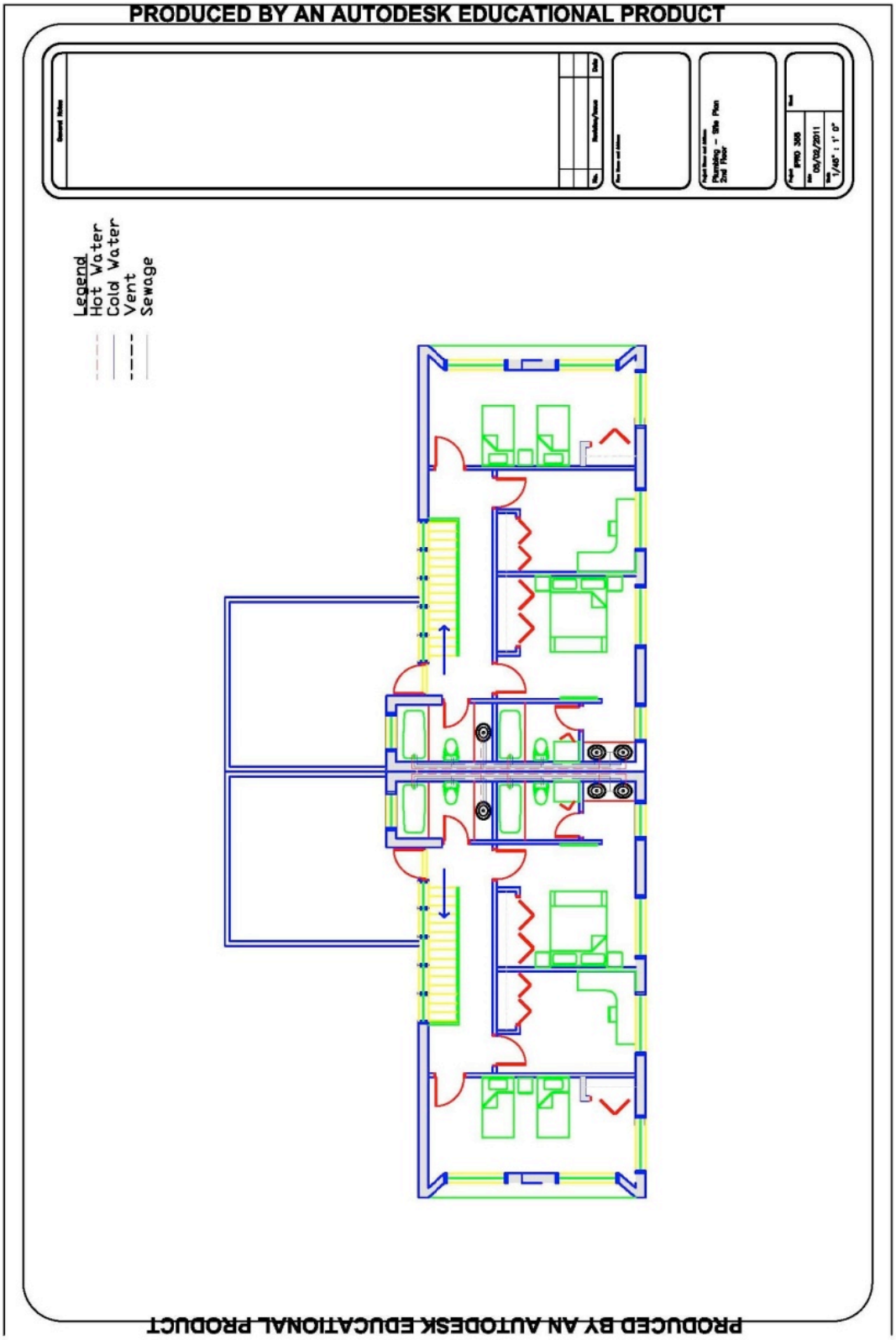
Basement Plumbing Plan



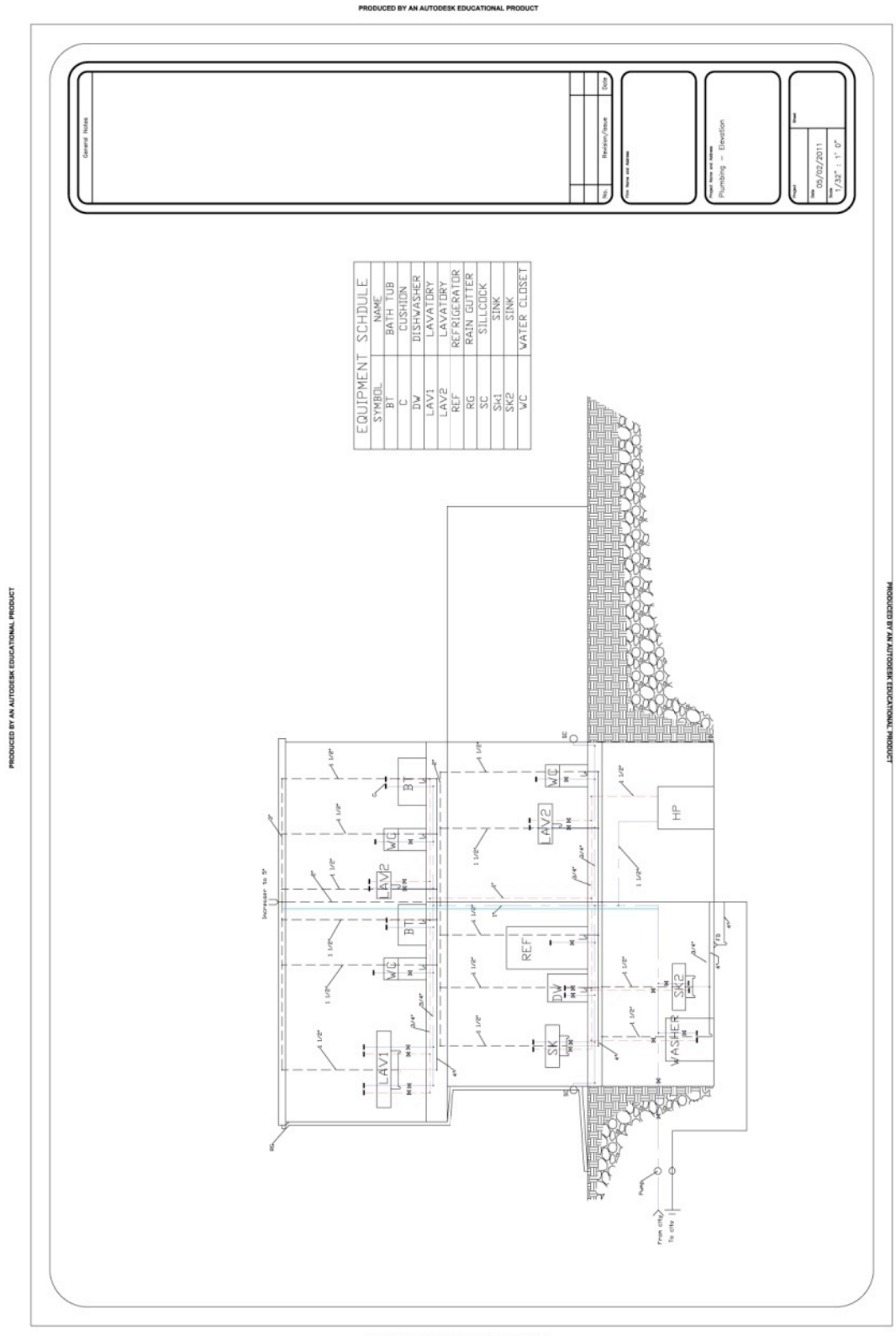
1st Floor Plumbing Plan



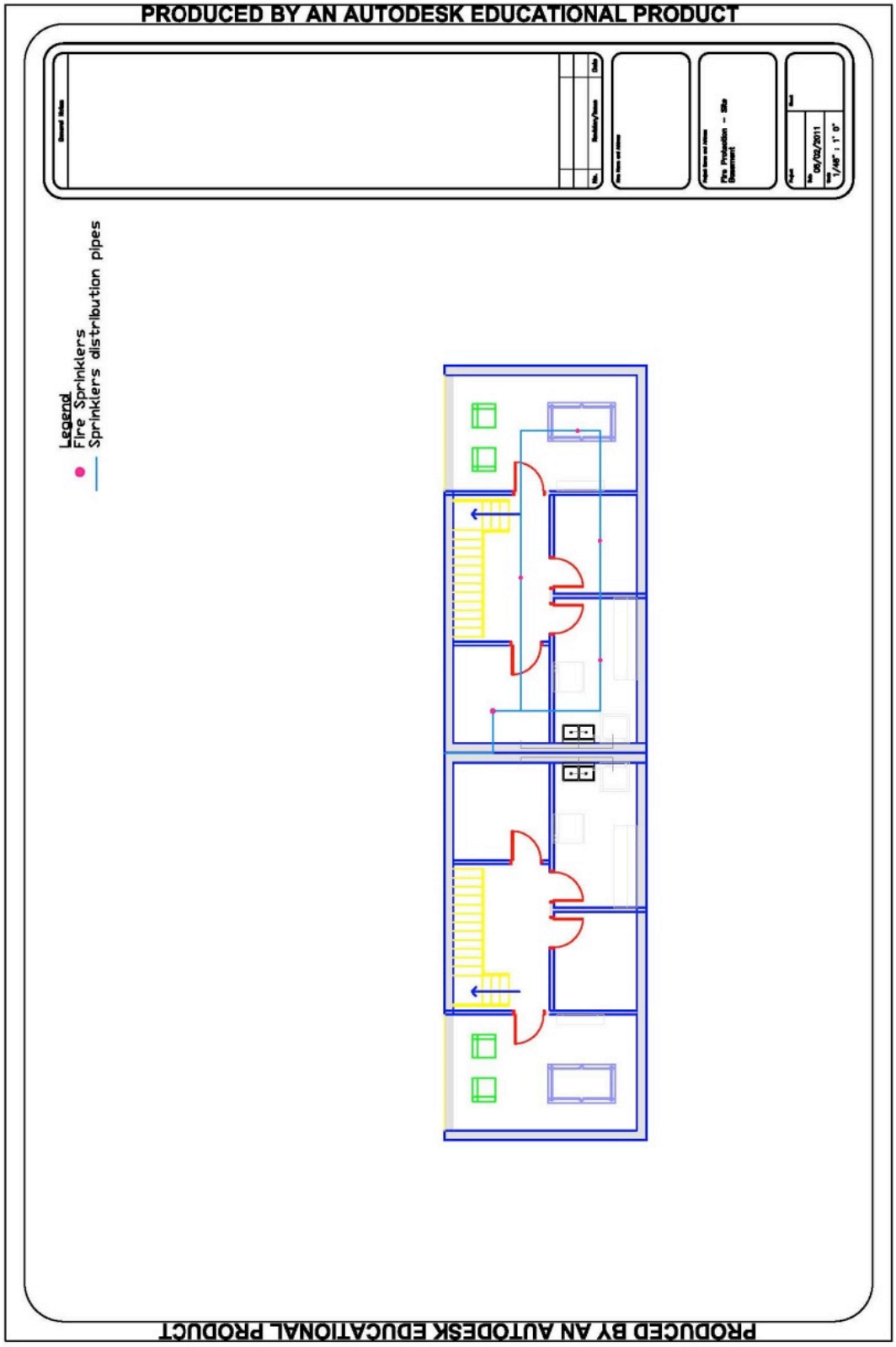
2nd Floor Plumbing Plan



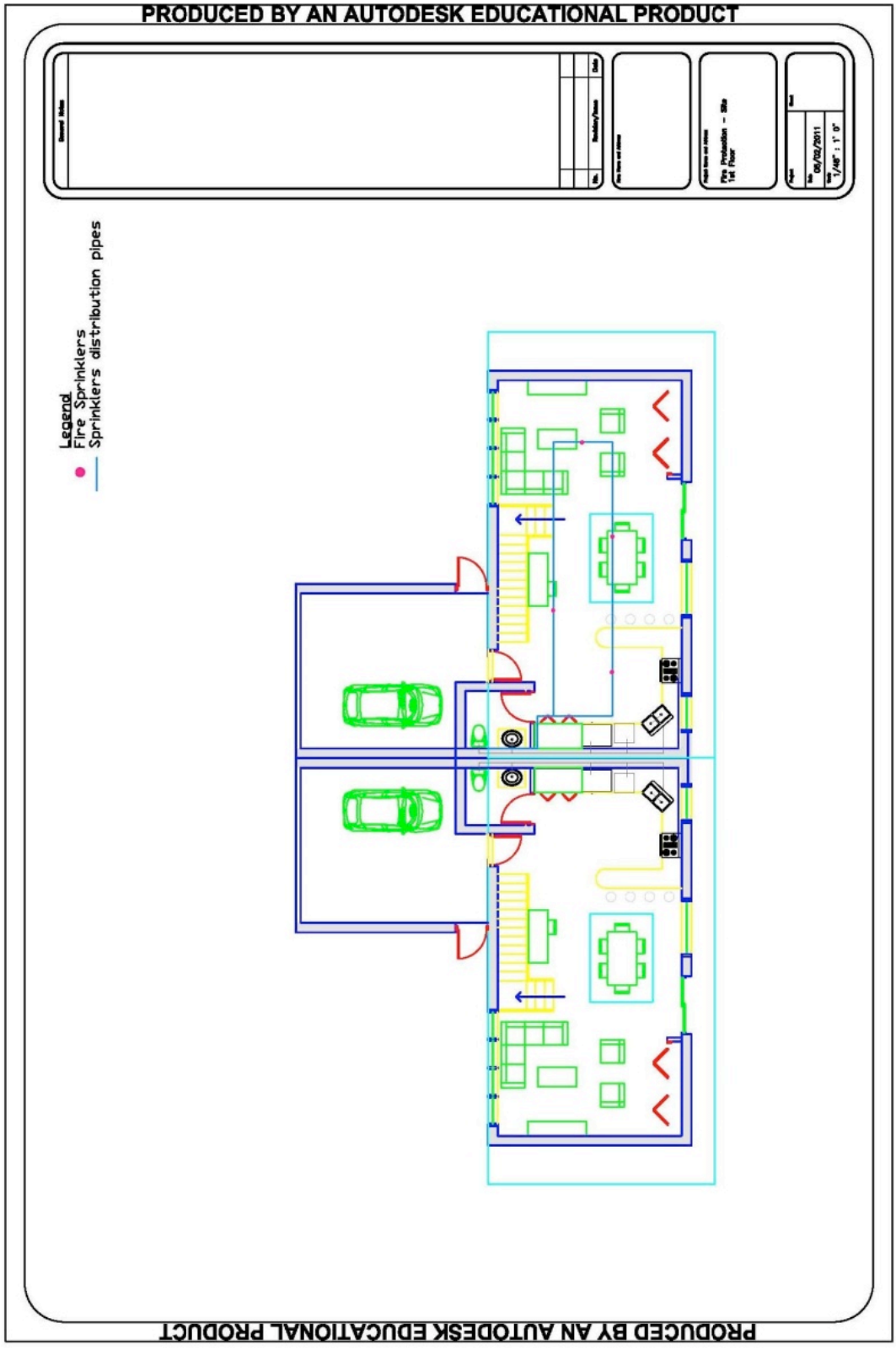
Plumbing Riser Diagram



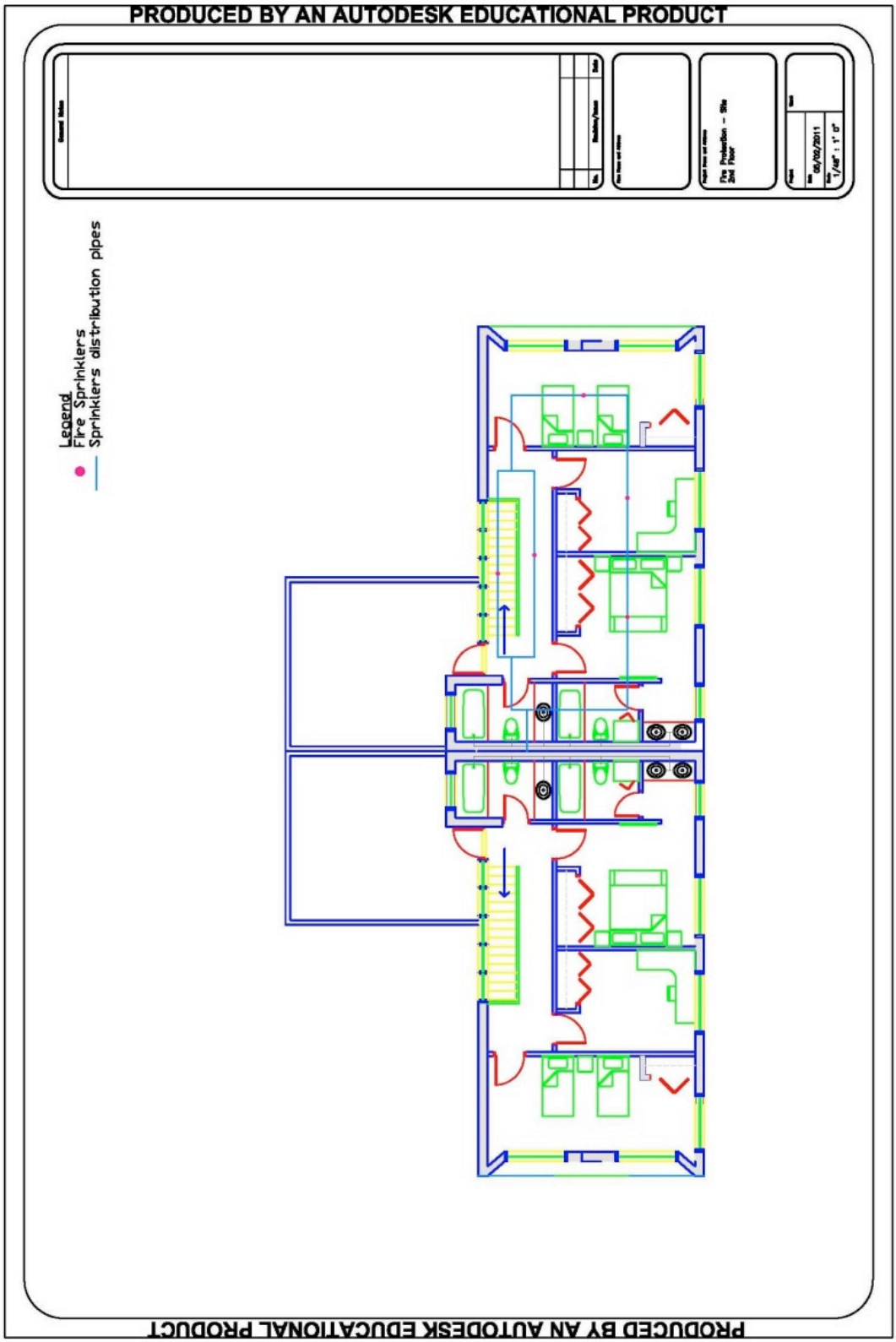
Basement Fire Protection Plan



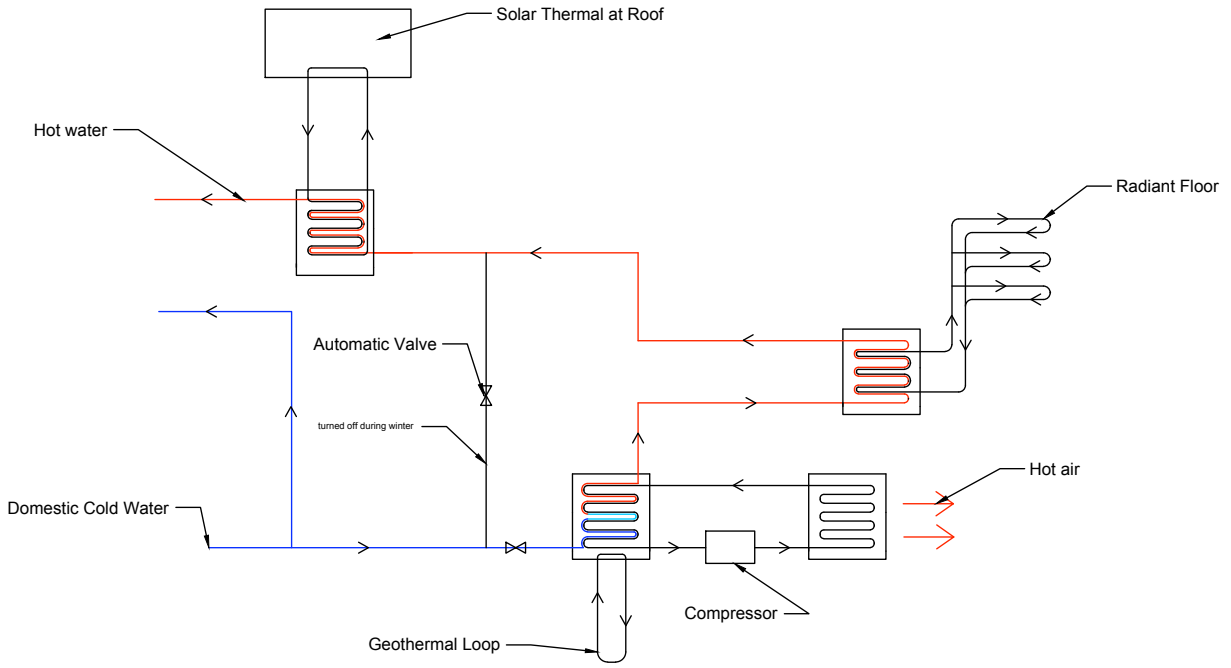
1st Floor Fire Protection Plan



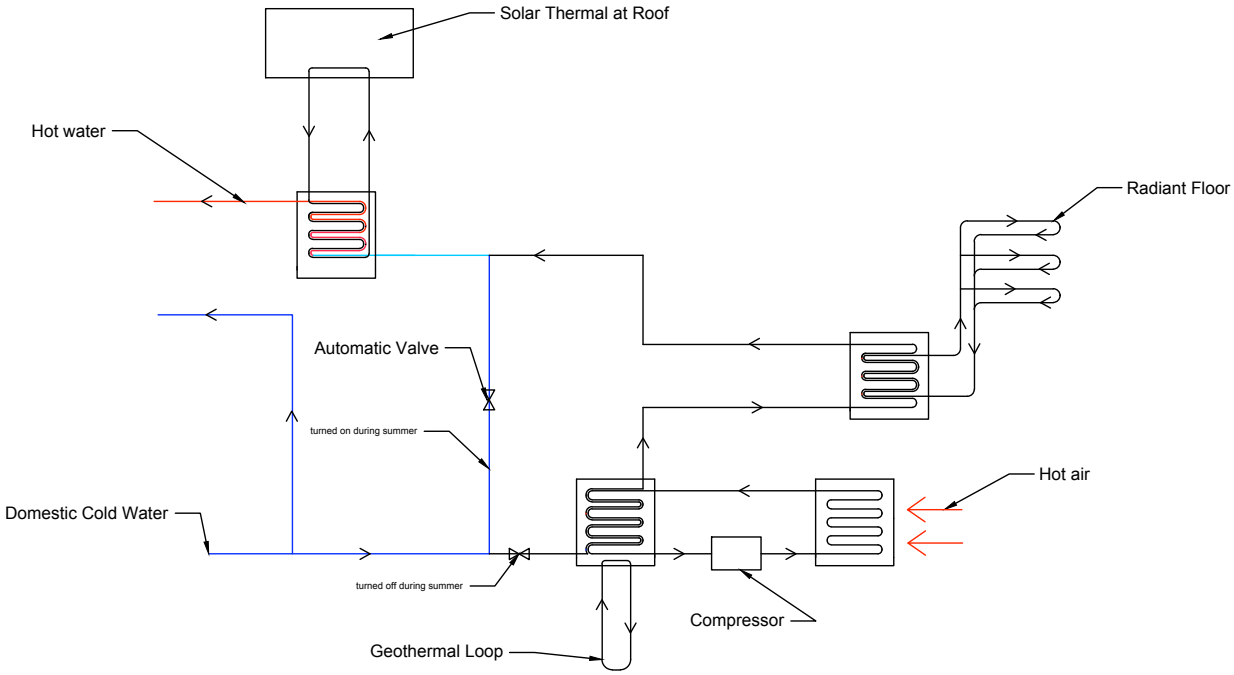
2nd Floor Fire Protection Plan



Geothermal System



Schematic Diagram of Geothermal and Solar Thermal Systems during Winter

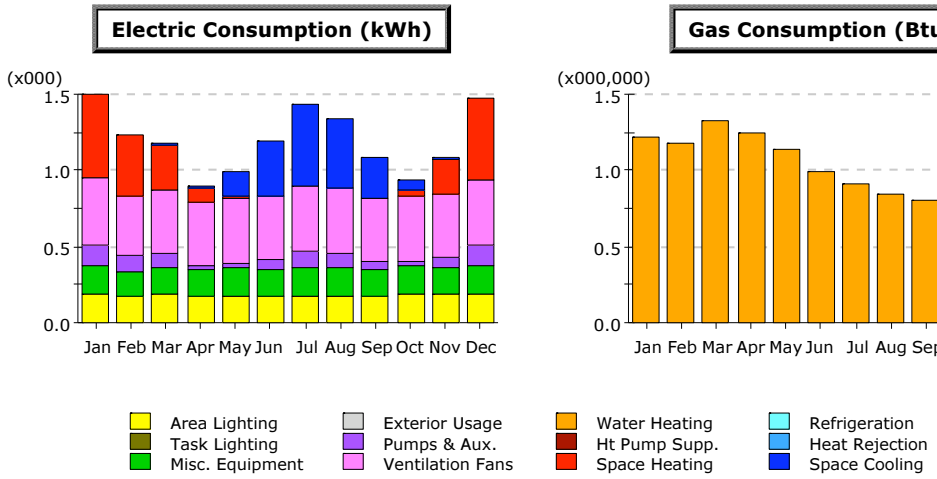


Schematic Diagram of Geothermal and Solar Thermal Systems during Summer

Appendix F: Energy Model Results

IPRO 358 Fall 2010 eQuest Results

Project/Run: 358_995_SF tilted - Baseline Design Run Date/Time: 11/30/10 @ 23:39



Electric Consumption (kWh x000)

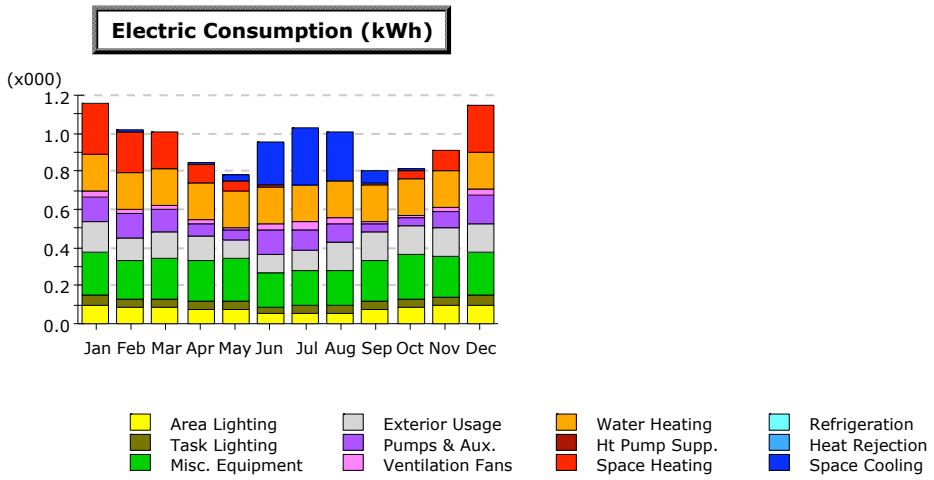
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.00	0.01	0.16	0.36	0.53	0.45	0.26	0.06	0.01	-	1.84
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.55	0.40	0.29	0.09	0.01	-	-	-	0.00	0.04	0.23	0.53	2.16
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.44	0.39	0.42	0.41	0.43	0.41	0.43	0.43	0.41	0.43	0.42	0.43	5.05
Pumps & Aux.	0.14	0.11	0.09	0.03	0.03	0.07	0.11	0.10	0.05	0.03	0.07	0.14	0.96
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.18	0.16	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	2.14
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.19	0.17	0.18	0.17	0.18	0.17	0.18	0.18	0.18	0.19	0.18	0.19	2.16
Total	1.50	1.23	1.17	0.89	0.99	1.19	1.43	1.33	1.08	0.94	1.08	1.47	14.31

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1.22	1.17	1.33	1.25	1.14	1.00	0.91	0.84	0.81	0.89	0.96	1.12	12.63
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1.22	1.17	1.33	1.25	1.14	1.00	0.91	0.84	0.81	0.89	0.96	1.12	12.63

North Units eQuest Results

Project/Run: IPRO 358 rev3 - Baseline Design Run Date/Time: 04/24/11 @ 17:10



Electric Consumption (kWh x000)

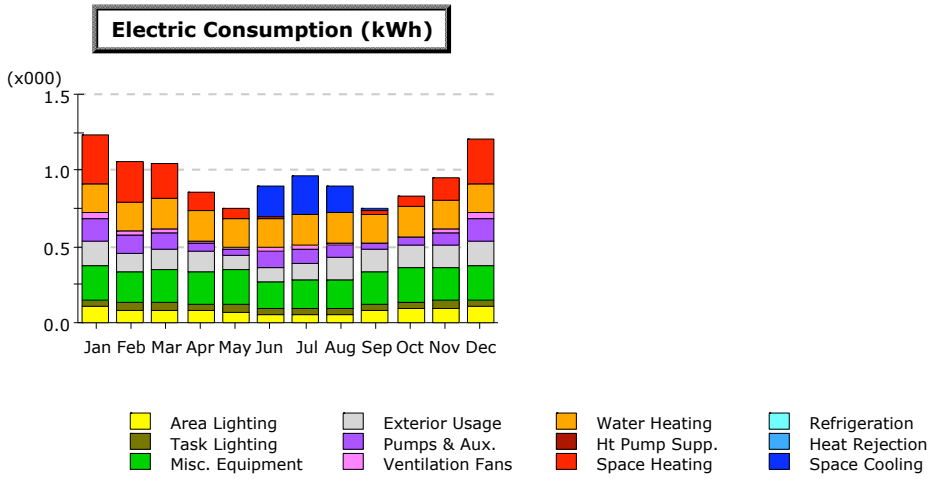
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.00	0.01	0.00	0.00	0.03	0.23	0.30	0.26	0.05	0.01	0.00	0.00	0.91
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.26	0.21	0.19	0.11	0.06	0.01	0.00	-	0.02	0.04	0.11	0.25	1.26
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	2.31
Vent. Fans	0.03	0.03	0.02	0.01	0.01	0.03	0.04	0.03	0.01	0.01	0.01	0.03	0.28
Pumps & Aux.	0.13	0.13	0.12	0.06	0.05	0.12	0.11	0.10	0.05	0.05	0.08	0.14	1.15
Ext. Usage	0.16	0.12	0.14	0.13	0.10	0.10	0.10	0.15	0.15	0.15	0.15	0.16	1.61
Misc. Equip.	0.23	0.20	0.22	0.22	0.22	0.18	0.19	0.18	0.22	0.23	0.22	0.22	2.51
Task Lights	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.53
Area Lights	0.10	0.08	0.08	0.07	0.07	0.05	0.06	0.06	0.07	0.09	0.10	0.10	0.94
Total	1.16	1.02	1.01	0.84	0.78	0.96	1.03	1.01	0.80	0.82	0.92	1.15	11.48

Gas Consumption (Btu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task Lights													
Area Lights													
Total													

South Units eQuest Results

Project/Run: IPRO 358 rev3 - South units Run Date/Time: 04/24/11 @ 17:11



Electric Consumption (kWh x000)

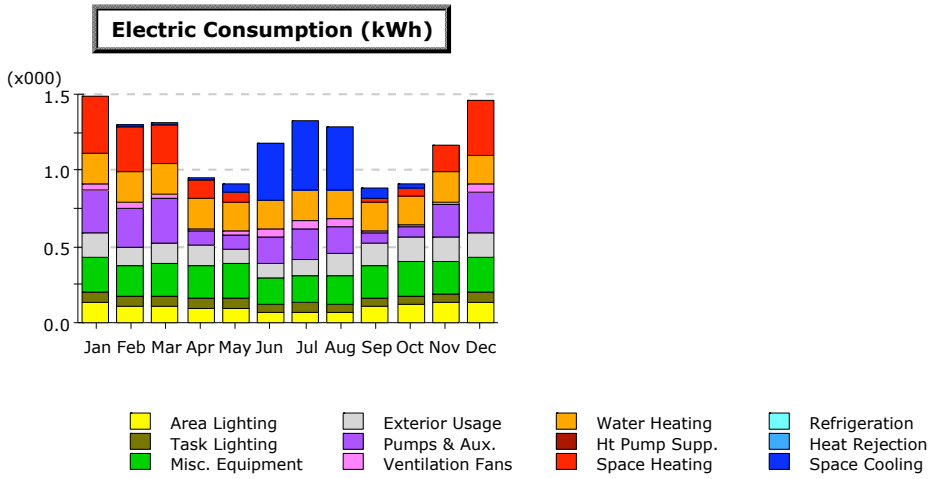
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.00	-	0.01	0.20	0.26	0.19	0.01	0.00	-	-	0.67
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.33	0.26	0.23	0.12	0.06	0.01	0.00	-	0.02	0.06	0.15	0.30	1.54
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	2.31
Vent. Fans	0.04	0.03	0.03	0.02	0.01	0.03	0.03	0.02	0.00	0.01	0.02	0.04	0.28
Pumps & Aux.	0.14	0.12	0.11	0.06	0.04	0.10	0.10	0.07	0.04	0.05	0.08	0.15	1.05
Ext. Usage	0.16	0.12	0.14	0.13	0.10	0.10	0.10	0.15	0.15	0.15	0.15	0.16	1.61
Misc. Equip.	0.23	0.20	0.22	0.22	0.22	0.18	0.19	0.18	0.22	0.23	0.22	0.22	2.51
Task Lights	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.53
Area Lights	0.10	0.09	0.08	0.07	0.07	0.05	0.06	0.06	0.08	0.09	0.10	0.10	0.95
Total	1.24	1.06	1.04	0.85	0.75	0.90	0.96	0.90	0.74	0.82	0.95	1.21	11.43

Gas Consumption (Btu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task Lights													
Area Lights													
Total													

eQuest Results Without Home Automation

Project/Run: IPRO 358 rev3 - No auto - gar light Run Date/Time: 04/24/11 @ 17:18



Electric Consumption (kWh x000)

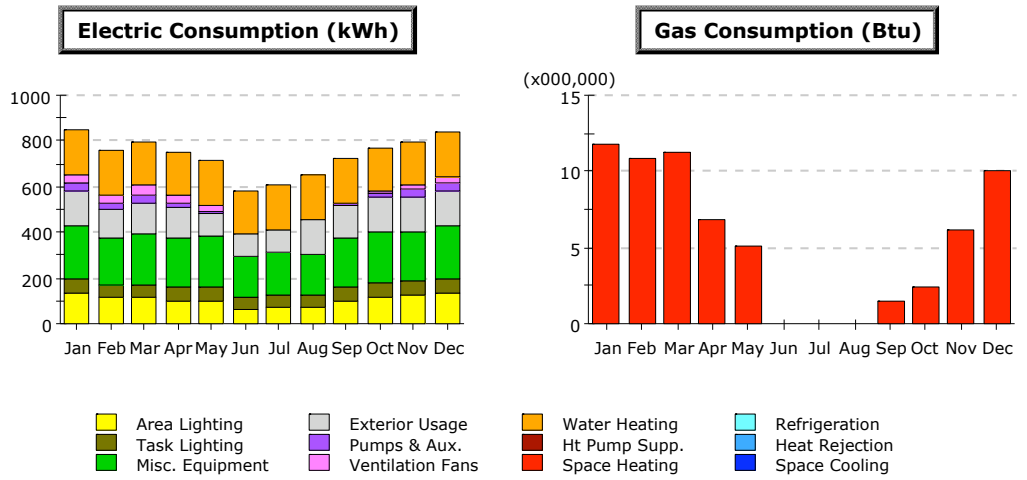
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.00	0.01	0.01	0.01	0.05	0.38	0.47	0.40	0.08	0.03	0.01	0.00	1.43
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.37	0.30	0.26	0.13	0.07	-	-	-	0.02	0.05	0.18	0.36	1.74
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	2.31
Vent. Fans	0.05	0.04	0.03	0.02	0.02	0.05	0.06	0.05	0.01	0.01	0.02	0.05	0.42
Pumps & Aux.	0.28	0.26	0.29	0.09	0.10	0.17	0.20	0.17	0.07	0.07	0.21	0.28	2.19
Ext. Usage	0.16	0.12	0.14	0.13	0.10	0.10	0.10	0.15	0.15	0.15	0.15	0.16	1.61
Misc. Equip.	0.23	0.20	0.22	0.22	0.22	0.18	0.19	0.18	0.22	0.23	0.22	0.22	2.51
Task Lights	0.07	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.71
Area Lights	0.13	0.11	0.11	0.10	0.10	0.07	0.07	0.07	0.10	0.12	0.13	0.14	1.26
Total	1.49	1.29	1.31	0.95	0.91	1.18	1.33	1.28	0.89	0.92	1.17	1.46	14.18

Gas Consumption (Btu)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool													
Heat Reject.													
Refrigeration													
Space Heat													
HP Supp.													
Hot Water													
Vent. Fans													
Pumps & Aux.													
Ext. Usage													
Misc. Equip.													
Task Lights													
Area Lights													
Total													

eQuest Results For Typical Construction

Project/Run: IPRO 358 rev3 - Standard - no shades | Run Date/Time: 04/24/11 @ 16:07



Electric Consumption (kWh)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	192.3	192.3	192.3	192.3	192.3	192.3	192.3	192.3	192.3	192.2	192.3	192.3	2,307.2
Vent. Fans	36.9	37.3	41.0	29.1	25.0	-	-	-	6.0	7.2	16.4	28.5	227.4
Pumps & Aux.	36.8	33.5	35.1	24.0	8.5	0.6	-	-	2.2	15.3	31.0	36.6	223.7
Ext. Usage	156.7	123.8	137.1	132.7	101.6	98.3	101.6	150.2	145.3	150.2	151.6	156.7	1,605.6
Misc. Equip.	226.2	201.9	217.2	215.4	223.2	177.1	185.2	182.8	215.5	226.3	215.9	224.4	2,511.1
Task Lights	66.1	57.8	60.7	60.4	62.8	49.2	53.7	50.5	59.8	64.7	62.1	64.3	712.2
Area Lights	133.2	112.6	112.3	98.5	96.9	66.5	72.2	72.3	99.6	114.1	127.6	136.2	1,241.9
Total	848.1	759.2	795.7	752.3	710.2	584.0	604.9	648.0	720.8	770.1	797.0	839.1	8,829.3

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	11.75	10.84	11.22	6.81	5.15	-	-	-	1.52	2.36	6.19	10.01	65.84
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	11.75	10.84	11.22	6.81	5.15	-	-	-	1.52	2.36	6.19	10.01	65.84

Appendix G: Cost Estimates

Exterior Estimate

Number	Item	Unit	Cost Per	Amount	Cost
Exterior house wall					
07 44 73.10 0400	Textured aluminum, 4'x8'x5/16" plywood backing, single face	sqft	7.20	1044.75	7522.20
07 25 10.10 0480	Housewrap, large roll	sqft	0.27	1044.75	282.08
07 21 13.10 2120	2" thick expanded polystyrene	sqft	1.49	1044.75	1556.68
06 16 36.10 0600	1/2" OSB sheathing	sqft	1.01	1044.75	1055.20
06 11 40.40 6160	Studs, 12' high wall, 2"x6"	mbf	1450.00	0.522375	757.44
07 21 26.10 0030	Blown cellulose insulation, 5-3/16" thick	sqft	0.76	1044.75	794.01
09 29 10.30 0350	Gypsum board, 1/2" on walls, finished	sqft	1.37	1044.75	1431.31
					13398.92
Roof					
07 51 13.20 2200	Built up asphalt roofing, smooth surface, 3 plies	sq	260.00	14.18	3686.80
07 21 13.10 2120	2" thick expanded polystyrene	sqft	1.49	1418	2112.82
06 16 23.10 0200	3/4" thick plywood subfloor	sqft	1.30	1418	1843.40
06 17 33.10 1200	Wood I-joists, 15'-24' span, 50 psf live load	sqft	2.82	1418	3998.76
07 21 26.10 1450	Blown cellulose insulation, 16" thick	sqft	2.14	1418	3034.52
09 29 10.30 0350	Gypsum board, 1/2" on ceilings, finished	sqft	1.65	1418	2339.70
					17016.00
Exterior garage wall					
07 44 73.10 0400	Textured aluminum, 4'x8'x5/16" plywood backing, single face	sqft	7.20	272	1958.40
07 25 10.10 0480	Housewrap, large roll	sqft	0.27	272	73.44
06 16 36.10 0600	1/2" OSB sheathing	sqft	1.01	272	274.72
06 11 40.40 6160	Studs, 12' high wall, 2"x6"	mbf	1450.00	0.136	197.20
					2503.76
Wall between garage and house					
06 16 36.10 0600	1/2" OSB sheathing	sqft	1.01	241.5	243.92
06 11 40.40 6160	Studs, 12' high wall, 2"x6"	mbf	1450.00	0.12075	175.09
07 21 26.10 0030	Blown cellulose insulation, 5-3/16" thick	sqft	0.76	241.5	183.54
09 29 10.30 0350	Gypsum board, 1/2" on walls, finished	sqft	1.37	241.5	330.86
					933.40
Doors and windows					
08 32 19.15 0012	Vinyl sliding door, 1" insul. glass, 6'x6'10"	ea	2000.00	1	2000.00
08 36 13.20 0300	Overhead garage door, 16'x7', w/ automatic opener	ea	2625.00	1	2625.00
08 13 13.20 0060	Prehung, insulate, steel exterior door, 3'x7'	ea	420.00	3	1260.00
08 52 10.50 0200	Wood double hung window, 4'x4'6", insulated, low e	ea	360.00	3	1080.00
08 52 10.50 0300	Wood double hung window, 3'x4', insulated, low e	ea	440.00	2	880.00

Exterior Estimate

08 52 10.50 1530	Wood double hung window, 4'x6', insulated	ea	830.00	8	6640.00
					14485.00
Floor framing					
06 16 23.10 0200	3/4" thick plywood subfloor	sqft	1.30	1922	2498.60
06 17 33.10 1200	Wood I-joists, 15'-24' span, 50 psf live load	sqft	2.82	1922	5420.04
09 29 10.30 0350	Gypsum board, 1/2" on ceilings, finished	sqft	1.65	1922	3171.30
					11089.94
Concrete					
03 31 05.70 2900	Placing slab on grade, over 6" thick, direct chute	CY	15.75	23.28395	366.72
03 31 05.70 4900	Placing 8" thick wall, direct chute	CY	28.50	27.11111	772.67
03 31 05.35 0150	3000 psi normal weight concrete, delivered	CY	107.00	50.39506	5392.27
					6531.66
Heavy timber					
06 18 13.20 8122	4"x16"x24' glulam	ea	520.00	2	1040.00
06 18 13.20 8134	6"x10"x24' glulam	ea	505.00	1	505.00
06 18 13.20 8106	3"x10"x18' glulam	ea	267.00	1	267.00
					1812.00

Interior Estimate

Number	Item	Unit	Cost Per	Amount	Cost
09 21 16.33 0050	Partition wall assembly, 2x4 stud, 1/2" gypsum board	sqft	4.24	1219.75	5171.74
					5171.74
Stairs					
06 43 13.20 1550	Prefabricated wood stairs, stair handrail with balusters	linft	97.3	34	3308.20
					3308.20
Floors					
09 64 29.10 4900	Select quartered oak, unfinished, select	sqft	6.25	1922	12012.50
09 64 29.10 7800	Sanding and finishing, 2 coats poly	sqft	2.24	1922	4305.28
					16317.78
Painting					
09 91 23.74 0880	Interior zero VOC latex, spray, two coats	sqft	0.39	3060.25	1205.43
09 91 23.74 0880	Interior zero VOC latex, spray, two coats	sqft	0.39	2116	1031.55
09 91 23.52 7450	Trim paint, under 6" wide, latex, inc. puttying, 3 coats	linft	1.5	704.5	951.08
					3188.06
Finish carpentry					
06 22 13.15 0550	Moldings, base, oak, 3 piece, 4-1/2" x 9/16" thick	linft	5.19	367	1904.73
08 14 33.20 2720	Closet doors, birch, 2'6" bifold w/ hardware	ea	135	6	810.00
08 14 33.20 7780	Passage door assembly, birch hollow core, 3'	ea	256	10	2560.00
					5274.73
Kitchen					
12 32 23.10 0800	Kitchen base cabinet, one drawer, 12"	ea	294	2	588.00
13 32 23.10 1060	Kitchen base cabinet, four drawers drawer, 24"	ea	380	2	760.00
14 32 23.10 1500	Kitchen base cabinet, two doors, 30"	ea	385	3	1155.00
15 32 23.10 2000	Corner cabinet w/ lazy susan	ea	855	1	855.00
16 32 23.10 0880	Kitchen base cabinet, one drawer, 24"	ea	390	4	1560.00
17 32 23.10 7000	Broom cabinet, 84"x18"	ea	735	2	1470.00
14 32 23.10 5300	Kitchen wall cabinet, two doors, 27"	ea	375	3	1125.00
15 32 23.10 6500	Corner wall cabinet w/ lazy susan	ea	525	1	525.00
11 31 13.13 0050	Cooking range, free standing, 1 oven, 30" wide, maximum	ea	2035	1	2035.00
11 31 13.23 6799	Refrigerator, energy star qualified, 21.7 CF, maximum	ea	1866	1	1866.00
11 31 13.43 3350	Garbage disposal, sink type, maximum	ea	271	1	271.00
11 31 13.53 4300	Range hood, vented, 2 speed, 42" wide, minimum	ea	316	1	316.00
11 31 23.23 0500	Laundry, dryers, gas-fired, 16 lb capacity, average	ea	928	1	928.00
11 31 23.13 6750	Washing machine, energy star, front loading, minimum	ea	913	1	913.00
11 31 13.33 3100	Dishwasher, built-in, energy-star qualified, minimum	ea	641	1	641.00
					15008.00

Electrical Estimate

Unit Detail Report

Cost Estimate Report CostWorks RSMeans

Year 2011

Date: 19-Apr-11

IPRO_Electric

Prepared By:
Se Yen Lai
Illinois Institute of Technology

LineNumber			Description	Quantity	Unit	Total Incl. O&P	Ext. Total Incl. O&P
Division 26 Electrical							
260519200220			Armored cable, copper, solid, 600 V, 4 conductor, #12, BX, exposed	7.00	C.L.F.	$567.05	$3,969.35
260533170401			Switch boxes, plastic, with 2 mounting nails, 1 gang	19.00	Ea.	$21.95	$417.05
260533170601			Switch boxes, plastic, 3 gang	1.00	Ea.	$37.24	$37.24
260590104015			Receptacle devices, resi, duplex outlet, ivory, type NM cable, 20', 15 amp, incl box & cover plate	37.00	Ea.	$45.80	$1,694.60
260590104300			Receptacle devices, resi, decorator style, GFI, type NM cable, 15 amp, incl box & cover plate	9.00	Ea.	$88.34	$795.06
260590108200			Vent/exhaust fan, resi, hook-up, type NM cable, 20'	3.00	Ea.	$30.01	$90.03
260590108260			Bathroom vent fan, resi, hook-up, (use w/above hook-up), economy model, 50 CFM	3.00	Ea.	$73.83	$221.49
262416200100			Circuit breakers, bolt-on, 10 k A I.C., 1 pole, 120 volt, 15 to 50 amp	13.00	Ea.	$87.50	$1,137.50
262416202082			Circuit breakers, arc fault circuit interrupter, 120/240 V, 1-15 A & 1-20 A, 1 pole	5.00	Ea.	$153.71	$768.55
262416300800			Panelboards, 3 phase 4 wire, main lugs, 120/208 V, 100 amp, 30 circuits, NQOD, incl 20 A 1 pole plug-in breakers	1.00	Ea.	$2,401.90	$2,401.90
262713100200			Meter socket, single position, 4 terminal, 150 A	1.00	Ea.	$283.62	$283.62
265113502300			Fluorescent fixture, interior, strip, surface mounted, R.S., 2-40 W, 4' long, incl lamps, mounting hardware and connections	5.00	Ea.	$105.23	$526.15
265113504470			Incandescent fixture, interior, high hat can, round alzak reflector, prewired, 100 W, incl lamps, mounting hardware and connections	6.00	Ea.	$138.74	$832.44
265113505300			Incandescent fixture, interior ceiling, surface mounted, opal glass drum, 1-60 W, 8", incl lamps, mounting hardware and connections	24.00	Ea.	$98.03	$2,352.72
Division 26 Subtotal							**$15,527.70**

Plumbing Estimate

Number	Item	Unit	Cost Per	Amount	Cost
Plumbing					
224113440420	Toilet seat, molded composition, white, residential, regular bowl, closed front, includes cover	Ea.	$ 58.00	3	$ 174.00
224119100220	Bath, tub, recessed porcelain enamel on cast iron, 72" x 36", includes trim	Ea.	$ 2,910.00	2	$ 5,820.00
224116100680	Lavatory, vanity top, porcelain enamel on cast iron, white, oval, 20" x 17", includes trim	Ea.	$ 359.00	4	$ 1,436.00
224139100150	Faucets/fittings, bath, faucets, diverter spout combination, soldered	Ea.	$ 175.00	2	$ 350.00
224139101000	Faucets/fittings, kitchen sink faucets, top mount, cast spout	Ea.	$ 131.50	1	$ 131.50
224139102000	Faucets/fittings, laundry faucets, shelf type, I.P.S. or copper unions	Ea.	$ 108.00	1	$ 108.00
224139102100	Faucets/fittings, lavatory faucet, center set, excludes drain	Ea.	$ 113.00	4	$ 452.00
224116302200	Sink, kitchen, counter top style, porcelain enamel on cast iron, double bowl, 32" x 21", includes faucet and drain	Ea.	$ 545.00	1	$ 545.00
221316204100	Pipe, cast iron soil, no hub, 1-1/2" diameter, includes couplings 10' O.C., clevis hanger assemblies 5' O.C.	L.F.	$ 26.15	116.3	$ 3,041.25
221316204120	Pipe, cast iron soil, no hub, 2" diameter, includes couplings 10' O.C., clevis hanger assemblies 5' O.C.	L.F.	$ 27.35	62.2	$ 1,701.17
221316204160	Pipe, cast iron soil, no hub, 4" diameter, includes couplings 10' O.C., clevis hanger assemblies 5' O.C.	L.F.	$ 37.20	123	$ 4,575.60
224139105000	Faucets/fittings, sillcock, compact brass, I.P.S. or solder to hose	Ea.	$ 38.15	2	$ 76.30
019313151900	Relief valve, test and adjust	Ea.	$ 32.50	21	$ 682.50
077123100600	Aluminum downspouts, round, corrugated, 3" diameter, .020" thick	L.F.	$ 5.05	30	$ 151.50
221113231180	Pipe, copper, tubing, solder, 3/4" diameter, type K, includes coupling & clevis hanger assembly 10' O.C.	L.F.	$ 18.40	198.5	$ 3,652.40
221113231200	Pipe, copper, tubing, solder, 1" diameter, type K, includes coupling & clevis hanger assembly 10' O.C.	L.F.	$ 22.70	72.9	$ 1,654.83
221113231240	Pipe, copper, tubing, solder, 1-1/2" diameter, type K, includes coupling & clevis hanger assembly 10' O.C.	L.F.	$ 33.80	13.9	$ 469.82
					$ 25,021.87
Fire Protection					
221113745309	Pipe, plastic, CPVC, socket joint, 2" diameter, schedule 40, includes couplings 10' OC, and hangers 3 per 10'	L.F.	30.65	250	7662.5
	Reliable Model RFC43 Concealed Residential Sprinkler	ea	46.50	14	651
	Sprinkler Cover	ea	22.88	14	320.32
					8633.82

HVAC Estimate

Ridgeway Precision Mechanical Inc.
280 West St. Charles Road
Villa Park, Illinois 60181
Phone 630-279-4822 Fax 630-279-4822
Web RPMechanical.com

HVAC Installation Proposal

Date	Estimate #
4/11/2011	2217

Name / Address	Ship To
Se Yen Laui Evanston, IL	

Terms	Rep	Project

Description	Investment
Thank you for allowing Ridgeway Precision Mechanical to submit its proposal.	289,677.00
We propose to install a complete geothermal system for each unit. The systems will include a Waterfurnace synergy unit coupled with a domestic water heater and storage tank for radiant heating. We will install all ducting for forced air systems kitchen and bath exhaust fans as well. We will install radiant in the floors of the bath rooms. We will install all controls to control forced air heating and cooling domestic hot water production and radiant heat for bath rooms. * All high voltage electrical to be done by others.	
Our price is for all HVAC needed by code and as listed above. Upon work completion, this system shall be started, checked, adjusted, and tested for proper operation.All work will be performed during regular business hours, on regular business days. Work not included: Purchaser will provide a source for entry and will move interfering equipment, if any, for the delivery and setting up of equipment. This contract does not include any servicing of existing equipment, permits, drawings for permit approval, as-built drawings, electrical power or control wiring, roofing work required beyond the cold patch seal of the new equipment to the existing roof, removal of asbestos pipe covering, painting, patching, or redecorating.Temperature and humidity guarantee: Due to conditions and variables beyond our control, i.e., building usage, door openings, out side air intakes, temperature set point changes, non vapor sealed walls, etc., we do not guarantee temperature or humidity maintenance levels. Customer agrees to pay for all collections cost and attorneys fees if collected by suit or otherwise. There is an 18% (eighteen percent) that will be charged after 30 (thirty) days from invoice date and every month until balance is paid. All extras or changes to the plan must be submitted in writing will be charged on a time and material basis or as discussed. RPM reserves the right to withdraw this proposal if not accepted in sixty days.	
Thank you for allowing RPM to handle all of your electrical plumbing and HVAC needs.	
Sales Tax	0.00
If you have any questions please do not hesitate to call at (630) 67-4HVAC (4822)	**Total** **$289,677.00**

Make sure to make the most of your experience with Ridgeway Precision Mechanical Inc. and get an estimate for your HVAC and Electrical needs. We also offer extended warranties on all the products we carry. Be sure to clean those ducts with our Duct Cleaning services to help reduce your energy bills and indoor contaminants.

Signature/Date _____

Site/Civil Estimate

Number	Item	Unit	Cost Per	Amount	Cost
Excavation					
31 23 16.13 0500	Excavating, trench or continuous footing, common earth, 3/4 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	bcy	4136	7.61	31474.96
Paving					
32 12 16.14 0020	Asphaltic concrete, parking lots & driveways, 6" stone base, 2" binder course, 1" topping	sqft	6209	2.46	15274.14
					15274.14
Playground Equipment					
11 68 13.20 0100	Modular playground, deck, square, steel, 48" x 48"	ea	3	1969.7	5909.10
11 68 13 20.0160	Modular playground, roof, square poly, 54" side	ea	3	1351.43	4054.29
11 68 13 20.1350	Modular playground, bridge, suspension	ea	2	1467.08	2934.16
11 68 13.20 1300	Modular playground, ladder, vertical, for 24" - 72" high deck	ea	1	935.8	935.80
11 68 13.20 1220	Modular playground, slide tunnel, straight, stainless steel, 54" high deck	ea	1	804.84	804.84
					14638.19
Tree					
32 93 43.30 0230	Deciduous trees, acer ginnala, (Amur Maple), B&B, zone 2, 12' to 14'	ea	21	250.01	5250.21
32 93 43.30 0120	Deciduous trees, acer campestre, (Hedge Maple), B&B, zone 4, 5' to 6'	ea	40	95.66	3826.40
32 93 43.40 1207	Conifer trees, abies iasiocarpa arizonica, (Cork Fir), container/B&B, zone 5, 10' t	ea	17	323.93	5506.81
					14583.42
Grass					
32 92 23.10 0300	Sodding, bluegrass sod, on level ground, 1000 S.F.	msf	26	531.05	13807.30
					1290.00
Garden					
32 91 13.26 1000	Planting beds preparation, excavate planting pit, sandy soil, by hand	cy	20	50.93	1018.60
					1018.60
Pond					
33 47 13.53 1200	Pond and Reservoir Liners, membrane lining systems HDPE, 100,000 S.F. or mo	sqft	978	1.48	1447.44
31 23 16.13 0050	Excavating, trench or continuous footing, common earth, 3/8 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	bcy	230	8.79	2021.70
					3469.14
Pavilion					
32 14 40.10 1100	Stone pavers, flagging, bluestone, irregular, 1" thick	sqft	300	16.99	5097.00
					5097.00

Demolition Estimate

IPRO358
Ying Xiao
2/22/2011

- Address of the site
  - 1108 Dodge Ave Evanston, IL 60202 (42.037856,-87.699291)
- Area of the site:
  - Width: 187.71ft
  - Length: 417.71ft
  - Area of the site: 78,450sqft
  - http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&ll=42.037943,-87.699936&spn=0.002247,0.005681&z=18&msid=209392047574973145565.00049cd093c225cb15357
- Buildings and other stuff exist on the site
  - J & B Transmission and Auto Repair
  - Foreign & Domestic Auto Repair
  - Parking garage
  - Cars maybe….don't remember so well
- Demolition cost (calculation)
  - Call number (708) 675-7374 – Brackenbox (demolition company inChicago)
  - Demolition calculator: http://www.buildingjournal.com/commercial-construction-estimating-demolition.html

- Type of Building: Auto Sales - Project Location: Illinois-Chicago - Type of Work: Demolition - Cost Index: Median - Square Feet: 78,450sqft - Total Budget: $72,863.91 - Per Square Foot: $0.93	- Type of Building: Parking Garage - Project Location: Illinois-Chicago - Type of Work: Demolition - Cost Index: Median - Square Feet: 78,450sqft - Total Budget: $42,106.20 - Per Square Foot: $0.54
- Type of Building: Auto Sales - Project Location: Illinois-Chicago - Type of Work: Demolition - Cost Index: Low - Square Feet: 78,450sqft - Total Budget: $62,298.64 - Per Square Foot: $0.79	- Type of Building: Parking Garage - Project Location: Illinois-Chicago - Type of Work: Demolition - Cost Index: Median - Square Feet: 78,450sqft - Total Budget: $36,000.80 - Per Square Foot: $0.46

Conclusion: demolition cost should be around $54000.00

Appendix H: Proforma

IPRO 358 Spring 2011
Dodge and Greenleaf St.
Evanston, IL

Proforma Summary

Scope of Development		Size of the Lot	67,000	s.f.
		Permitable Lot Coverage	45%	
		Permitable Square Footage	30,150	s.f.
		No. of Allowable Units	No limit as long as separated according to code, 5 ft. min.	
		Height Restriction	35	ft
		Required Parking	1.25	per unit
Proposed Development		No. of Residential Units	12	
		Total Residential Square Foot.	24,000	s.f.
		Average Residential Unit Size	2,000	s.f.
		Height	21	ft
		No. of Parking Spaces	18	
Revenue			**$ 5,190,720**	
Expenses	1	Lot	$ 250,000	
	2	Site Preparation	$ 54,000	
	3	Construction	$ 3,437,141	
	4	Lender Inspections	$ 15,000	
	5	Architecture	$ 171,857	
	6	Legal/Accounting	$ 44,683	
	7	Financing/Appraisal	$ 13,749	
	8	Title Insurance	$ 10,908	
	9	Insurance	$ 13,749	
	10	R.E. Taxes/Fees	$ 220,664	
	11	Marketing	$ 68,743	
	12	Survey/Testing	$ 10,311	
	13	Developer Fees	$ 100,000	
	14	Interest	$ 509,000	
		Total	**$ 4,919,804**	
Project Profit			$ 270,916	
Capital			$ 1,475,941	
Rate of Return			18.36%	
Annualized Return			5%	

Sources and Uses of Funds

Sources		
General Partner Contribution:		$ 1,967,922
Construction Lender:		$ 2,951,883
Proceeds from Residential:		$ 5,190,720
Total		**$ 10,110,524**
Uses:		
Soft Costs:	(Land & Marketing)	$ 1,482,664
Hard Costs:	(Construction)	$ 3,437,141
Return of Bank Loan:		$ 2,951,883
Return of Principal:		$ 1,475,941
Distribution of Profit:		$ 270,916
Total		**$ 9,618,544**

IPRO 358 Spring 2011
Dodge and Greenleaf St.
Evanston, IL

Proforma Summary

Project Schedule							Purchase Land			Demolition	Grading and Foundations, Utilities and Geothermal	Rough Carpentry, Electric, Plumbing	Rough Carpentry, Electric, Plumbing	Roof, Building Enclosure and Insulation	Drywall, Interior and Exterior Finishes
0															
Scope of Development															
			Loan Length							1	2	3	4	5	6
						Sep-02	1-Oct	31-Oct	30-Nov	30-Dec	29-Jan	28-Feb	30-Mar	29-Apr	29-May	28-Jun
REVENUES:		SALES:	Rented Units			0	0	0	0	0	0	0	0	0	0	0
			Sale of Units													
			Monthly Rent			0	0	0	0	0	0	0	0	0	0	0
		MONTHLY TOTAL REVENUES				0	0	0	0	0	0	0	0	0	0	0
		ACCUM. PROJECT REVENUES			**5,190,720**	0	0	0	0	0	0	0	0	0	0	0
Home Sale Price	$400,000.00															
Rental Rate	$2,200.00	To Investor	1760													
	1 FINISHED LOT															
	COSTS	A. Land Acquistion			250,000			$ 250,000.00								
		B. Gen. Cond. Fees			17,500			$ 17,500.00								
		SUBTOTAL			**267,500**	0	0	$ 267,500.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	2 DIRECT	A. Direct Base Construction			3,437,141						$ 54,000.00	$ 971,073.00	$ 740,994.72	$ 103,605.84	$ 373,572.00	$ 536,940.00
	CONSTRUCTION	B. Gen. Cond. Fees			240,600						$ 240,599.84					
		SUBTOTAL			**3,677,740**	0	0	$ -	$ -	$ -	$ 294,599.84	$ 971,073.00	$ 740,994.72	$ 103,605.84	$ 373,572.00	$ 536,940.00
	3 INDIRECT	A. Arch/Engineer			171,857				$ 171,857.03							
	COSTS	B. Survey/Testing			10,311				$ 10,311.42							
		C. Appraisal/Market		$	13,749				$ 13,748.56							
		D. RE Tax/Permit		$	220,664				$ 220,664.42							
		E. Insurance		$	13,749				$ 13,748.56							
		F. Legal/Accounting		$	44,683				$ 44,682.83							
		G. Maintenance		$	12,000											
		SUBTOTAL		**$**	**487,013**	$ -	$ -	$ -	$ 475,013	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	4 SALES AND	A. Sales Costs		$	68,743											
		SUBTOTAL		**$**	**68,743**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	5 DEV. OH FEE	A. Dev. Oh Fee		$	100,000											
		SUBTOTAL		**$**	**100,000**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	6 FINANCE &	A. Construction Interest		$	509,000	$ -	$ -	$ 1,449	$ 3,528	$ 3,034	$ 4,136	$ 8,903	$ 12,422	$ 12,490	$ 14,020	$ 16,434
	CARRY COSTS	B. Title Insurance		$	15,000											
		C. Loan/Fees/Inspections		$	15,000											
		SUBTOTAL		**$**	**539,000**											
	7 COSTS AT	A. Employee Commission		$	21,600											
	SALES	B. Closing Costs		$	10,908											
		SUBTOTAL		**$**	**32,508**	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		MONTHLY TOTAL EXPENSES				$ -	$ -	$ 267,500	$ 475,013	$ -	$ 294,600	$ 971,073	$ 740,995	$ 103,606	$ 373,572	$ 536,940
		ACCUM. PROJECT EXPENSES				$ -	$ -	$ 267,500	$ 651,351	$ 560,190	$ 763,628	$ 1,643,540	$ 2,293,373	$ 2,305,817	$ 2,588,228	$ 3,034,006
Payment						$ -	$ -	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161
		Monthly Const. Loan Amount				$ -	$ -	$ 267,500	$ 475,013	$ -	$ 294,600	$ 971,073	$ 740,995	$ 103,606	$ 373,572	$ 536,940
		Accum. Const. Loan Amount				$ -	$ -	$ 267,500	$ 651,351	$ 560,190	$ 763,628	$ 1,643,540	$ 2,293,373	$ 2,305,817	$ 2,588,228	$ 3,034,006
		Interest Rate:			6.50%											
		Equity Calculation:														
		Cost Less Comm. & Title		$	2,951,883											
		Loan Amount		$	(2,951,883)											

		Drywall, Interior and Exterior Finishes	Mechanical Systems	Finishes and Close Out on Some Homes	Move In	Move In	Move In														
	Loan Length	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22				
		28-Jul	27-Aug	26-Sep	26-Oct	25-Nov	25-Dec	24-Jan	23-Feb	24-Mar	23-Apr	23-May	22-Jun	22-Jul	21-Aug	20-Sep	20-Oct				
SALES:	Rented Units	0	0	0	2	4	6	6	6	6	6	6	6	6	6	6	6				
	Sale of Units							2400000													
	Monthly Rent	0	0	0	3520	7040	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560				
MONTHLY TOTAL REVENUES		0	0	0	3520	7040	10560	2410560	10560	10560	10560	10560	10560	10560	10560	10560	10560				
ACCUM. PROJECT REVENUES		0	0	0	3520	10560	21120	2431680	2442240	2452800	2463360	2473920	2484480	2495040	2505600	2516160	2526720				
To Investor	1760																				
A. Land Acquistion																					
B. Gen. Cond. Fees																					
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
A. Direct Base Construction		$ 402,264.00	$ 216,180.00	$ 38,511.00																	
B. Gen. Cond. Fees																					
SUBTOTAL		$ 402,264.00	$ 216,180.00	$ 38,511.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
A. Arch/Engineer																					
B. Survey/Testing																					
C. Appraisal/Market																					
D. RE Tax/Permit																					
E. Insurance																					
F. Legal/Accounting																					
G. Maintenance													$ 12,000.00								
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,000	$ -	$ -	$ -	$ -				
A. Sales Costs					$ 68,743																
SUBTOTAL		$ -	$ -	$ -	$ 68,743	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
A. Dev. Oh Fee													$ 100,000								
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 100,000	$ -	$ -	$ -	$ -				
A. Construction Interest		$ 18,119	$ 18,797	$ 18,511	$ 18,566	$ 18,072	$ 17,578	$ 17,085	$ 16,591	$ 16,097	$ 15,603	$ 15,109	$ 15,222	$ 14,729	$ 14,235	$ 13,741	$ 13,247				
B. Title Insurance																					
C. Loan/Fees/Inspections																					
SUBTOTAL																					
A. Employee Commission																					
B. Closing Costs																					
SUBTOTAL		$ -	$ -	$ -	$ 32,508	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
MONTHLY TOTAL EXPENSES		$ 402,264	$ 216,180	$ 38,511	$ 101,251	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 112,000	$ -	$ -	$ -	$ -				
ACCUM. PROJECT EXPENSES		$ 3,345,109	$ 3,470,127	$ 3,417,477	$ 3,427,566	$ 3,336,405	$ 3,245,243	$ 3,154,082	$ 3,062,920	$ 2,971,759	$ 2,880,597	$ 2,789,436	$ 2,810,274	$ 2,719,113	$ 2,627,951	$ 2,536,790	$ 2,445,629				
		$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161				
Monthly Const. Loan Amount		$ 402,264	$ 216,180	$ 38,511	$ 104,419	$ 6,336	$ 9,504	$ 2,169,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 121,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504				
Accum. Const. Loan Amount		$ 3,345,109	$ 3,470,127	$ 3,417,477	$ 3,427,566	$ 3,336,405	$ 3,245,243	$ 3,154,082	$ 3,062,920	$ 2,971,759	$ 2,880,597	$ 2,789,436	$ 2,810,274	$ 2,719,113	$ 2,627,951	$ 2,536,790	$ 2,445,629				
Interest Rate:																					
Equity Calculation:																					
Cost Less Comm. & Title																					
Loan Amount																					

	Loan Length		23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
			19-Nov	19-Dec	18-Jan	17-Feb	19-Mar	18-Apr	18-May	17-Jun	17-Jul	16-Aug	15-Sep	15-Oct	14-Nov	14-Dec	13-Jan	12-Feb	14-Mar
SALES:	Rented Units		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	Sale of Units																		
	Monthly Rent		10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560
MONTHLY TOTAL REVENUES			10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560	10560
ACCUM. PROJECT REVENUES			2537280	2547840	2558400	2568960	2579520	2590080	2600640	2611200	2621760	2632320	2642880	2653440	2664000	2674560	2685120	2695680	2706240
To Investor		1760																	
A. Land Acquistion																			
B. Gen. Cond. Fees																			
SUBTOTAL			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A. Direct Base Construction																			
B. Gen. Cond. Fees																			
SUBTOTAL			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A. Arch/Engineer																			
B. Survey/Testing																			
C. Appraisal/Market																			
D. RE Tax/Permit																			
E. Insurance																			
F. Legal/Accounting																			
G. Maintenance																			
SUBTOTAL			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A. Sales Costs																			
SUBTOTAL			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A. Dev. Oh Fee																			
SUBTOTAL			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
A. Construction Interest			$ 12,753	$ 12,260	$ 11,766	$ 11,272	$ 10,778	$ 10,284	$ 9,791	$ 9,297	$ 8,803	$ 8,309	$ 7,815	$ 7,322	$ 6,828	$ 6,334	$ 5,840	$ 5,346	$ 4,853
B. Title Insurance																			
C. Loan/Fees/Inspections																			
SUBTOTAL																			
A. Employee Commission																			
B. Closing Costs																			
SUBTOTAL			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
MONTHLY TOTAL EXPENSES			$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
ACCUM. PROJECT EXPENSES			$ 2,354,467	$ 2,263,306	$ 2,172,144	$ 2,080,983	$ 1,989,821	$ 1,898,660	$ 1,807,498	$ 1,716,337	$ 1,625,175	$ 1,534,014	$ 1,442,852	$ 1,351,691	$ 1,260,529	$ 1,169,368	$ 1,078,206	$ 987,045	$ 895,883
			$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161
Monthly Const. Loan Amount			$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504
Accum. Const. Loan Amount			$ 2,354,467	$ 2,263,306	$ 2,172,144	$ 2,080,983	$ 1,989,821	$ 1,898,660	$ 1,807,498	$ 1,716,337	$ 1,625,175	$ 1,534,014	$ 1,442,852	$ 1,351,691	$ 1,260,529	$ 1,169,368	$ 1,078,206	$ 987,045	$ 895,883
Interest Rate:																			
Equity Calculation:																			
Cost Less Comm. & Title																			
Loan Amount																			

	Loan Length	40	41	42	43	44	45	46	47	48	
		13-Apr	13-May	12-Jun	12-Jul	11-Aug	10-Sep	10-Oct	9-Nov	9-Dec	TOTALS
SALES:	Rented Units	6	6	6	6	6	6	6	6		
	Sale of Units									2400000	4,800,000
	Monthly Rent	10560	10560	10560	10560	10560	10560	10560	10560		390,720
MONTHLY TOTAL REVENUES		10560	10560	10560	10560	10560	10560	10560	10560	2400000	**5,190,720**
ACCUM. PROJECT REVENUES		2716800	2727360	2737920	2748480	2759040	2769600	2780160	2790720	5190720	**5,190,720**
To Investor	1760										
A. Land Acquistion											$ 250,000.00
B. Gen. Cond. Fees											$ 17,500.00
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 267,500.00**
A. Direct Base Construction											$ 3,437,140.56
B. Gen. Cond. Fees											$ 240,599.84
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 3,677,740.40**
A. Arch/Engineer											$ 171,857.03
B. Survey/Testing											$ 10,311.42
C. Appraisal/Market											$ 13,748.56
D. RE Tax/Permit											$ 220,664.42
E. Insurance											$ 13,748.56
F. Legal/Accounting											$ 44,682.83
G. Maintenance											$ 12,000.00
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 487,012.83**
A. Sales Costs											$ 68,742.81
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 68,742.81**
A. Dev. Oh Fee											$ 100,000.00
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 100,000.00**
A. Construction Interest		$ 4,359	$ 3,865	$ 3,371	$ 2,878	$ 2,384	$ 1,890	$ 1,396	$ 902	$ 585	$ 509,000.28
B. Title Insurance											$ 15,000.00
C. Loan/Fees/Inspections											$ 15,000.00
SUBTOTAL											**$ 539,000.28**
A. Employee Commission										$ 21,600	$ 21,600.00
B. Closing Costs										$ 10,908	$ 10,908.00
SUBTOTAL		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 32,508	**$ 32,508.00**
MONTHLY TOTAL EXPENSES		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 32,508	
ACCUM. PROJECT EXPENSES		$ 804,722	$ 713,560	$ 622,399	$ 531,237	$ 440,076	$ 348,914	$ 257,753	$ 166,592	$ 107,938	
		$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	$ 91,161	
Monthly Const. Loan Amount		$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 9,504	$ 32,508	
Accum. Const. Loan Amount		$ 804,722	$ 713,560	$ 622,399	$ 531,237	$ 440,076	$ 348,914	$ 257,753	$ 166,592	$ 107,938	

Total	Difference
$ 4,919,804	$ 2,109,530

Interest Rate:

Equity Calculation:
Cost Less Comm. & Title
Loan Amount

IPRO 358 Spring 2011
Dodge and Greenleaf St.
Evanston, IL

Hard Costs

0

	Item	Unit Total	Project Total
	Demolition	$ 4,500	$ 54,000
	Grading/Excavation	$ 32,890	$ 394,680
	Paving	$ 15,274	$ 183,288
	Landscaping	$ 3,209	$ 38,511
	Concrete	$ 7,519	$ 90,228
	Rough Carpentry	$ 21,200	$ 254,400
	Finish Carpentry	$ 20,416	$ 244,992
	Cabinets	$ 9,324	$ 111,888
	Water Proofing	$ 1,740	$ 20,880
	Insulation	$ 12,391	$ 148,692
	Siding	$ 10,997	$ 131,964
	Roofing	$ 17,000	$ 204,000
	Garage Door	$ 3,045	$ 36,540
	Door/Hardware	$ 3,782	$ 45,384
	Windows	$ 9,976	$ 119,712
	Drywall	$ 15,080	$ 180,960
	Painting	$ 8,692	$ 104,304
	Appliances	$ 6,970	$ 83,640
	Plumbing	$ 25,022	$ 300,262
	Fire Protection	$ 8,634	$ 103,606
	HVAC+ERV	$ 25,240	$ 302,877
	Electrical	$ 15,528	$ 186,332
	Home Automation	$ 8,000	$ 96,000
TOTAL		$ 286,428	$ 3,437,141