



# PLAYHAVEN GREEN BUILDING PROJECT

The goal of the PlayHaven Green Building Project is the creation of a complex that:

- » Is energy efficient, and meets ENERGY STAR and LEED for Homes qualifications,
- » Uses renewable energy systems,
- » Combines new technology with recycled and reclaimed products,
- » Is designed to meet the needs of the homeowners, and
- » Promotes a sustainable lifestyle.

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## SITE

The site is a 10-acre lot located in a rural part of Lafayette County, MO which is zoned agricultural/residential. It is part of a subdivision of 5-acre and 10-acre lots surrounded by farm land. The absence of strict regulations makes this a good choice for the innovative construction techniques of sustainable "green" building.

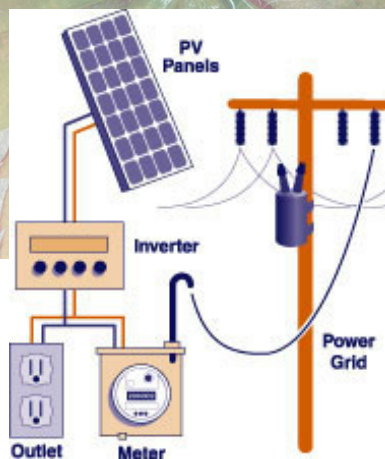
The 10-acre lot is situated on the south side of the road and is rectangular (330 ft by 1370 ft). It is a gently rolling field with a difference of approximately 30 feet from its highest point in the northwest to the lowest point in the southeast. Prevailing winds during the summer months are from the south/southwest and shift to the north/northwest during the winter months.

The site has full solar access with no obstructions to remove before construction. The garage/workshop and the house are aligned along an east, west axis which allows for effective solar collection. It also has sufficient wind capacity for a residential wind turbine. The site is also conducive to both underground storm water storage and geothermal heating/cooling.

The top soil at the site is rich and favorable for organic farming. A soil morphology, done in 2004, shows that a conventional wastewater system can be assigned to a depth of 22 inches.

The site is connected to a rural water utility and has a meter on the lot.

There is electric access and Missouri allows for net metering.







## CLIENT

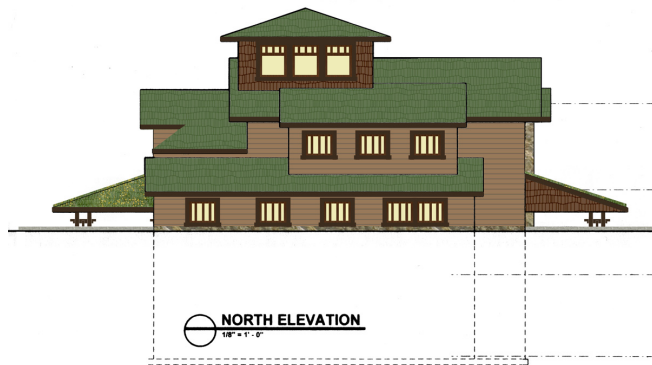
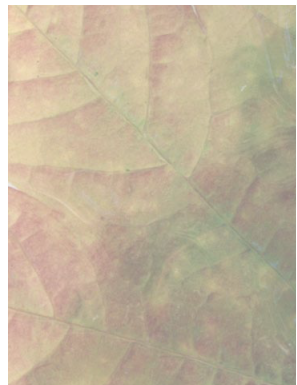
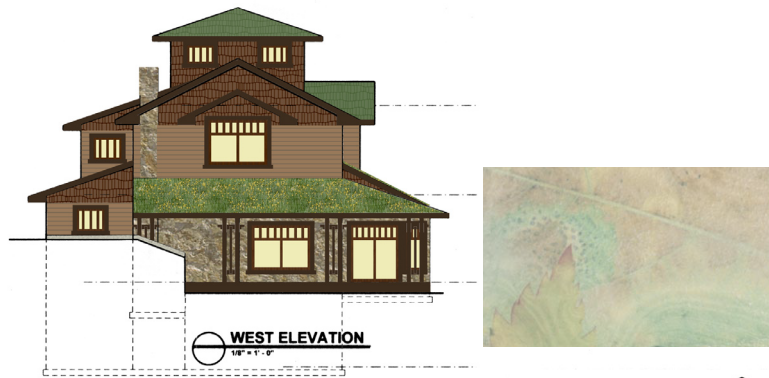
The client is a middle-aged couple without children who do not feel middle-aged. The couple enjoys living with and training their Newfoundland Dogs in obedience, conformation and working activities (such as draft and water rescue).

The husband enjoys woodworking and will be maintaining the grounds and requires an area adjacent to the garage which allows for these activities and a place to clean both him and equipment.

The wife is a graphic artist and works from a home office. She requires an area that has excellent lighting without being hot during the day. She is also an avid environmentalist and proponent of sustainable building and renewable energy production. She is a co-author of the DY0® Kits "The Green Building Decision Kit". It is her intention to provide tours of the PlayHaven Green Building Project to show the average person a range of options they can incorporate into their own new building or remodeling projects.

The couple intends to reside in this complex for the remainder of their lives. To do this, accommodations have been considered and features planned to handle compromised mobility. Among these compromised mobility features are a dumbwaiter and stair lifts. The house is intended to qualify for the American Lung Association's Healthy® House program.

The couple enjoys entertaining and has designed the common areas of the house to be open and inviting.



## DESIGN: SITE

The house is designed as a two-story hillside structure with a lower level. The hill side is to the north protecting the main and lower level during the winter months.

Longitudinal access is east/west to maximize exposure to the sun in winter months. A sunroom on the south side of the house which opens to all three levels allows for passive solar heating during the winter. The covered wrap-around porch protects the main level from solar gain during summer months.

Upper level windows are designed with protective overhangs to maximize solar gain in the winter and minimize solar gain in the summer.

Roofing materials will be light colored to reflect UV rays. Guttering will be used to harvest rain water for re-use.

Trees will be planted to protect the house... conifers on the north and deciduous on the south, east and west.

Views are primarily to the south due to the rectangular shape of the lot.

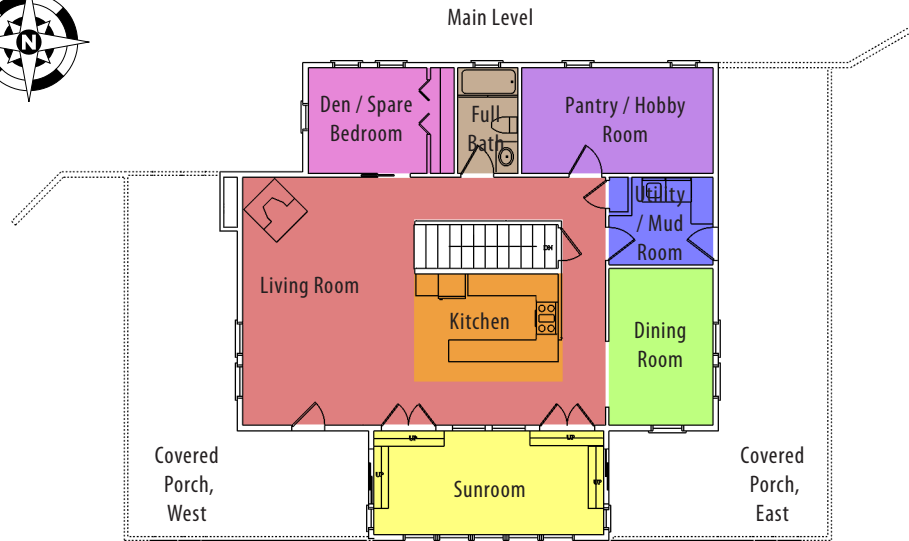
The PlayHaven Green Building Complex will be placed approximately 300 feet south of the road, with the house centered east to west on the lot.

The garage/workshop is designed to be located to the west of the house on the other side of the circular driveway. Area to the north and south of the garage/workshop is suitable for livestock.

The septic system is best located to the north of the house and will be covered by a rock garden. Further to the north will be an orchard to minimize dust from the gravel road reaching the house.

The area to the east of the house will be a designated dog yard. And the area directly south of the house will have vegetable and flower gardens.

The rest of the lot (to the south of the complex) will be cross fenced and is planted in brome grass and red clover suitable for pasture.



The floor plan of the second floor is shown. It features a large central area labeled "Open Unfinished Area". To the top left of this area is a red-shaded rectangular region labeled "Mechanicals". To the top right is a blue-shaded rectangular region labeled "Cool Room". A staircase is located in the center of the "Open Unfinished Area". The entire floor plan is enclosed by a dashed line, indicating the building's footprint.

The floor plan shows a central hallway with a staircase leading up. To the left is a large purple Master Bedroom. To the right of the hallway is a tan Master Bath and a light brown Full Bath. Two areas are labeled ATTIC, one above the Master Bath and one above the Full Bath.

Cupola Room  
Office

The house is composed of:

- » Living Room/Kitchen,
- » Dining Room,
- » Sunroom,
- » Den/Spare Bedroom,
- » 1st level Full Bath,
- » Pantry/Hobby Room and
- » Utility Room.

- » Master Suite,
- » Bedroom,
- » 2nd level Full Bath.

- » Open Unfinished Area (plumbed for possible future remodeling),
- » Mechanicals Room, and
- » "Cool" room.

Natural ventilation features include transoms over the interior doors and operable windows on all levels.

The cupola room allows for a “chimney” effect when desired; eliminating the need for a whole house fan.

- » garage,
- » workshop,
- » bathroom,
- » bio-diesel processing area, and
- » storage loft  
(plumbed for possible future remodeling).



## DESIGN: ACCESSIBILITY

As needs change, it is important to incorporate accessibility into home design, a concept that strives to incorporate characteristics for access into products, elements and spaces that can be used by everyone.

Because this home is designed for a middle-aged couple desiring to stay in the house through their senior years, the house contains many features conducive to making it accessible should their health become compromised. These features are as much a part of the design as they are products and goods purchased for use in the house.

### House:

- » Kitchen is wide enough to accommodate wheelchairs and walkers.
- » Doorways have a flat threshold and are at least 36" wide.
- » Hallways and stairs are 48" wide, stair risers are 6" high, and stair lifts are planned for the future.
- » A dumbwaiter that extends from the lower level to the upper level will be installed.
- » Textured surfaces to prevent slipping.
- » The wrap-around porch will be 10' wide.

### Lighting:

- » Daylighting is a dominant design feature in this house. Natural lighting reduces energy use and increases the comfort level of the inhabitants.
- » Artificial lighting will be a combination of CFL and LED technology to reduce heat gain and energy use.
- » Sensors and timers will be used in appropriate areas, i.e. closets, passageways, etc.

- » Dimmers, switches, and thermostats will be positioned between 42" and 48" above the floor.
- » Exterior steps will be well lit with solar powered LED lighting.

### Appliances:

- » All appliances will be Energy Star rated.
- » The dishwasher will use drawer-style loading, eliminating the need to bend or stoop to load or unload the dishwasher.
- » A combination washer/dryer unit will be included in the Master Bathroom.

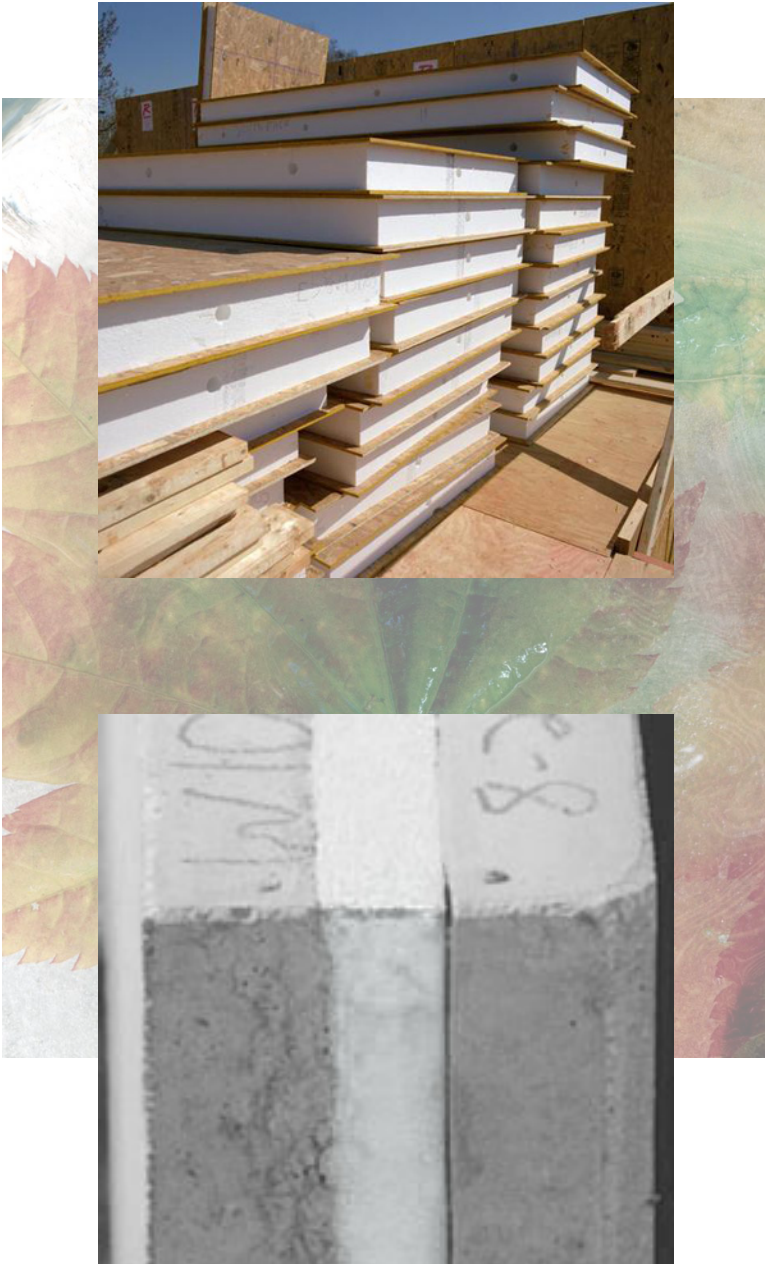
### Cabinets & Storage:

- » Base cabinets will be equipped with full-extension drawers and rollout shelves.
- » Lever handles will be used for faucets and doors.

### Bathtubs & Showers:

- » Tubs and showers will be equipped with grab bars, hand held showerheads, and non-slip flooring.



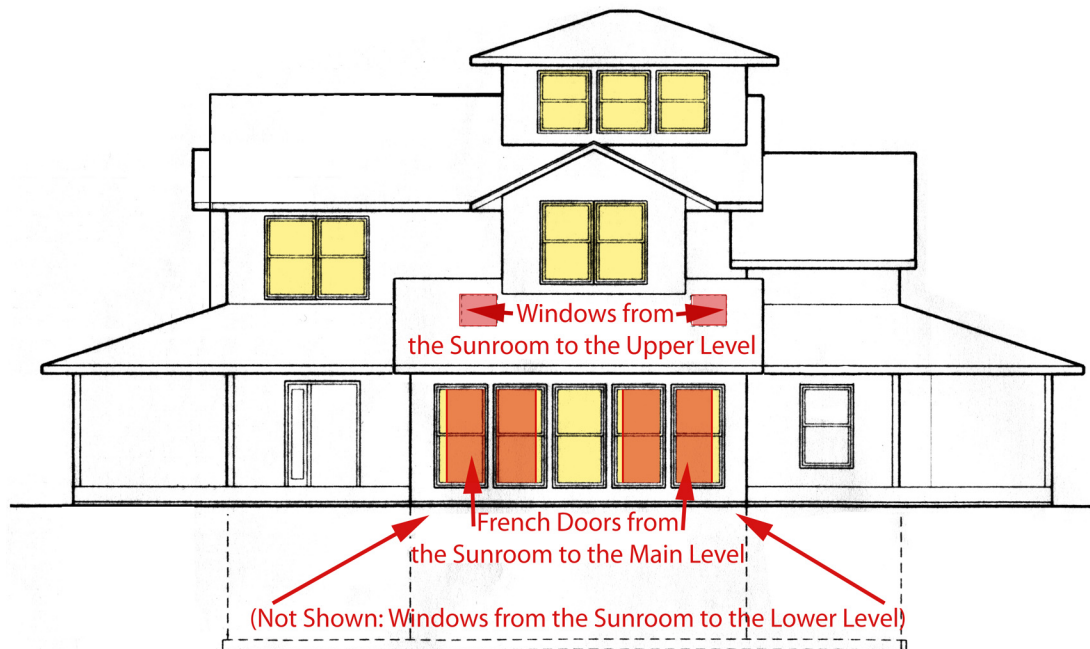
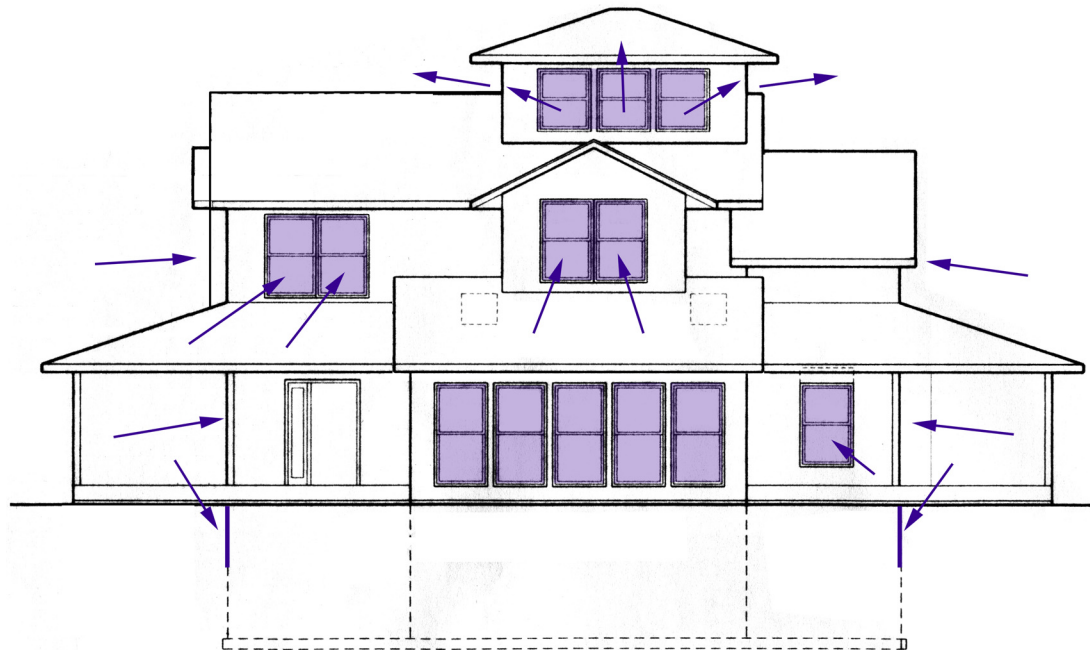


## DESIGN: SHELL CONSTRUCTION

Both house and garage/workshop are designed to use SIPs (Structural Insulated Panels) as the above ground framing product (and as the roof on the house). SIPs are made by sandwiching a “foam” core (usually EPS or expanded polystyrene) with OSB (oriented strand board) panels. SIPs are engineered to create strong, durable structures, and provide the added benefit of integrated insulation which makes them ideal for residential buildings. SIPs provide a tight building envelope with a high insulation value, which leads to a decrease in operating costs to maintain a comfortable environment for the occupants. This product is able to withstand a wide range of weather conditions and it has been proven that houses built with SIPs are able to withstand a variety of natural disasters. Also, because of the “all-in-one” nature of SIPs, construction time can be greatly reduced when compared to a stick frame home. This is because SIPs incorporate framing, insulation, and exterior sheathing, and can come precut from the factory for the specific job; therefore, the exterior building envelope can be built quickly.

The below ground walls of the house will be created using a Fully Insulated Concrete Foundation (FICF) system which sandwiches an EPS core between two “panels” of concrete called thermal mass walls. This configuration allows for the passive solar features of the house to combine with the thermal mass of the concrete and provide a natural heating effect during the winter months. This FICF system will also help to maintain a cool lower level and north wall on the main level during the summer months. Thermal mass walls consist of 4 inches of concrete facing the interior, 2 inches of concrete on the exterior and 2 inches of EPS insulation sandwiched in between. Fiber composite connectors, spaced 16 inches on center, hold the assembly together. The thermal mass walls take advantage of the thermal mass effect, which occurs when concrete walls and floors absorb daytime heat and release it at night. During the daytime, the 4 inches of interior concrete warm up to the indoor temperature. Once the home’s interior temperature falls below the wall temperature, the concrete releases this heat back into the home. This effect reduces both cooling and heating loads, thus the homes HVAC system is downsized. Along with decreasing the total amount of heating and cooling required, it also shifts the load to off-peak hours, which can offer even greater cost savings in areas with variable electricity rates. Although the wall has a material R-value of 11.33, its effective R-value (which considers the thermal mass and other effects of the concrete) is two to three times as high depending on the climate. The extent to which the thermal mass effect increases the effective R-value of a wall is affected by the number of heating degree-days. The general rule is that areas with fewer heating degree-days will benefit more from the thermal mass effect, making this a logical selection for the climate at the site.





## SYSTEMS: VENTILATION

**Summer Cooling --** The site has prevailing breezes from the south/southwest. The house is designed to take full advantage of these breezes and use air conditioning only when absolutely necessary. The 10-foot wide, wrap-around porch of the main level helps to cool the air entering through the windows.

Additionally, the lower level and 50% of the north wall of the main floor will be below ground and that allows for natural cooling of those spaces.

Natural ventilation features include transoms over the interior doors and operable windows on all levels.

The cupola room allows for a "chimney" effect when desired; eliminating the need for a whole house fan.

During the summer months, the sunroom will act as a screened porch; outside the building envelope.

**Winter Heating --** The passive solar design of the house in combination with the thermal mass provided by the below ground concrete walls provides a natural heating effect. When the sunroom is included in the building envelope and windows to the lower level, French doors to the main level, and windows to the upper level are open, the natural ventilation/circulation features move the warmed air throughout the structure. Heating equipment will be utilized as a secondary system.

Because the house is so tightly constructed, an High Efficiency Recirculation and Ventilation system will be used to introduce fresh air into the house when the weather does not permit opening the windows. An ERV (Energy Recovery Ventilator) will be used to retrieve heat and moisture and transfer it from the exhaust air stream to the incoming air stream during the heating season (and vice versa during the cooling season). The ERV also includes a high efficiency filter to reduce air-borne pathogens, producing a better indoor air quality.





## SYSTEMS: HEATING

The garage/workshop is designed to maximize the efficiency of hydronic radiant flooring heating.

The house will use passive solar features as the primary heat source. Secondary heating system(s) will be incorporated in zones to ensure maximum efficiency. Using heating zones is not only practical; it creates a more comfortable atmosphere and is very cost effective. Programmable thermostats will be used for each zone. Hathmore Technologies, LLC has been engaged to work with the general contractor and subcontractors to consult on the options that will work best with the lowest costs and maintenance. Therefore, design charrettes will be conducted to facilitate these decisions.

## SYSTEMS: COOLING

The garage/workshop is not designed to incorporate anything other than natural ventilation for cooling. However, because it will be built using SIPs, it will be a well insulated building. Appropriate venting will add to the comfort level.

The house is designed to use natural ventilation as the primary cooling feature. Secondary cooling system(s) will be incorporated in zones to ensure maximum efficiency. Using cooling zones is not only practical; it creates a more comfortable atmosphere and is very cost effective. Hathmore Technologies, LLC has been engaged to work with the general contractor and subcontractors to consult on the options that will work best with the lowest costs and maintenance. Therefore, design charrettes will be conducted to facilitate these decisions.

## ENERGY EFFICIENCY: INSULATION

The garage/workshop will use a combination of Structural Insulated Panels (SIPS) and blown-in foam insulation to create an extremely energy efficient structure. Windows and doors will be chosen to continue this highly insulated quality.

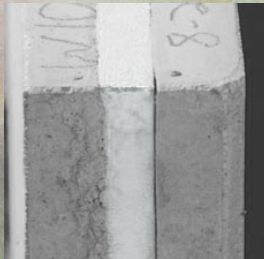
The house uses a combination of SIPS and Fully Insulated Concrete Foundation (FICF) to create its building envelope.

Unlike stick and batt construction, which can be subject to poorly installed (even missing) insulation, the nature of SIPS and FICF is such that the structural and insulation elements are joined as one. There are no hidden gaps, because a solid layer of foam insulation is integral to panel construction.

A SIPS wall also outperforms stick and batt when it comes to maintaining consistent interior temperatures, and that translates to improved occupant comfort. The interior surface temperature of frame construction drops sharply at every stud, while the SIP wall remains consistent across its entire surface. No temperature dips mean improved occupant comfort, regardless of where you are in the room. With SIPS and FICF, thermal efficiency and comfort are built in.

Exterior windows and doors will also be chosen to continue the highly insulated quality of the house. Windows will have Low-E coatings where necessary and be double paned. Additionally, the windows on the main level will be protected and shaded by the wrap-around porch; while the windows on the upper level will be shaded by overhangs to allow solar gain in the winter months but not in the summer months.

Hathmore Technologies, LLC has been engaged to work with the general contractor and subcontractors to consult on the options that will work best with the lowest costs and maintenance. Therefore, design charrettes will be conducted to facilitate these decisions.



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|  | <b>World's Best Window Co.</b><br>Millennium 2008®<br>Very Good Window Frame<br>Double Glazing, Single Pane, 2 1/2" x 4 1/2"<br>Product Type: Vertical Slider |
| <b>ENERGY PERFORMANCE RATINGS</b><br>(Per NFRC 100)                               |   |
| <b>0.35</b>   | <b>0.32</b>   |
| <b>ADDITIONAL PERFORMANCE RATINGS</b>   |   |
| <b>0.51</b>   | <b>0.2</b>  |
| <b>51</b>   |   |





## ENERGY EFFICIENCY: RENEWABLE ENERGY PRODUCTION

The garage/workshop is designed using a gambrel-style roof which has the correct angles to incorporate photovoltaic (PV) products on its roof for year-round production of electricity. Storage of batteries will be provided for in both the garage/workshop and the house.

The 10-acre lot is large enough to accommodate a residential-size wind turbine.

Hathmore Technologies, LLC has been engaged to work with the general contractor and subcontractors to consult on the options that will work best with the lowest costs and maintenance. Therefore, design charrettes will be conducted to facilitate these decisions.

## ENERGY EFFICIENCY: APPLIANCES

The house will utilize ENERGY STAR rated appliances.

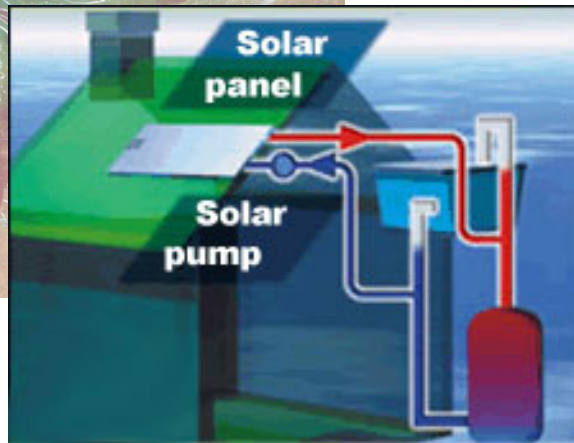
ENERGY STAR qualified refrigerators use up to 40 percent less energy than the conventional models sold in 2001 and at least 15 percent less energy than models built to current federal standards. These refrigerators feature high-efficiency compressors, improved insulation, and more precise temperature and defrost mechanisms.

ENERGY STAR qualified freezers use at least 10 percent less energy than required by current federal standards.

ENERGY STAR qualified dishwashers use at least 25 percent less energy and up to 40 percent less water than standard models and can save more than \$25 a year in energy and water costs. These dishwashers use “smart” features such as effective washing action, energy-efficient motors, and sensors that determine the necessary cycle length and water temperature.

ENERGY STAR qualified clothes washers use up to 50 percent less energy and about one-third less water than standard washers. As a result, expect to save up to \$75 per year on utility and water bills with additional savings from using less detergent. Most ENERGY STAR qualified washers extract more water during the spin cycle, providing further energy savings when using a clothes dryer because drying time will be shorter. The client will see less wear and tear on clothes from front loading model(s), which do not need an agitator. Since there is not ENERGY STAR rating for clothes dryers, a unit that matches the clothes washer will be purchased. Additionally, clothing will be dried outside using the sun and wind whenever feasible.





## ENERGY EFFICIENCY: LIGHTING

Artificial lighting will be a combination of CFL and LED technology to reduce heat gain and energy use.

Sensors and timers will be used in appropriate areas, i.e. closets, passageways, etc.

Exterior steps will be well lit with solar powered LED lighting.

## ENERGY EFFICIENCY: SOLAR WATER HEATER

The PlayHaven Green Building Complex is designed to use a solar water heater as its primary heated water source.

The sun's heat has been used for decades to heat water for homes and businesses. At the turn of the 20th century, solar heated water systems were common in Southern California. Some countries have made their use mandatory. For example, all homes in Israel have solar hot water systems. More than one-half million solar hot water systems have been installed in the United States, mostly on single-family homes. Typically, a homeowner relying on electricity to heat water could save up to \$500 in the first year of operation by installing a solar water heating system. The savings over time increases due to increasing electricity rates. The average solar heating system pays for itself in four to seven years.





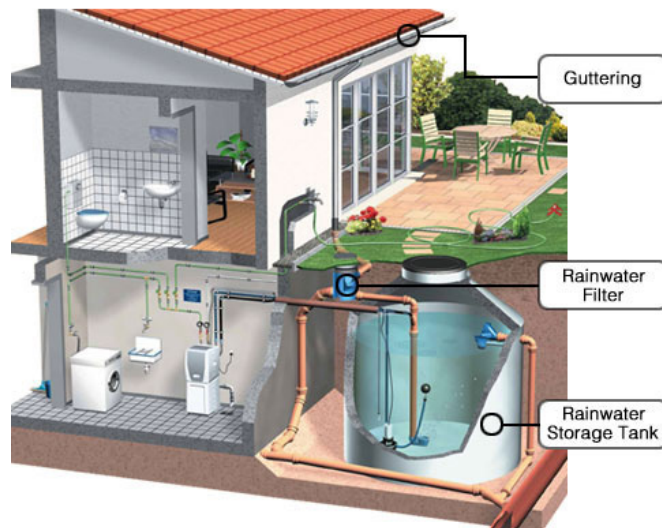
## **SUSTAINABILITY: SIPS PANELS**

- » Environmentally Friendly
- » At least 50% savings in heating and cooling costs
- » Reduces dependence on old growth lumber
- » Reduces atmospheric pollutants
- » Utilizes recyclable materials
- » Energy Star Program

Besides providing excellent structural integrity, working with SIPS also ensures a high level of environmental sustainability. The finished product uses fewer materials than a conventionally built home, requiring less energy to maintain, emitting less pollution and resulting in an improved living space.

SIPS provide superior insulation properties over typical “stick-built” construction. Independent testing has shown that SIPS walls are up to 45% more energy efficient and reduce air leakage by up to 90% when compared to fiberglass insulated walls of the same thickness, making them just the thing for an energy-conscious world.

The panels are more environmentally friendly than conventional construction methods. The OSB is made from recycled or new growth trees, requiring less virgin lumber. In addition, no outgassing is produced from the foam releasing system, and the EPS foam core can be recycled.



## SUSTAINABILITY: GREEN ROOF

The house is designed to incorporate a living – also known as “green” – roof on the covered porch.

Because green roofs reduce the surface temperature of a roof by minimizing heat-absorbing surfaces, the green roof helps to reduce energy costs inside the building as well. For example, on a 90-degree day, while a blacktop roof surface can be as hot as 160 degrees, a typical green roof temperature will only be 95 degrees.

The green roof helps to protect the roof membranes from extreme temperature fluctuations and the negative impact of ultraviolet radiation. Green roofs can double the life span of a conventional roof.

The plants capture and hold rainwater. Water stored in the growing media is released through evaporation and transpiration. Rain water retention rates are determined by saturated infiltration capacity, thickness of the growing media, field capacity, porosity, under-drainage layer water retention and flow, and relief drain spacing. Green roofs also filter out fine, airborne particulate matter as the air passes over the plants. Airborne particulates tend to get trapped in the surface areas of the greenery. Rains wash it into the growing medium below. Plants also absorb gaseous pollutants through photosynthesis and sequester them in their leaves.

## SUSTAINABILITY: WATER COLLECTION SYSTEM

The garage/workshop will have rain barrels at each down spout.

The house will use gutters to harvest rain water and collected in at least one underground cistern. This water will be used for tertiary uses e.g., watering plants.

The use of rain water not only promotes water conservation, but it also promotes an aspect of sustainable development of such an irreplaceable resource.





## SUSTAINABILITY: REUSE AND RECYCLE

The PlayHaven Green Building Complex will incorporate as much reused, reclaimed and recycled material/products as possible.

The interior of the house is designed to be simple aesthetically so that unique architectural salvage may be incorporated into it over time. Kansas City is home to Habitat for Humanity's ReStore, one such resource for recycled materials and products. The garage/workshop will be built first to a weather-tight condition of the main level to store building materials and collected architectural salvage.

New, recycled products that are planned for inclusion are:

- » Countertops made from recycled glass aggregate, and
- » A variety of floorings including recycled PET carpeting, reclaimed timber, stained concrete, cork, natural linoleum, and porcelain tile.

The porch on the exterior of the house will use recycled composite decking and railing products. This type of decking and railing products are made from a unique combination of reclaimed wood and plastic, giving you the best qualities of both materials.

## SUSTAINABILITY: ECO-FRIENDLY PRODUCTS

It is important to maintain a healthy indoor air quality; therefore, the PlayHaven Green Building Complex will use:

- » low and no-VOC paints, stain, varnishes, and sealants,
- » FSC certified interior wood and panel products, and
- » Environmentally-friendly cleaning products.