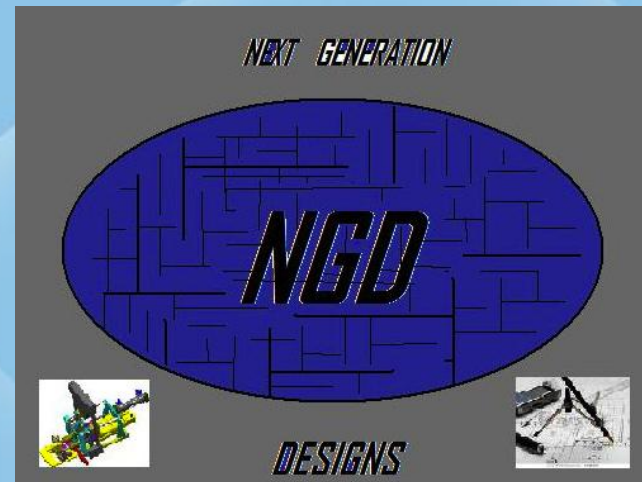


Lakeview Villa



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10/27/2010

r-point-templates.com



Project Overview

- Goals of Project
 - Effective Teamwork
 - Design an innovative model
 - Practice resource conservation
 - Apply engineering principles to form informed decisions
- Project Key Features
 - Photovoltaic System
 - Solar Water Heater
 - Geothermal Heat Pump
 - Minimal Air Leakage
 - Landscape

Basic Stats	
Location	Allentown, PA
House Size	1950 sq. ft.
# of Floors	2
# of Occupants	~ 4
Heating System	Geothermal Heat Pump
Main Heating Fuel	Electricity
Photovoltaic System	7 Kilowatts
Solar Water Heater	Present
Wall Insulation	R-20
Ceiling Insulation	R-60
Ventilation Air Heat Recovery	Present



Researched Homes

Orleans, Massachusetts

- 2000 sq. ft.**
- 2 Floors**
- 2-6 Occupants**
- 3 Bedrooms**
- High Efficiency Gas Furnace
- Heat Recovery Ventilator
- Electric Heat Line**
- Photovoltaic System**
- Solar Water Heater**
- R-25 Wall Insulation**
- R-62 Ceiling Insulation**



Southern, California

- 2300 sq. ft. **
- 2 floors**
- 2 Occupants
- 3 Bedrooms**
- Geothermal Heat Pump **
- Solar Electric Heating**
- 6 kw Photovoltaic System
- Solar Water Heater**
- R-15 Wall Insulation**
- R-30 Ceiling Insulation
- No Heat Recovery Ventilation



** Indicates similarity to Lakeview Villa design model



Research Conclusions

Solar Electric

- 6-8 kw photovoltaic system is common
- Converts solar energy into usable electricity
- Approximately 14w per square foot of panel

Solar Thermal

- Uses solar energy to heat water in the home
- Typically a 4'x8' solar collector per two occupants

Windows

- Contains reflective glazing to maximize passive solar energy
- Typically non-metal frames for minimal heat transmission

Walls / Siding

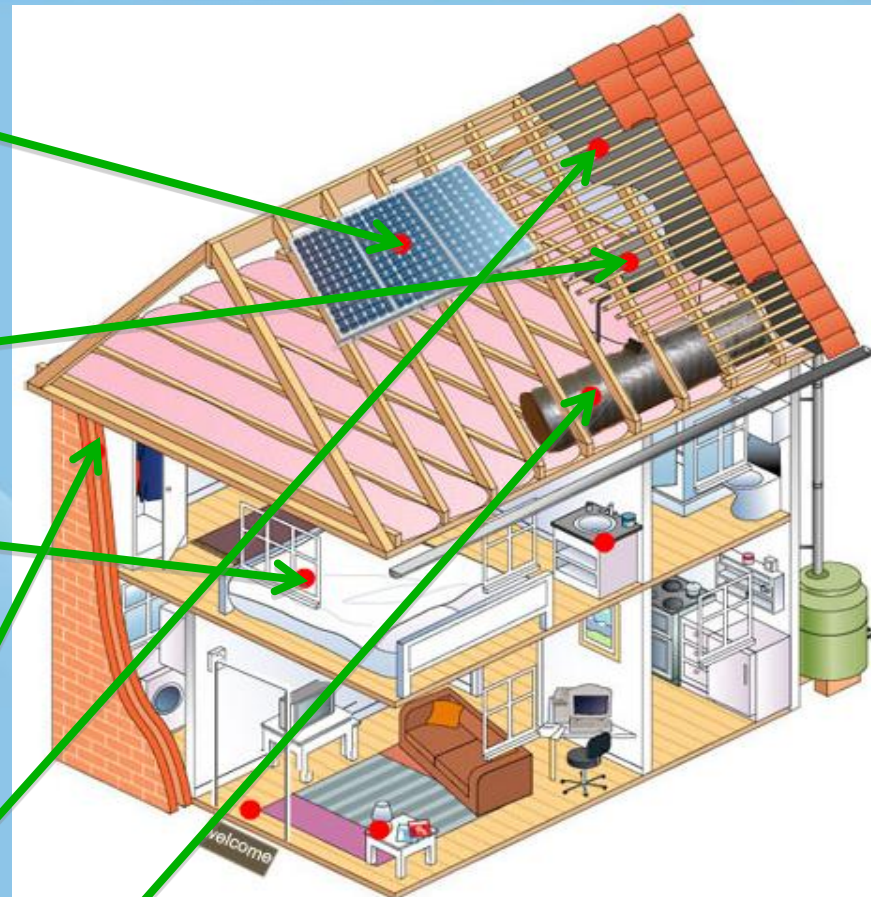
- Optimal R-values fall between R-15 and R-40

Roofing

- Low pitch to maximize solar absorption
- Highly insulated with R-values around R-60

Heating & Ventilation

- Use of heat air recovery system to maximize recycling of heat





Envelope Choices

- Increased insulation in walls, ceilings, and floors
- Specifically chose R-20 for exterior walls, and R-60 for ceiling and floor
- Chose triple pane low-energy window for a high R-value of R-4

Heat
Transmission

Air Leakage

- Tightly constructed to minimize air infiltration
- Use of caulking and weather stripping for tight seal
- Approximated 0.1 Air changes per hour

- Windows placed on all sides of the house
- More windows facing toward waterfront for maximal wind intake
- Major open rooms for wind travel

Natural
Ventilation

Solar Gain

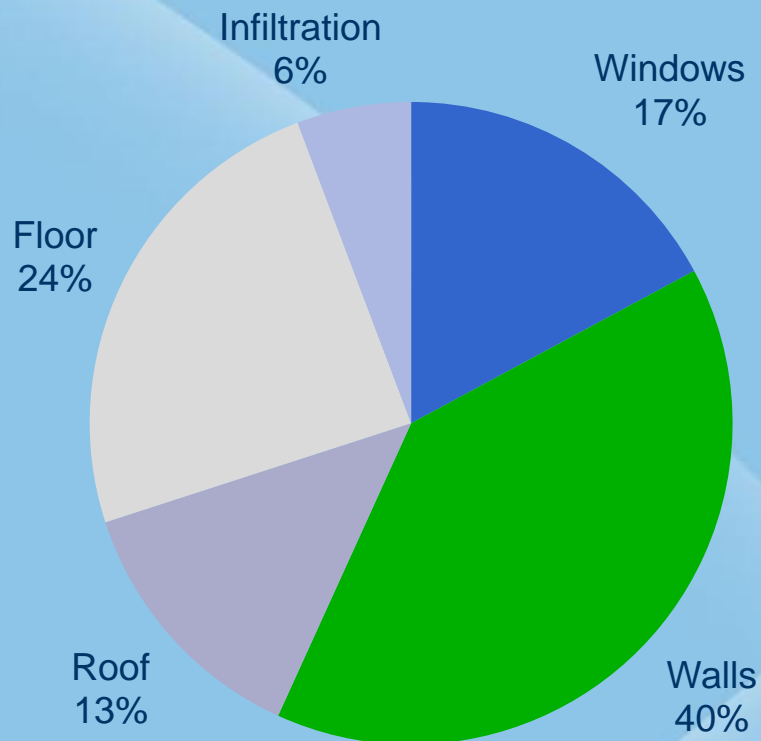
- Increased numbers of windows
- All glass doors allow for solar energy to pass into the house
- Allowing for maximal passive solar



Envelope Specifics

Graphical Representation of Envelope

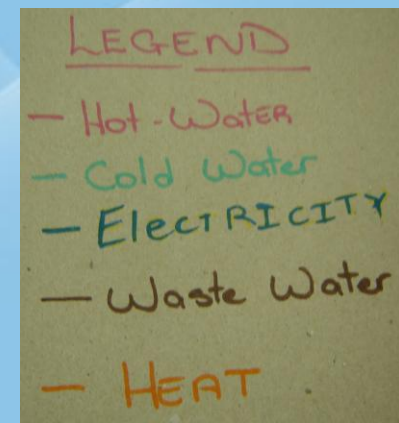
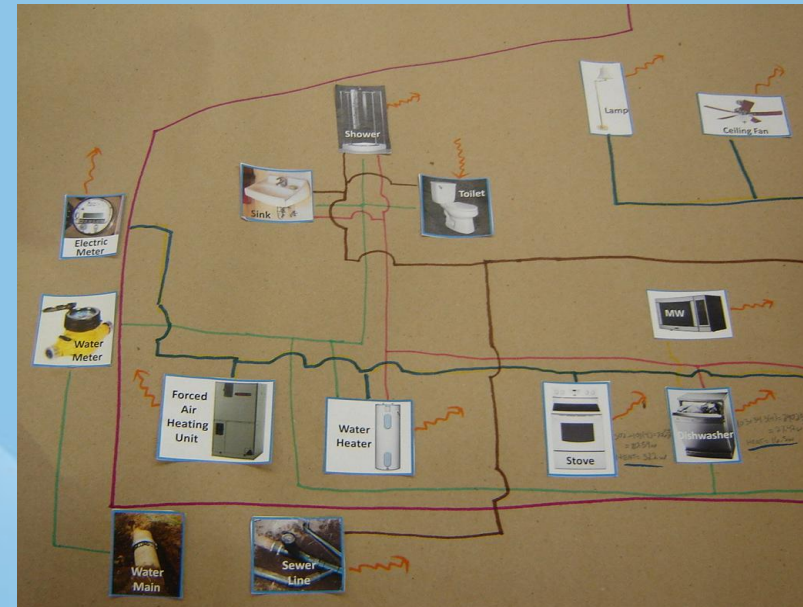
Envelope Heat Transmission





Appliance Choices

- From appliance flowchart experiment
 - All home appliances have various inputs and outputs
 - Components within the home have an overall affect on the larger component of the home
 - Vast majority of appliances give off heat which can be harnessed and used beneficially for the home
 - Heat the home
 - Provide energy for possible use by other systems





Main Appliances



LG 42" Plasma Television

- Energy efficient stand by mode of 0.1w
- Least expensive brand compared to other energy efficient models



Whirlpool Black Dishwasher

- Uses 320 kwh annually when ran with average occurrences for a typical home
- Energy Star high efficiency rating



Maytag M1TXEMMWW Refrigerator

- Less then 400 kwh per year
- Starting cost over 30% less expensive than other energy efficient models



Samsung White High Efficiency Washer

- Requires less than 130 kwh per year for average amount of laundry
- Energy Star high efficiency rating

Conservation Tip:

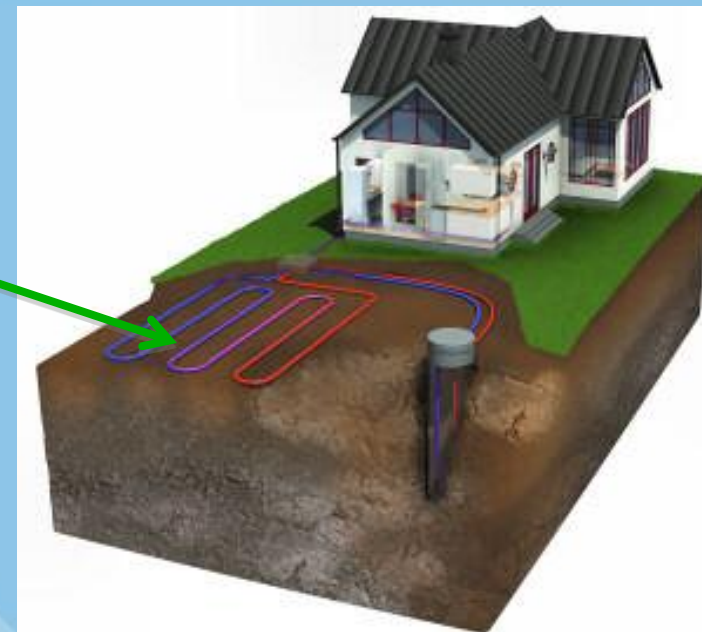
- Use fluorescent lighting instead of normal light bulbs
- Use clothesline instead of electric dryer to dry clothes
- Search for energy rating before buying an appliance
- Wash only full loads of clothes and dishes
- Keep TV in stand by mode unless actively watching



Heating, Ventilation, and Cooling

Geothermal Heat Pump

- Long underground trenches with pipes form a closed water circuit
 - Solar Energy and Landscape heat the water in pipes
- Under floor heating
 - Requires far lower temperatures than above floor heating
- Reasons for choosing
 - Sources of energy are natural
 - Requires low maintenance
 - Compact size inside the home
 - Energy efficient which leads to being cost effective



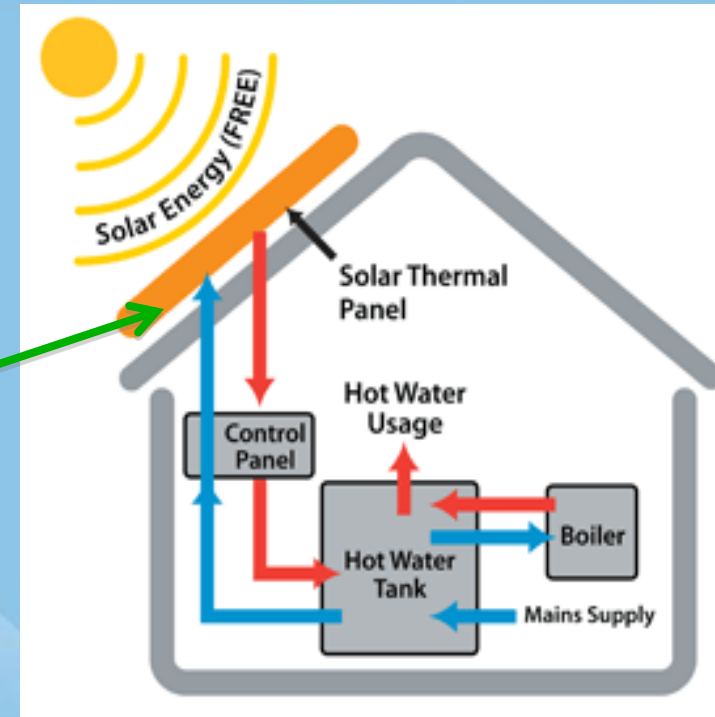
Conservation Tip:

- Keep the thermostat in the home set back during times away from the home



Solar Thermal

- Components of system
 - Solar panel on outside of home to heat the water
 - Control panel and water tank for storage and regulation
 - Piping running through the inside of the panel → control panel → water tank → home uses → water tank → solar panel
- Uses of the system
 - Hot water for washing clothes & dishes in the home
 - Heated water for bathing and showering
- Reasons for Choosing
 - More energy efficient and cost effective than electric water heating



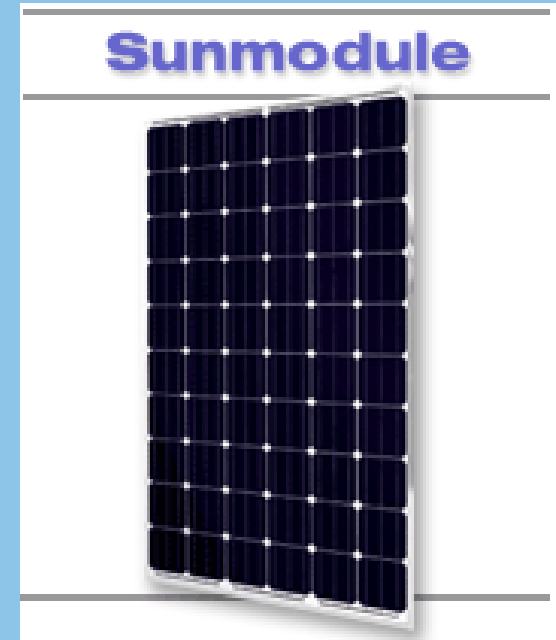
Conservation Tip:

- Use and install low-flow water fixtures throughout the home to minimize hot water usage



Solar Electric

- Takes in solar energy and converts it into electricity for home use
- 7 kw system needed to achieve a net energy usage of zero
- Solar World Sunmodule
 - High efficiency rating
 - 12% higher yield than other energy efficient models
 - Required 500 sq. ft. of roof space for installation
 - Installed on south-facing side of the roof





Project Behavior

Overall lessons learned from specific decisions

- Passive Solar
 - Direct gain from the sun allows for heat to come into the house through windows and glass doors
 - Use of an overhang allows sun to come in during certain parts of the day, but not during other parts
- Natural Ventilation
 - In-class cooler experiment showed the affects of windows and openings in the home
 - Envelope of the home is a main factor when considering energy conservation
- Conservation
 - There are numerous and simple ways for people to save energy throughout the day
 - If people would simply make an active effort to conserve more energy, less un-renewable resources would have to be used to meet our desires
- House Size
 - From research, and class lessons, the square footage of a ZEH has a direct connection to amount of energy used



CAD Model

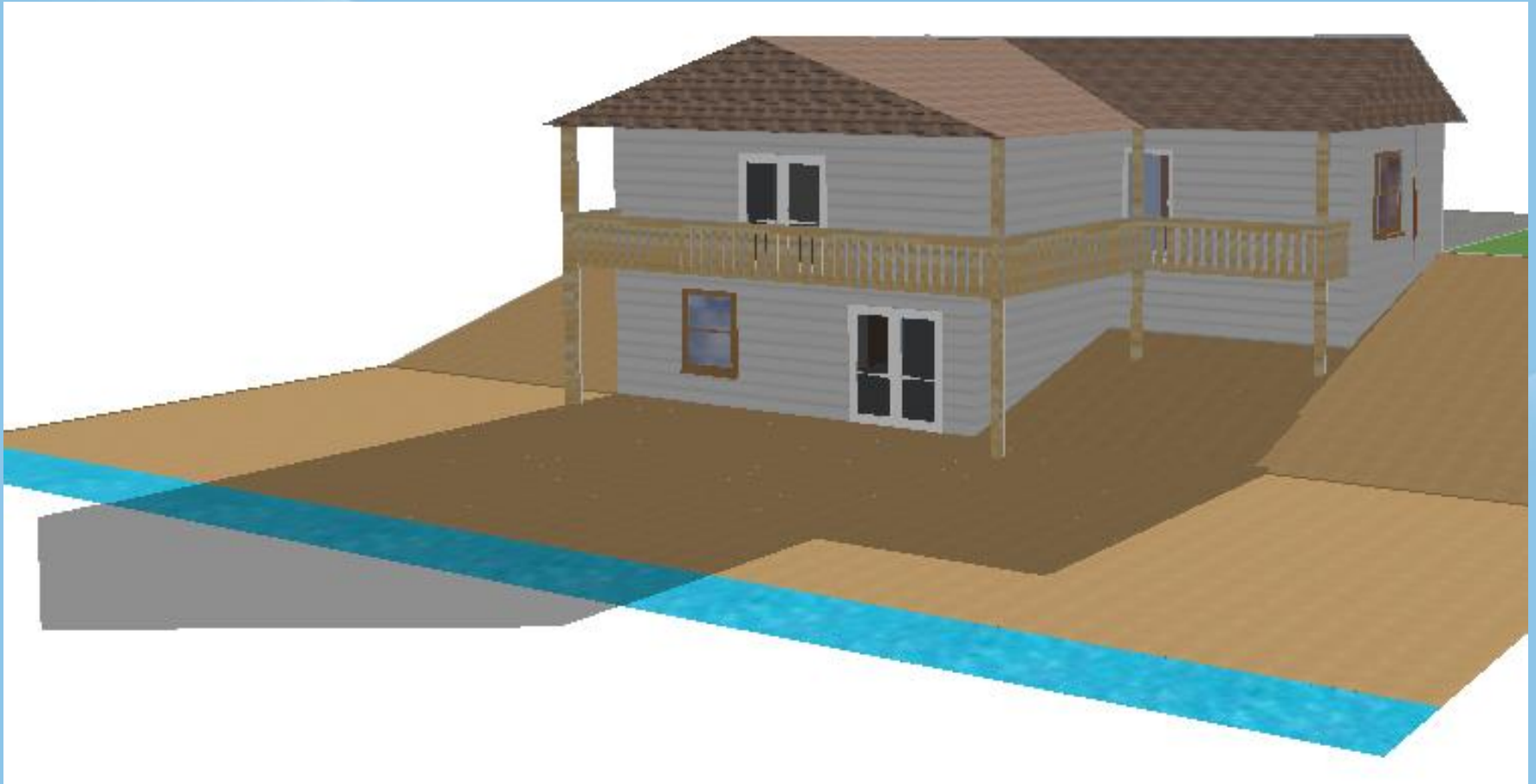


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January 1st Front View



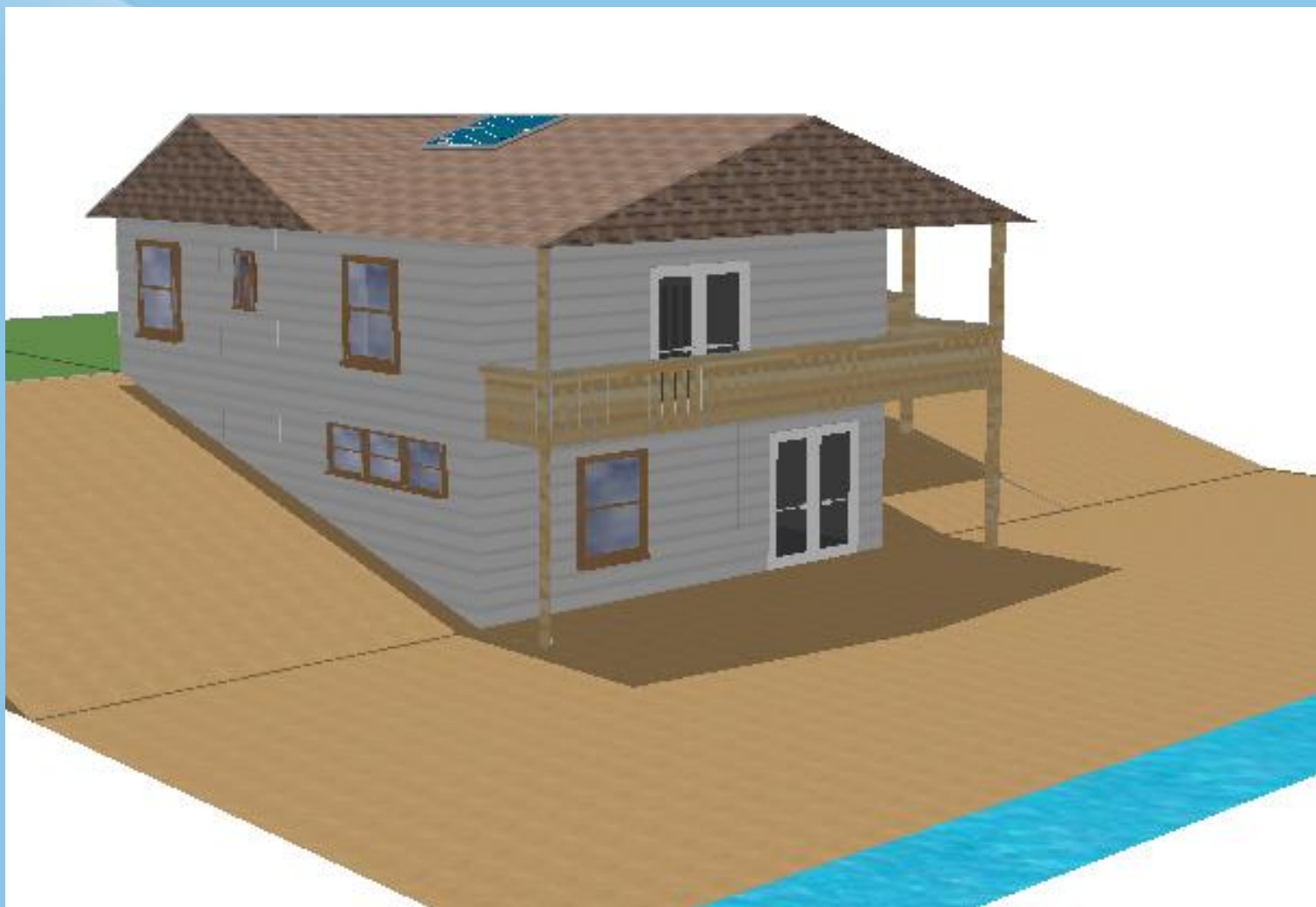
CAD Model



January 1st Read View



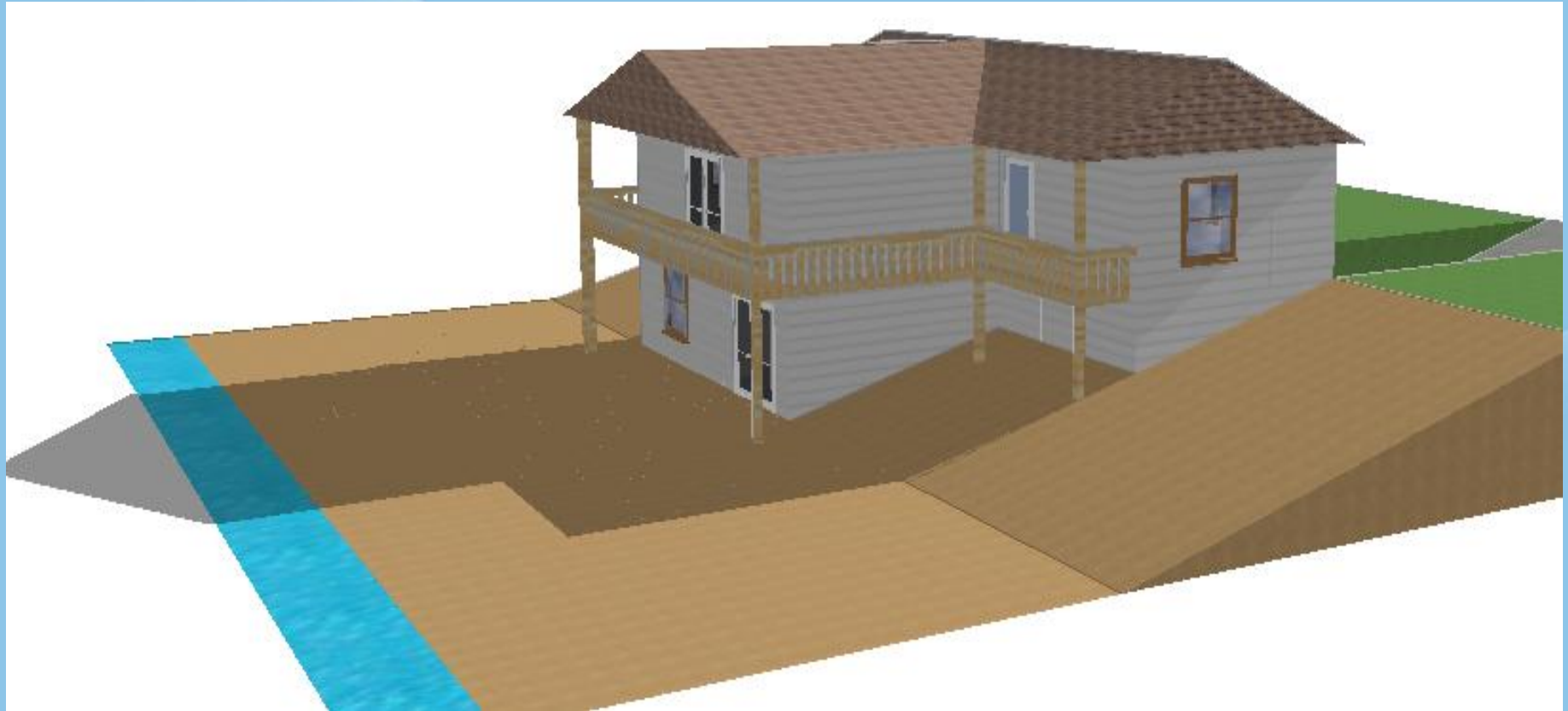
CAD Model



March 21st Side View



CAD Model



November 21st Side View



CAD Model



Top Floor



CAD Model



Bottom Floor



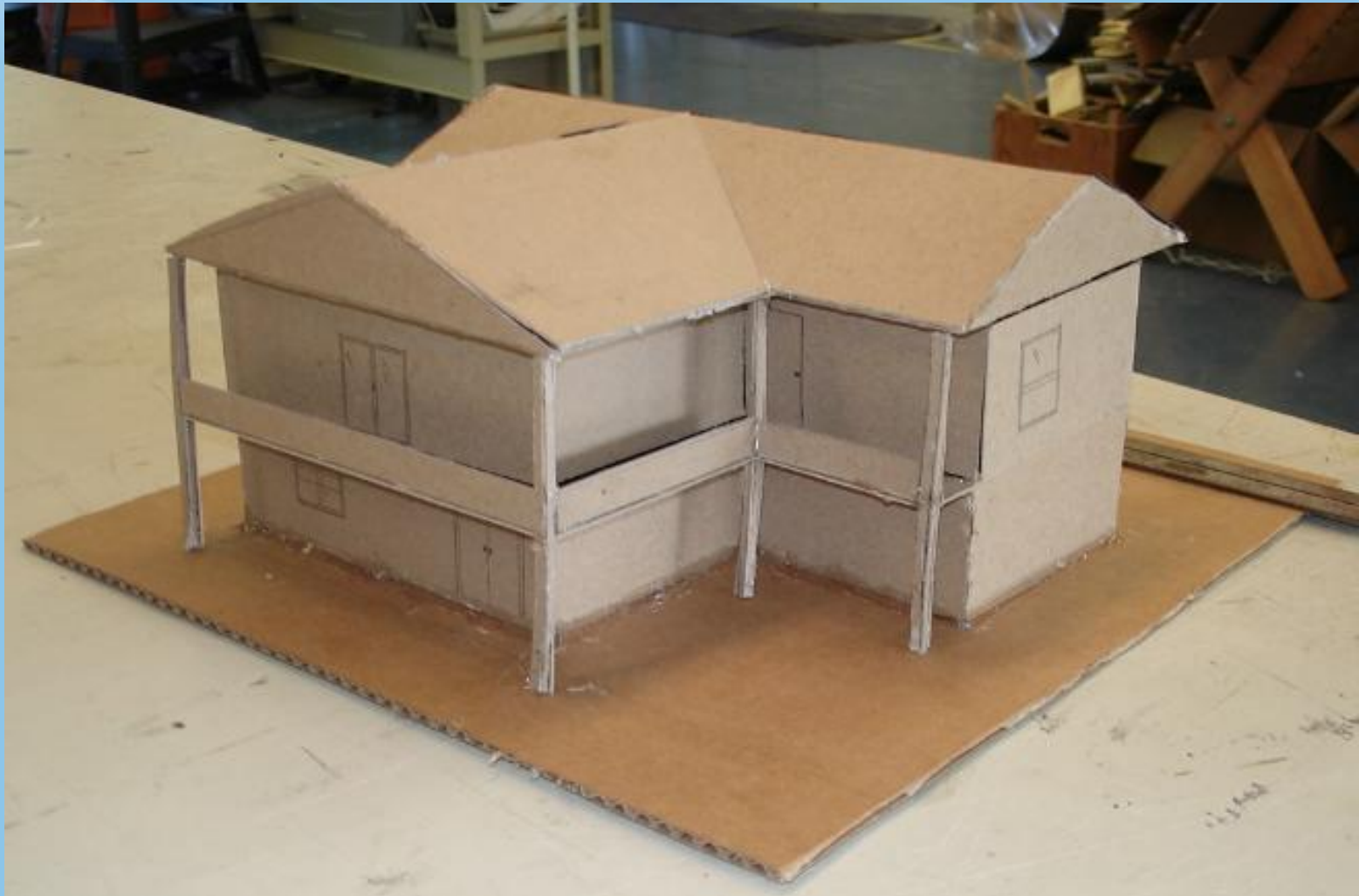
Physical Model



Front View



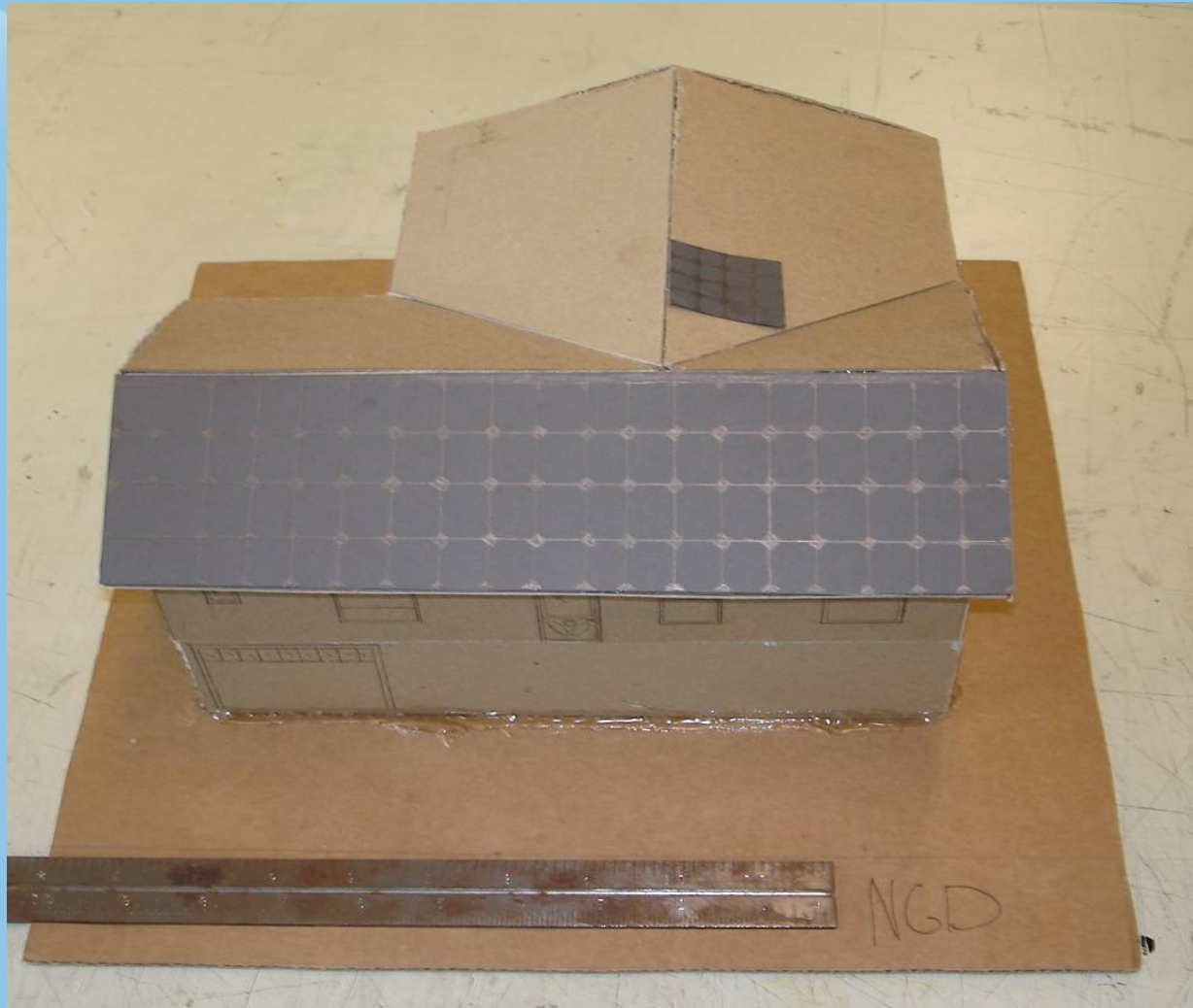
Physical Model



Rear View



Physical Model



Above View



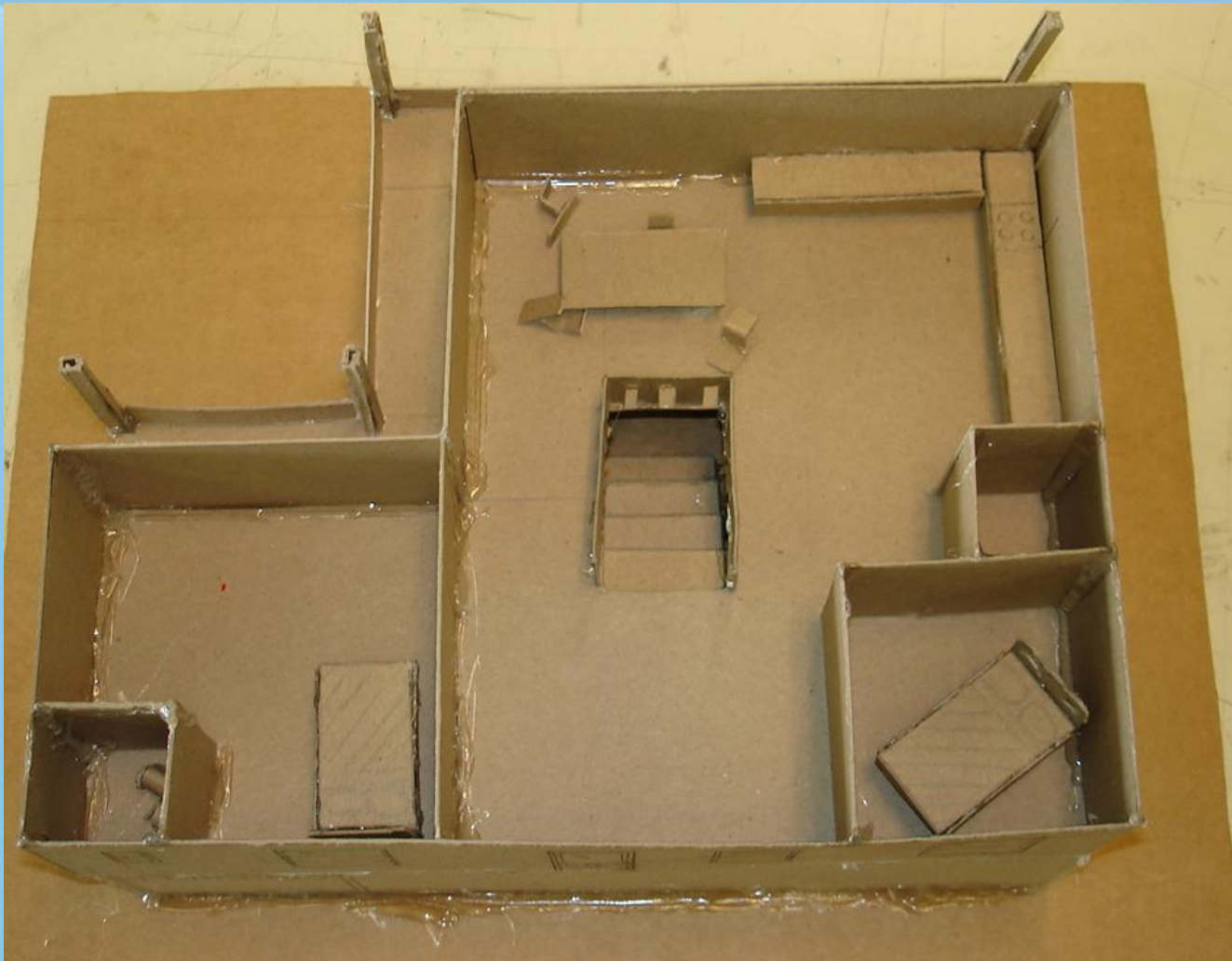
Physical Model



Bottom Floor



Physical Model



Top Floor



Summary of Design

- Important Features of Model
 - Aesthetic design for a lake front home
 - Net energy usage of zero
 - Use of Geothermal Heat Pump
 - Use of Photovoltaic system
- Greatest Challenges of Design
 - Discovering how to use the least amount of energy for everyday tasks
 - Getting all ideas into the model
 - Keep an energy efficient home with all of the modern desires



Personal Likes

Alex Bauer

- Discovering the true research behind zero energy homes
- Applying that research to our own self-sustainable home
- Photovoltaic system

Win Ton

- The involvement of all home appliances when conserving energy
- Using those appliances in various ways to achieve a net energy use of zero

EJ Henry

- Bringing all of the team's ideas into one big project
- Transforming the teams desires into a zero energy home
- Like side view from porch

Nelly Diaz

- Working with the physical model to build ideas into concrete items
- Using the concrete items to show everything comes together



Reflection

- Now, our team is able to calculate the ZEH equations such as heat transmission and air leakage.
- Even though this project was designing a ZEH, we still followed the design model and took an idea from sketches, to a computer model, to a physical model, to a real life application.
- We now know that solar energy is one of the only resources that is free to consume, as well as extremely efficient in building a ZEH.
- From this project, we learned that it is possible to achieve a modern home that is a ZEH, all it takes is a little planning and engineering.
- As a team, we were able to bring all of our ideas into one main idea, which is a useful aspect of learning for the future.
- For the next project, we could improve our performance by equally spreading the work load to all members of the team.
- Using the Google Sketchup, we learned the importance for a written drawing to be down on paper before beginning the CAD sketch, so that Google Sketchup doesn't build the house for you.