Aspendale Mountain Retreat Center:

Six Cabin Single Family Designs

Group B

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Senior Design II

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Abstract

This senior design project consisted of developing designs for several cabins for the Aspendale Mountain Retreat Center, located in the heart of the Lincoln Forest. Various conditions were examined when developing an appropriate quantity and specific design of cabins to be used. We had to determine our limitations that came with the project, namely; funds, resources, and access to labor and equipment. Six cabins with four different designs were chosen. From that point, design began for assigning environmental features, cost analysis, and possible components for project feasibility, in accordance to Mr. Hammond, the camp curator. Six cabins were expanded on with features such as passive solar design, handicap accessibility, and energy efficient materials.

Introduction

This project is a partnership with Aspendale Mountain Retreat Center located in Cloudcroft, New Mexico which can be viewed in Figures 1 and 2 (Google, 2011). Currently they have large dorm like cabins that cater to large groups. Because of this they are looking to diversify their facility and cater toward single families. This project will be funded through the El Paso Baptist Association. Our role in this venture is to provide four cabin designs, one being handicap accessible. Out of these designs there will be a total of six cabins. These cabins are to be eco-friendly and cost efficient while maintaining the traditional cabin feel. In deciding on these designs we considered passive solar, some energy efficient appliances and capability to drain cabins when not in use.

Background

The Aspendale Mountain Retreat Center began in the spring of 1958 (Aspendale Mountain Retreat Center, 2011). El Paso Baptist Association purchased one hundred twenty three acres of land located five miles from Cloudcroft, New Mexico. In the center of Lincoln National Forest a full service, year round Christian camp was created. Currently it is a two hundred and fifty bed facility that provides private cabins, lodges and dorms for various activities. A map of the location is shown in figure 3.

Methods

The Aspendale Camp is currently curetted by Mr. Hammond (Aspendale Mountain Retreat Center, 2011). In our first meeting with Mr. Hammond, he gave us an idea of the parameters and a visualization of what the cabins would look like. We were able to also view the site where the cabins would be built. The site itself sits in an open valley surrounded by Forrest and high mountains.

Temperature, Climate

Due to the type of surroundings, temperatures do not average very high. In the Figure 4 you can see that even during the summer months it does not even reach a temperature of 80 degrees Fahrenheit, but will average around the 70's (Weather, 2011). In Figure 5 you can also see that during the summer months they record the highest average rainfall, which is 14.34 inches of rain, followed by fall which drops down to about half the average to about 6.46 inches. Also in Figure 4 you can be see the winter temperatures drop down to around the 40's and will stay consistent from November to about March. It is during these months that they will get their highest amount of snowfall which averages about 64.9 inches, which can be viewed in Figure 5 (Cloudcroft, 2011). Due to year round moisture from the amount of snow and rain soil stability may vary.

Geological Setting

Aspendale Mountain Retreat is south of the urban center of Cloudcroft, New Mexico. This southern area of the Sacramento Mountains has high elevation watersheds that serve as sources of recharge to local aquifers and the major stream systems that connect to the lower Pecos River valley (Aquifer, 2009). Precipitation is the primary source of all ground water recharge in this area. Topography and elevation influence the amount of rainfall that will fall in a given location. The average elevation for the Aspendale Mountain Retreat area is 8630 feet, Figure 6. The aquifer associated with this area is the High Mountain Aquifer system. The High Mountain Aquifer system, Figure 7, is complex and varies due to exposure of the Yeso Formation's heterogeneity and regional fracture systems. Samples of water have calcium

bicarbonate or calcium magnesium bicarbonate; have a slightly higher concentration of sulfate. Bicarbonate creates hard water which tends to form carbonate scale in pipes and boilers.

Furthermore, it reacts with soaps to form an undesirable scum. Sulfate in water can give a bitter taste and have a laxative effect on people consuming well water. Locals usually do not notice any health effects, however, visitors unaccustomed to higher sulfate levels can feel a difference.

Geotechnical

A soil analysis performed for construction of the adjacent dining hall indicated that the top soil is highly organic, figure 8 (J. Hammond, personal communication, November 1, 2011). Organic soil consists of silts or clays blended with decomposing vegetation and organisms. The engineering properties of organic soils vary greatly from coarse and fine grained soil. It is important to note that organic soil is considered to be cohesive. This term will come in effect when discussing settlement. Presence of this soil in the foundation of a structure is not ideal and undesirable due to the load bearing capacity that it exhibits. Holtz et al. (1981) states these organic soils exhibit poor strength under loading and offer marginal stability. Poor stability may be accredited to the high compressibility of these soils. Thus, significant short and long-term settlement can be expected, even from lightweight structures. Another parameter to take into consideration is high acidity of organic soils. The acidity can essentially corrode buried underground pipes and piles.

Primary and secondary consolidation must be taken into consideration when constructing on organic soil. The difference in settlement between granular and cohesive soils is the degree of permeability that the soils exhibit. Under loading, water is squeezed out of the material. It can be observed that granular materials, which exhibit higher permeability relative to cohesive

materials, allow for more water to permeate through under a shorter period of time. This leads to significant initial settlement during construction but declining settlement in the long term. This behavior of settlement is different for cohesive soils, particularly clay. Cohesive materials have relatively low-permeability. When loaded or compressed, the water is squeezed out of the pores in a time-controlled process. The compression of the cohesive soil, dependent on time, is referred to as consolidation. Consolidation must be predicted in both the short and long term in order to design for the structure stability and structure foundation.

Site Grading and Earthwork

Site development can be a costly factor in preparing for the construction of the cabins. Ideally little earthwork will be necessary on the current slope with the foundation being implemented. The location offers an adequate area necessary for the septic drain field.

Foundation Support

The cabins will be built with piers and beams for a foundation. Building on a pier and beam will reduce the cost for the foundation work, is ideal for cold weather climates, and can be less problematic with possible organic soils. Unfortunately the exact size of the piers would be difficult to calculate at this point because of possible earthwork that may change heights. They will also vary because of cabin size and length.

Colder climates require the footings to sit on the soil below the frost line (Country Plans, 2009). The frost line for this specific location is approximately 4 feet. The footing can be either a pressure treated wood post or concrete pier. Considering the resources available a concrete pier is the more likely choice. A concrete footing with a cross of half an inch, number four rebar to reinforce and tie into the pier. The bars can be set on rocks or broken brick to sit up three inches from the bottom of the pour. An example of the design can be seen on Figure 9. A section of

rebar is wired vertical and this will tie into another bar running up the core of the pier. The center will be poured with concrete which will tie the footing and beam straps together with the pier. An advantage with the concrete pier is a much better anchorage against uplift and wind forces.

Alternative Foundation

An alternative footing was found to be the footing tube (2010) shown in Figures 10 and 11. The tube is made of recycled polyethylene and offers the following benefits: no stripping of form required, one piece pouring, slip joint created by form, frozen ground cannot freeze to pier, and tapered design allows frozen ground to move freely. When the ground freezes it expands which can cause shifting of the pier. Compared to traditional concrete piers the tube allows a dynamic reaction to the expansion of the soil which decreases the probability of a separation of the footing and pier.

Wood

For this entire project all lumber will be cut from trees in the surround area (Mr. Hammond 2011). Although this not in accordance to LEEDs this project has to be as cost efficient as possible. Since lumber is not cheap to buy it would save a lot of money for this project if already cut trees were used for any type of lumber needed for this project. Mr. Hammond already posses permits for lumbering and would follow all rules and regulations accordingly.

Insulated Concrete Form

As for insulation we found the best fit under the conditions to be insulated concrete forms. These forms are made of expanded polystyrene (a by-product of petroleum) and no ozone CFC's (chlorofluorocarbons) are used in the manufacturing of these forms. The steel and the

polystyrene that make these forms are recyclable materials. They are the most cost effective, have a 4 hour fire rating, and are also very lasting. They can save energy from 50% to 80% over conventional construction methods. They also provide safety from fire, floods, and severe weather conditions. The concrete walls combined with the polystyrene insulation provide thermal insulation as well as soundproof. Buildings made out of these forms lower the cost of energy, and with less energy there is less pollution (Polysteel, 2005).

For our project we decided to go with the waffle grid forms instead of the flat wall form because the waffle grid used up to 25% less concrete. These forms are very easy to install because they have an easy guide for proper alignment. For our cabins we would be using the 6" forms form the waffle grid series; this include the PS-3600 which is just straight and the PS-3690 which are used for 90˚ corners. For two of our cabin designs we would also have to include the PS-3645 which is used for 45˚ corners. Besides the concrete forms dry wall would be used inside the cabin and also for the ceilings of the cabin. Calculating an R-Value can help determining the appropriate insulations. The R-Value is itself an index value that takes temperature, moisture and heating options into account. The higher the R-Value, the higher the heat resistance the insulation possesses. Utilizing the Dept. of Energy R-Value recommendations (online calculator) the R-Value recommended for the Aspendale Cabins are:

Table 1

Insulation Locations with R-Values (R-value recommendations for new buildings, 2008)

Insulation Location	R-Value (F-ft^2*h)/Btu
Attic	49
Cathedral Ceiling	38
Floor	25
Wall Sheathing	5
Wall Cavity	15
OVE Wall Cavity	21
Concrete or Masonry Wall	15.6
Band Joist	30

Polysteel model PS 3000 contains an R-Value of 20-25. This R-Value is in compliance with the recommended insulation value from the Department of Energy (Polysteel Insulating Concrete Forms, 2005).

Premium Green Fiber can be an insulation candidate for the roof insulation. It contains 85% recycled paper and is SCS Certified (85% minimum recycled content)

Assuming an R-Value of 49, the Green Fiber product is sold as:

- 2.2 feet^3/package(Greenfiber 2.2 cu. ft. natural fiber blow-in insulation, 2011)
- 1.14 feet (13.68) in thickness when settled

Due to the high cost used for a recommended R-Value of 49, an R-Value of 22 will be utilized for the attic. Therefore the settled thickness is approximately .6 feet (7.12 inches).

Roof

When we first started this project, Mr. Hammond expressed that he didn't want to go with metal roofs for a couple of reasons. He expressed that in his opinion the metal roofs took away from the welcoming feeling he was looking for in the cabins and preferred the traditional shingle roofing. There are issues with the shingles that Mr. Hammond was referring to. The lifecycle cost of a wooden shake roof may be high when you factor in mold, rot, insects, required

maintenance, and the repair cost being the largest driving part of this. Additionally, this past summer, Cloudcroft experienced severe brush and forest fires and we looked into the fire retardant capability of the wood shingles. This is effective but only for a few years. Since primary reason for the wood shingle preference was for ascetics, we believe we have found a happy median. We were looking at the roofing material that is available on the market for log cabins and came across some metal shake roofing that gives the appearance of shingles but are constructed of 60 gage steel (Best Buy Metals, 2011). They are fireproof and have a lifecycle of 50 years.

Piping and drainage

This past winter Cloudcroft, as well as the regional area, experienced some record breaking freezing temperatures. As a result of this, many homes and businesses were affected by busted pipes which meant no running water. To counter this, we have elected to go with PEX (cross-linked polyethylene) Tubing (PEX Tubing, 2011). There are many advantages for using PEX tubing over metal tubing because it is flexible, resistant to scale and chlorine, doesn't corrode or develop pinholes, it is faster to install than metal or rigid plastic, and has fewer connections and fittings. Since it is lighter than metal tubing, shipping costs are lower which transfers the savings into the cost of the material. An added bonus is that the PEX tubing is easier to access and repairs are quick, simple, and don’t require a plumber. Mr. Hammond was looking into the prepping and closing of the cabins after every weekend and by going with the PEX tubing, he’ll be able to do so quickly. PEX tubing is connected through junction boxes that have shut off valves. By cutting off the water coming into the cabins, there is less of a risk of water being left in the lines. Only requirement would be to add half a cup of antifreeze to the sinks, bath tub, and toilets for the water left in the traps. The only downfall to the PEX tubing is that it

does not fare well outdoors because of the UV rays. Since this plumbing is primarily for the inside of the cabins, then this is a nonissue.

Water heater

In our selection for a water heater we decided to look into a Tankless water heater specifically, the Rinnai Tankless Water Heater R50LSi (Rinnai, 2011). With a Tankless water heater the demand for hot water is that in the same as a regular water heater, but also long time term energy savings. Since these cabins will not be occupied all the time a Tankless water heater is ideal for our situation. A Tankless water heater provides unlimited amount of hot water and less physical space. Tankless water heaters also reduce the risk of water damage. Another advantage is with no water storage, there is a less likely possibility of tank rupture or failure. There is also a matter of safety. Tankless water heaters can precisely control the temperature of the treated water, which means dangerous temperature levels and spikes are no longer a problem. Although a tankless water heater might cost more initially it may result in both energy and cost savings in the long term. Tankless heaters are often installed throughout a household at more than one point-of-use, however with the R50LSi you only need one unit to provide all the hot water requirements for an entire cabin. Also being that our cabins will only be one bathroom they will only require one water heater.

Windows

Selecting windows for any living environment should not be over looked, because the amount of energy savings can be highly beneficial. The energy savings which can be saved from choosing the proper window installation should greatly influence anyone, since a typical window can lose almost 30% of heat. Windows lose and gain heat by conduction, convection, radiation and air leakage. These losses and gains can be attributed to the U-value. This factor should be

taking into account for the purchase of any window, as it directly represents the amount of insulation. Another factor is windows with low-E coatings which resist ultraviolet light. Low-E coatings are very thin metallic coatings that reduce visible light transmission by about 10 percent compared to uncoated glass. Essentially in selecting windows to purchase we took into account quality and energy efficiency and came up with a standard size window, Ply Gem Windows 24” x 38” SH HP SC GRL 2600 New Construction and bathroom windows, JELD-WEN 36" x 12" Builders Series Left-Operable Double-Pane Sliding Window (LOWES, 2011). Both of these windows are ENERGY STAR Qualified South/Central Zone, have low E with argon, U-value of 0.3, and are double pane. The designs for the cabins also called for us to look into picture windows and those are custom made to order. The size we decided to go with would be 36” x 72” and would also meet the ENERGY STAR requirements.

Doors

For the front door of the cabins we decided on using an energy efficient door. It is called an energy efficient door because the multiple glass panes that are used to reduce heat flow, fiber glass, wood cladding, and steel with polyurethane core provides the most energy efficient door materials this days, and a tighter fit weather stripping creates a better seal that reduces the air leakage around the edges of the door.

The front door we decided upon was an energy star qualified door. This door is a 36”x 80” 4 panel steel door that is rust and corrosion resistant (LOWES, 2011). The core of the door is made out of polyurethane for long lasting insulation; the door has also weather stripping, and a dual pane insulated glass to reduced heat flow, and is energy star qualified. For the inside of the cabins we decided to use the standard doors that would be 32”x 80” 6 panel hollow doors, as for the handicap cabin the inside doors would be 36”x 80” also 6 panel hollow doors.

Flooring

Flooring selected is conventional laminate flooring (Lamton 6mm laminate flooring, 2011). This was selected for all living areas due to cost considerations, ease of installation, and aesthetic purpose. The selected laminate flooring is described as being appropriate for general residential use and moderate foot traffic. Priced at $.68/square feet, this flooring is economical when compared to carpet and tile. Carpet, tile, and laminate are each approximately the same cost, but differences can be observed in short and long term expenses. Carpeting requires underlays at an extra expense, as well as more costly periodic maintenance for cleaning and replacement. Tile floor surfaces require costly installation due to the installation complexity. Laminate flooring does not often require periodic maintenance and is easy to maintain and install. This flooring is ideal for the camps budget and installation laborers.

Heating and Cooling

We chose the Procom Blue Flame Vent Free Wall heater with a heating capacity of 1000 square feet, simply to be practical (Procom, 2011). Because the camp does not have existing natural gas lines propane has to be purchased as used. This heater can be used with propane and is energy efficient. The cabin will first heat with this when someone arrives. This will heat the cabin quicker than a wood stove. Once the cabin is heated and the wood stove would start giving off more heat this heater would be shut off.

Besides the heating system that will be used in the cabins there will also be a wooden stove. The wooden stove we decided upon was a United States Stove APS1100B, is a pedestal wood stove with blower that gives out 3800BTU to 67,000BTU (United States Stove, 2011). This stove is able to heat up to 1100 square feet, is EPA approved and it has 75% efficiency. One advantage to wood stoves is the peace of mind during a Power

outage. The idea of a wood stove was because Mr. Hammond preferred this over a fire place. This would not only heat the cabin but at the same time give that outdoor camping feel to it without all the smoke. The cost for wood stoves varies depending on their size and how much square footage they heat up. We ended up choosing a wood stove that would be EPA approved but also be able to heat the size of each cabin.

An attic fan is a ventilation fan which regulates the heat level of a building's attic by exhausting hot air. We picked a solar power attic fan, The Sun Rise standard Flat –Base style FB850FT for part of the ventilation in the cabin (Sun Rise, 2011). This fan uses no electricity it saves up to 30% in cooling costs, and it can cool up to 1200 square feet. This fan has an included thermostat that will turn on when the temperature is at 80˚F and shut down once it reaches 65˚F. The fans' solar panel captures sunlight even on overcast days, as well as in inclement and extreme weather such as hail. It is also resistant to corrosion and it also has strength and stability for high winds. This attic fan also operates very quietly which is good when one is trying to sleep.

Layouts

When first began this project we thought of only using one design and having all six cabins look exactly the same. But as time went on we found that this would not be appealing to guests. Mr. Hammond was very adamant about using designs that were already built so we searched for designs that would incorporate ideas he had originally wanted. We each found several and presented them to Mr. Hammond who then chose the designs being used. For utilities the camp site already has an established local electrical system which will supply electricity to these cabins as well.

The first which is also the largest is the Alpine Ridge cabin design and layout (Conestoga Log Cabin and Homes, 2011). This cabin will be approximately 1220 square feet which will include a loft area. As seen in Figure 12 this cabin will have two bedrooms, one bath with a fairly large living room area and equally large windows. Ideally two of these cabins would be likely built. The cabin will be placed facing mainly south for passive solar design. The windows in the front will have to be customized to be twelve feet high in total meaning six feet high each. Also because there are eight total windows, four on top and four on bottom, they do not require being very wide only about 36 inches. Because of these dimensions windows will have to be customized which can be costly. For the passive solar design the windows will have to be hung two feet under the roof and the roof overhang length will only be three feet. With these specifications as seen in Figure 13 one can see that during the winter months the cabin will collect maximum about of sun light throughout the day. During the warmest months June and July there will be no direct sunlight entering into the cabin. This will predominately help with heating and cooling cost.

The next layout design is the hexagonal cabin design (Family Home Plans, 2011). Originally this design was in the shape of a hexagon but because it only had one bedroom, modification was made to accommodate Mr. Hammond's request. With this modification it now includes two bedrooms, one bath and a loft area for extra room to sleep. This cabin is approximately 800 square feet and also has large windows in front for passive solar design. Like the previous cabin the windows will have to be customized to optimum lighting purposes. Exact dimensions and specifications can be viewed in Figure 14 and there will also be two cabins with this design. In order to be sure of the angle in which the cabins have to be placed we looked at

the solar angle with respect to the site location (Solar Path Chart Program 2007), Figure 15, this gives a good estimate of the angle in which the sun travels through the year.

The third design is Aspen B which will only be one cabin will also have two bedrooms, one bath, as well as a loft area. This particular design was found by Mr. Hammond (Build A Log Cabin 2008) but does not incorporate the passive solar. Although modifications wanted to be made to incorporate a passive solar design the implication that this layout was to remain exact were noted and kept. Aspen B is approximately 993 square feet but unlike the other cabins this cabin is just a simple rectangle. All dimensions can be seen in Figure 16.

One cabin will have alterations to be handicap accessible shown in Figure 17. Following the 2010 ADA Standards for Accessible Design the following items are specifically addressed: parking, common rooms, bathroom, and kitchen space. When addressing each factor the main purpose of each alteration is to make path of travel accessible. Path of travel is defined as a continuous, unobstructed way of passage by means of which the area can be approached, entered, and excited and connects to other areas. This includes sidewalks, streets, path through lobbies, rooms, and parking areas. Note, when the cost of alterations necessary to make the path of travel fully accessible is disproportionate to the cost of the overall alteration, the path can be designed to a certain extent without incurring disproportionate cost (ADA 202.4). When making alterations the following is the order of importance that is required by ADA Standards: entrance, route to altered area, accessible restroom, accessible telephone, drinking fountain, parking, storage, and alarms. Some items do not pertain to the alterations of the cabin.

The standards require at least one accessible route to enter and exit the cabin. The entrance has to be a clear path, free of any obstruction such as vegetation. When designing the entrance and majority of the cabin, the turning radius is essential.

Entrance Path to Cabin

- Slope not steeper than 1:20 (ADA 403.3)
- Clear width of 32 inches minimum (ADA 403.5)
- Accessible route makes a 180 degree turn (ADA 403.5.2)
- Handrails provided if slope steeper than 1:20 (ADA 403.6)

The handicap accessible cabin will provide a ramp which will directly connect to the front of the porch. The slope is not expected to be steeper than 1:20; however, a handrail will be provided because of the climate. The weather in the area can result in slick entrance paths, so a handrail will provide support. No turning path will be necessary in the design. Upon entrance of the cabin focus will lie on the doorway and space after entry. The following criterion has to be met with the cabin design.

Cabin Entrance

- Floors and ground surfaces shall be stable, firm and slip resistant (ADA 302.1)
- Changes in level of ¼ inch high minimum with slope not steeper than 1:2 (ADA 303.3)
- Turning space 60 inches diameter minimum including knee and toe clearance (ADA 304.3.1)
- Door width 32 inches minimum (ADA 404.2.3)
- Open position has to be 90 degrees (ADA 404.2.8)
- Hardware on the door shall be 34 inches minimum and 48 inches maximum above the finish floor. (ADA 404.2.7)

The flooring will be laminate, which is fairly durable and easy to keep clean. The front door size will be 36 by 80; furthermore, the door will open to a 90 degree angle. The angle of the

door opening is shown in Figure 18. If necessary, a commercial grade hydraulic door closer will be installed in the front door to allow a delay in the reaction of the door. Continuing to follow the order of importance, next the bathroom will be undertaken.

Bathroom Space

- Doors shall not swing into the clear floor space or clearance required (ADA 603.2.3)
- Clearance around a water closet shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum refer to Figure 19 (ADA 604.3.1)
- Water closets shall be arranged for left hand or right hand approach (ADA 604.8.2)

Bathroom Toilet / Sink

Specifications available on Figure 20.

- Toilet seat height shall be 17 inches minimum and 19 inches maximum measured to the top of the seat (ADA 604.4)
- Grab bars shall be provided on the side wall to the water closet and on the rear wall (ADA 604.5)
- Rear wall grab bar shall be 36 inches long minimum and extend from the centerline 12 inches minimum on one side and 24 inches minimum from the other side (ADA 604.5.2)
- Sinks and countertops shall be installed with the front of the rim or counter surface 34 inches maximum above the finish floor (ADA 606.3)

Bathroom Tub

Specifications are available on Figure 21.

- Clearance in front of bathtubs shall extend the length of the bathtub and shall be 30 inches wide minimum. A permanent seat is provided at the head end of the tub and the clearance extend 12 inches minimum beyond the wall (ADA 607.2)

- Two grab bars shall be installed on the back wall. One located 8 inches minimum and 10 inches maximum above the rim of the bathtub. Length of grab bar is 24 inches minimum (ADA 607.4.2.1)
- A grab bar shall be installed on the control end wall at the front edge of the bathtub (ADA 607.4.3)
- A grab bar 12 inches long minimum shall be installed on the head end wall at the front edge of the bathtub (ADA 607.4.2.3)
- A shower spray unit with a hose 59 inches long minimum that can be used both as a fixed position shower head and hand held shall be provided (ADA 607.6)

Bathroom Fixtures

- Exposed pipes under lavatories and sinks shall be insulated or configured to protect against contact (ADA 606.5)
- Mirrors located above lavatories or countertops shall be installed with the bottom edge of the surface 40 inches maximum above the finish floor (ADA 603.3)
- Coat Hooks and Shelves shall be located within 40 inches minimum and 48 inches maximum above finish floor (ADA 603.4)

The bathroom for the cabin was redesigned from the original floor plan to accommodate the various factors necessary to comply with ADA standards. An example is shown in Figure 23. To allow a 60 inch turning radius an extra two feet were added to the bathroom space taking away from the closet space and bedroom. Instead of a swinging door that requires an unobstructed 90 degree opening, a hidden door will be used. The opening space will be a minimum 36 inches. Funds permitting, a specialty bathtub would like to be used in this specific cabin by a company called Remain Active. A hydro ease handicap accessible bathtub allows for

an easy transition from a wheelchair to the tub. The tub is enclosed on three sides and comes with a built in seat, safety bar, dual drain, faucets and deck mount already in ADA compliance. An example is shown in Figure 22. Similar to the bathroom, the kitchen can have a handful of modifications to allow ease of access.

Kitchen Space

Specification for space is available in Figure 25.

- Work space at least 30 inches wide minimum (ADA 804.3)
- Work surface shall be 34 inches maximum above the finish floor (ADA 804.3.2)
- Forward approach provided shall provide knee and toe clearance to prevent burn or shock. Location of controls shall not require reaching across burners (ADA 804.6.4)
- Combination refrigerators and freezers shall have at least 50 percent of the freezer space 54 inches maximum above the finish floor (ADA 804.6.6)
- Where a high forward reach is over an obstruction shall be 48 inches maximum and depth is 20 inches maximum. Example shown in Figure 24 (ADA 308.2.2)

The kitchen was redesigned compared to the original floor plan to implement a proper turning radius. Counter spaces and features will be built within compliance. The kitchen space, dining area, and living area will have free flow, unrestricted accessibility to all three spaces. Furniture and features will line the walls and not be placed in the center area of the cabin in order to continue accessibility. Finally, the parking area will be designed following ADA standards and to complete the requirements necessary to make this one cabin handicap accessible.

Parking

- Minimum one parking space required and accessible loading zone (ADA 206.2.1)
- Parking spaces are marked with lines and centerline (ADA 502.1)
- Spaces shall be 96 inches wide minimum and van parking spaces shall be 132 inches wide minimum Figure 26 (ADA 502.2)

The final design of the modified cabin is available in Figure 25. The key issue at hand was creating space and altering units in order to avoid obstructions.

Residential/Dwelling Building Code

New Mexico residential building codes are largely comprised of regulations posed by the International Building Codes (IRC). It should be noted that New Mexico has provided provisions and amendments to a portion of these codes for applicability in New Mexico. The following is a summary of the effective building codes effective as of January 28, 2011. The building codes are located in the Construction Industries Division (CID) rules of the New Mexico Regulation and Licensing Department under the following sections:

Title 14: Housing in Construction

Chapter 7: Building Codes General

Part 3: 2009 New Mexico Residential Building Codes

As described in the regulations, any and all construction, repair, alteration, relocation, use and occupancy of multi and single-family dwellings must adhere to specified building codes. The components and codes included in this summary are limited to living space and energy efficient components for practical purposes. The following is a summary of building codes that are to be implemented to the Aspendale Camp cabins under the scope of the senior design team: Group B. A portion of the building codes are included for practical purposes.

Solar Ventilation System: The code (Section: M2301.2.1) explains that this solar fan unit such as this one must be accessible for inspection, maintenance, repair and replacement. It also states that the supporting structure must be able to sustain the load. The unit must also be fire retardant. The assigned solar ventilation unit is in fact fire retardant, accessible and lightweight.

Roofing: Under roofing classification, the code (R901**)** states that the roofing material should fire retardant. The roof material selected is 30 grade steel, therefore there is compliance with the code. Drainage is also taken into account in the design of the structure. A drainage slope is constant in every roof design within this project.

Fireplace Stove: IRC codes states that the flue gas passageway of the chimney shall be sized for appropriate flow and condensation of flue gas. The flue liner, chimney inner wall and/or vents shall be continuous and free of gaps or cracks to prevent gas leakage. System shall be equipped with a pellet vent. Installation of the fireplace stove shall follow manufacturer instructions. There shall be a hearth extension designated for each fireplace stove for each respective cabin. The hearth extension shall be clearly distinguishable from the surrounding floor (M1414**)**.

Tankless Water Heater: Installation of these units must be in a sealed, enclosed area so combustion air is not taken away from the living space of the dwelling. Water heaters can be installed in crawling space of the dwelling. Water heaters should have a shut off valve in the supply and return piping (M2005).

Results

Table 2

Alpine Ridge Cabin Estimated Cost

	Type	$ per unit	Quantity	Total $
Columns	18 concrete	$135/ yard ^{3}	2.7 yards ^{3}	$386.37
Columns rebar	3/8" x 4ft	$3.51	36	$133.94
Footings	18 concrete	$135/ yard ^{3}	2.7 yards ^{3}	$386.37
Footings rebar	3/8" x 2ft	$1.52	36	$58
Insulation forms	PS-3000 series	$23.50	392	$9,212
Insulation	concrete	$135/ yard ^{3}	28 yards ^{3}	$3,780
Rebar in forms	1/2 x 20'	$5.98	91	$637.40
Dry wall	4x8 panel	$5.69	73	$456.14
Attic insulation	Natural fiber	$11.57/ 2.2 ft^3	864 ft^3	$4,543.85
Ceiling	4x8 panel	$5.69	45	$284.97
Flooring	laminate	$0.68 sq. ft	1220 sq. ft	$879.37
Roof	30 gauge steel	$6.00/sq. ft	1480 sq. ft	$9,412.80
Pipes	PEX 1/2"	$0.30/ foot	200 ft	$63.60
	MANABLOCS	$142.95	3	$454.58
Front door	36" x 80" steel door	$198.00	1	$209.88
Doors	32" x 80" hollow door	$22.00	4	$93.28
Windows			13	$4,660.82
Ventilation	FB850FT	$564.00	1	$597.84
Water heater	R50LSi	$700.00	1	$742.00
Heater	ProCom wall heater	$216.00	1	$228.96
Wood stove	APS1100B	$499.00	1	$528.94
Fans	42" ceiling fan	$26.98	1	$28.60
Rain diverters	6" x 6' rain diverter	$4.78	3	$17.32
			Total Estimated Cost	$37,797.03
			Estimated Cost for Two Cabins	$75,594.06

Table 3

Hexagonal Cabin Estimated Cost

	Type	$ per unit	Quantity	Total $
Column	14 concrete	$135/ yard ^{3}	2.1 yards ^{3}	$300.51
Column rebar	3/8" x 4ft	$3.51	20	$74.41
Footing	14 concrete	$135/ yard ^{3}	2.1 yards ^{3}	$300.51
Footing rebar	3/8" x 2ft	$1.52	20	$32.22
Insulation forms	PS-3000 series	$23.50	304	$7,144.00
Insulation	concrete	$135/ yard ^{3}	20 yards ^{3}	$2,700.00
Rebar in forms	1/2 x 20'	$5.98	70	$534.61
Dry wall	4x8 panel	$5.69	59	$370.56
Attic insulation	Natural fiber	$11.57/ 2.2 ft^3	504 ft^3	$2,650.58
Ceiling	4x8 panel	$5.69	28	$181.04
Flooring	laminate	$0.68 sq. ft	800 sq. ft	$576.64
Roof	30 gauge steel	$6.00/sq. ft	1111 sq. ft	$7,065.96
Pipes	PEX 1/2"	$0.30/ foot	200 ft	$63.60
	MANABLOCS	$142.95	3	$454.58
Front door	36" x 80" steel door	$198.00	1	$209.88
Doors	32" x 80" hollow door	$22.00	3	$69.96
Windows			10	$4,348.45
Ventilation	FB850FT	$564.00	1	$597.84
Water heater	R50LSi	$700.00	1	$742.00
Heater	ProCom wall heater	$216.00	1	$228.96
Wood stove	APS1100B	$499.00	1	$528.94
Fans	42" ceiling fan	$26.98	1	$28.60
Rain diverters	6" x 6' rain diverter	$4.78	3	$17.32
			Total Estimated Cost	$29,221.17
			Estimated Cost for Two Cabins	$58,442.34

Table 4

Aspen B Cabin Estimated Cost

Aspen B	Type	$ per unit	Quantity	Total $
Column	14 concrete	$135/ yard ^{3}	2.1 yards ^{3}	$300.51
Column rebar	3/8" x 4ft	$3.51	20	$74.41
Footing	14 concrete	$135/ yard ^{3}	2.1 yards ^{3}	$300.51
Footing rebar	3/8" x 2ft	$1.52	20	$32.22
Insulation forms	PS-3000 series	$23.50	371	$8,719
Insulation	concrete	$135/ yard ^{3}	27 yards ^{3}	$3,645
Rebar in forms	1/2 x 20'	$5.98	86	$637.40
Dry wall	4x8 panel	$5.69	70	$437.80
Attic insulation	Natural fiber	$11.57/ 2.2 ft^3	576 ft^3	$3,029.23
Ceiling	4x8 panel	$5.69	36	$229.95
Flooring	laminate	$0.68 sq. ft	993 sq. ft	$715.75
Roof	30 gauge steel	$6.00/sq. ft	1360 sq. ft	$8,649.60
Pipes	PEX 1/2"	$0.30/ foot	150 ft	$47.70
	MANABLOCS	$142.95	3	$454.58
Front door	36" x 80" steel door	$198.00	1	$209.88
Doors	32" x 80" hollow door	$22.00	4	$93.28
Windows			6	$626.07
Ventilation	FB850FT	$564.00	1	$597.84
Water heater	R50LSi	$700.00	1	$742.00
Heater	ProCom wall heater	$216.00	1	$228.96
Wood stove	APS1100B	$499.00	1	$528.94
Fans	42" ceiling fan	$26.98	1	$28.60
			Total Estimated Cost	$30,329.23

Table 5

Handicap Cabin Estimated Cost

Handicap	Type	$ per unit	Quantity	Total $
Column	12 concrete	$135/ yard ^{3}	1.8 yards ^{3}	$257.58
Column rebar	3/8" x 4ft	$3.51	24	$89.29
Footing	12 concrete	$135/ yard ^{3}	1.8 yards ^{3}	$257.58
Footing rebar	3/8" x 2ft	$1.52	24	$38.66
Insulation forms	PS-3000 series	$23.50	338	$7,943.00
Insulation	concrete	$135/ yard ^{3}	24 yards ^{3}	$3,240.00
Rebar in forms	1/2 x 20'	$5.98	78	$586.00
Dry wall	4x8 panel	$5.69	68	$425.56
Attic insulation	Natural fiber	$11.57/ 2.2 ft^3	840 ft^3	$4,417.64
Ceiling	4x8 panel	$5.69	28	$181.04
Flooring	laminate	$0.68 sq. ft	875 sq. ft	$630.70
Roof	30 gauge steel	$6.00/sq. ft	1005 sq. ft	$6,391.80
Pipes	PEX 1/2"	$0.30/ foot	150 ft	$47.70
	MANABLOCS	$142.95	3	$454.58
Front door	36" x 80" steel door	$198.00	1	$209.88
Doors	36" x 80" hollow door	$22.00	2	$46.64
Windows			9	$938.45
Ventilation	FB850FT	$564.00	1	$597.84
Water heater	R50LSi	$700.00	1	$742.00
Heater	ProCom wall heater	$216.00	1	$228.96
Wood stove	APS1100B	$499.00	1	$528.94
Fans	42" ceiling fan	$26.98	1	$28.60
Door closer		$69.47	1	$74.64
Bath tub		$2,795	1	$2,962.70
			Total Estimated Cost	$31,319.78

For Tables 2 through 5 we included a break down estimated cost of all the building materials is given. We have included a cost per cabin as well as a cost if there is more than one to be built. In the purchasing of all the materials they will be tax exempt because of the camp being a church camp. Also for this same reason we did not include cost of labor because the camp will be having volunteers construct these cabins. As stated before the camp currently has electricity we did consider including the cost of electrical wiring. Although we did not due to the fact that an electrician would have to be hired to look at each cabin in construction and give a total cost

plus labor. Other appliances were also not included because we knew that stoves, microwaves, washers and dryers would more than likely be donated to the camp. The Total Cost below is an estimate of the total cost of this project.

Table 6

Total Estimated Combined Cost	$195,685.41

Although this price may sound high one needs to remember this cost is for the construction of six cabins. We found this price to be reasonable when comparing it to the cost of a brand new cabin in the surrounding area. The overall cost of this project is feasible, especially when taking into consideration all the applied modifications for energy efficiency. The camp its self does not currently have a budget for this but funding for construction of this project will come from donations.

References

A 16’x24’ post and pier cabin.(2011, September). Retrieved from http://www.countryplans.com/velsko.html

American gypsum 1/2" x 4' x 8' drywall.(2011, November). Retrieved from http://www.lowes.com/pd_120998-71617-752278260012_4294858283_4294937087_?productId=3419836&Ns=p_product_prd_lis_ord_nbr|0||p_product_qty_sales_dollar|1&pl=1¤tURL=/pl_Drywall_4294858283_4294937087_?Ns=p_product_prd_lis_ord_nbr|0||p_product_qty_sales_dollar|1&facetInfo

An easy to build post and pier foundation. (2011, September). Retrieved from http://www.countryplans.com/foundation/index.html

Aquifer mapping program.(2009). Retrieved from http://geoinfo.nmt.edu/resources/water/projects/Southern_Sacramentos.html

Articles.(2011). Retrieved from http://www.loghome.com/ecofriendly-california-cabin-photos/articles/3324

Average monthly rainfall and snowfall (inches).(2011). Retrieved from http://cloudcroft.com/cgi-bin/rainfall.pl

Comprehensive log cabin inspection checklist.(2011, September). Retrieved from http://www.log-cabin-connection.com/cabin-inspection.html

Cost of picture windows (2011, November). Retrieved from http://www.homewyse.com/costs/cost_of_picture_windows.html

Door closer.(2011, November). Retrieved from http://www.lowes.com/pd_180769-77254-15641 BC PA DN_0__?productId=3018405&Ntt=hydraulic door closer&Ns=p_product_qty_sales_dollar|1&pl=1¤tURL=/pl__0__s?Ntt=hydraulic+door+closer&Ns=p_product_qty_sales_dollar|1&facetInfo

Favorite log home floor plan.(2008). Retrieved from http://logcabininmichigan.blogspot.com/2008_09_07_archive.htm

Forecasts.(2011). Retrieved from http://www.weather.com/weather/wxclimatology/monthly/graph/USNM0069

Green fiber 2.2 cu. ft. natural fiber blow-in insulation.(2011, November). Retrieved from http://www.lowes.com/pd_82480-2256-INS541LD_?PL=1&productId=3227256

Harbor breeze 42" armitage white ceiling fan.(2011, November). Retrieved from http://www.lowes.com/pd_98120-1811-BN42WW4C_0__?productId=1115281&Ntt=fans&pl=1¤tURL=/pl__0__s?Ntt=fans&facetInfo

Holtz, R., Kovacs, W., Sheahan, T.(1981). An introduction to geotechnical engineering, . New Jersey: Prentice Hall

Home.(2011). Retrieved from "http://aspendale.org/default.aspx

House plan.(2011). Retrieved from http://www.familyhomeplans.com/plan_details.cfm?PlanNumber=94308&src=search

How to build a post and pier foundation.(2011, September). Retrieved from http://www.ehow.com/how_6100284_build-post-pier-foundation.html

Insulation.(2011, February 09). Retrieved from http://www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11320

Interior doors.(2011, November). Retrieved from http://www.lowes.com/pl_Interior Doors_4294859730_4294937087_?cm_cr=Doors-_-Web Activity-_-Doors A1 Activity - Default-_-SC_Doors_Area1-_-19109_3_doors_area1_bucket3_-_interior_doors

International code council.(2007). Retrieved from http://publicecodes.citation.com/icod/irc/2006f2/index.htm?bu2=undefined

Leed for homes rating system.(2011). Retrieved from http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2135

Low-energy building design guidelines.(2011, November). Retrieved from http://www1.eere.energy.gov/femp/

Maps.(2011). Retrieved from http://maps.google.com/

Metal roofing. (2011). Retrieved from http://www.bestbuymetals.com/metal-roofing.html

National renewable energy laboratory.(2008, May 06). Retrieved from http://www.nrel.gov/learning/re_biofuels.html

New mexico state university agricultural experiment station.(1999). Retrieved from http://soils.usda.gov/survey/printed_surveys/state.asp?state=New Mexico&abbr=NM

Pex tubing.(2011, November). Retrieved from http://www.pexsupply.com/PEX-Tubing-516000

Polysteel insulating concrete forms.(2005). Retrieved from http://www.polysteel.com/technical.htm

Procom blue flame vent free wall heater - 30,000 btu output, 1000 sq. ft. heating capacity, model.(2011, November). Retrieved from http://www.amazon.com/PROCOM-Blue-Flame-Vent-Heater/dp/B002NVGJO0/ref=pd_sim_sbs_hi26

Products.(2011). Retrieved from http://www.conestogalogcabins.com/pages/products/26x39/26x39.html?gclid=CMHknpbIjqoCFcfD7Qod_13lww

Project source tan / oak laminate flooring.(2011, November). Retrieved from http://www.lowes.com/pd_103553-30029-2765_0__?productId=3049405&Ntt=flooring&pl=1¤tURL=/pl__0__s?Ntt=flooring&page=1&facetInfo

Ps-3000 waffle grid.(2005). Retrieved from http://www.polysteel.com/psform_3000.htm

R-value recommendations for new buildings.(2008, January 30). Retrieved from http://www.ornl.gov/cgi-bin/cgiwrap?user=roofs&script=ZipTable/ins_fact.pl

Reliabilt 36" x 80" 4-panel inswing steel door.(2011, November). Retrieved from http://www.lowes.com/pd_237186-42736-237186_4294807985 4294859744_4294937087_?productId=3190779&Ns=p_product_prd_lis_ord_nbr|0||p_product_qty_sales_dollar|1&pl=1¤tURL=/pl_Doors_4294807985+4294859744_4294937087_?Ns=p_product_prd_lis_ord_nbr|0||p_product_qty_sales_dollar|1&facetInfo

Rinnai tankless water heater.(2011, November). Retrieved from http://www.houseneeds.com/shop/rinnai/rinnai-gas-tankless-water-heaters-main.asp

Sacramento mountains hydrogeology study.(2011, October). Retrieved from http://geoinfo.nmt.edu/resources/water/projects/Southern_Sacramentos.html

Single hung window.(2011, November). Retrieved from http://www.lowes.com/pl_Single Hung Windows_4294807978_4294937087_?cm_cr=Windows-_-Web Activity-_-Windows Top Flexible-_-SC_Windows_TopFlexible_Area-_-204609_2_windows_Pop_Cat-2

Sliding windows.(2011, November). Retrieved from http://www.lowes.com/pl_Sliding Windows_4294772369_4294937087_?cm_cr=Windows-_-Web Activity-_-Windows Top Flexible-_-SC_Windows_TopFlexible_Area-_-204609_3_windows_Pop_Cat-3

Solar powered attic fan. (2010). Retrieved from http://www.sunrisesolar.net/prod01.html

State of new mexico building codes. (2011, January 28). Retrieved from http://www.nmcpr.state.nm.us/nmac/parts/title14/14.007.0003.htm

Steel rebar.(2011, November). Retrieved from http://www.lowes.com/SearchCatalogDisplay?Ntt=rebar&storeId=10151&N=0&langId=-1&catalogId=10051&rpp=24

Sun chart program. (2007). Retrieved from http://solardat.uoregon.edu/SunChartProgram.html

The average cost of a cubic yard of concrete.(2011, November). Retrieved from http://www.ehow.com/about_5869747_average-cost-cubic-yard-concrete.html

The footing tube.(2010). Retrieved from http://www.foottube.com/features

The hydro-ease handi-cap accessible bathtub.(2011, October). Retrieved from http://www.remainactive.com/hydro-ease-wheel-chair-accessible-tub.php

The hydro-elite series: Prelude soaker. (2008). Retrieved from http://www.remainactive.com/prelude.php

United states stove aps1100b 38000 btu pedestal wood stove with blower. (2011, November). Retrieved from http://www.build.com/united-states-stove-aps1100b-38000-btu-pedeood-stove-with-blower/p1587162?source=bec_1587162&baid=725479178

Washington, DC.(2010). 2010 ada standards for accessible design. . Retrieved from http://www.ada.gov/stdspdf.htm

Appendix

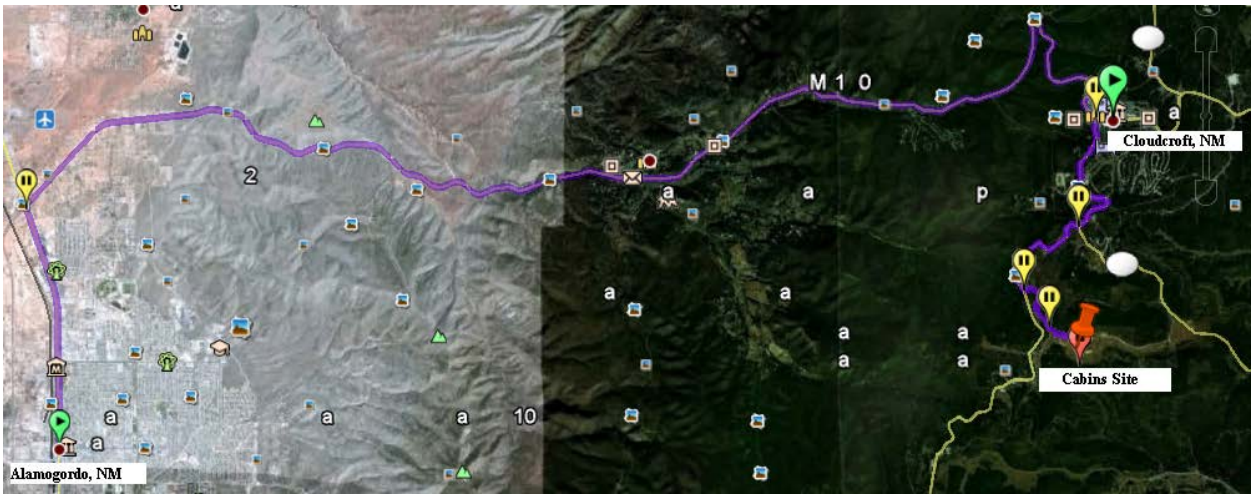


Figure 1: Route from Alamogordo, NM to Cabin Site

Figure 2: Route from Cloudcroft, NM to Cabin Site

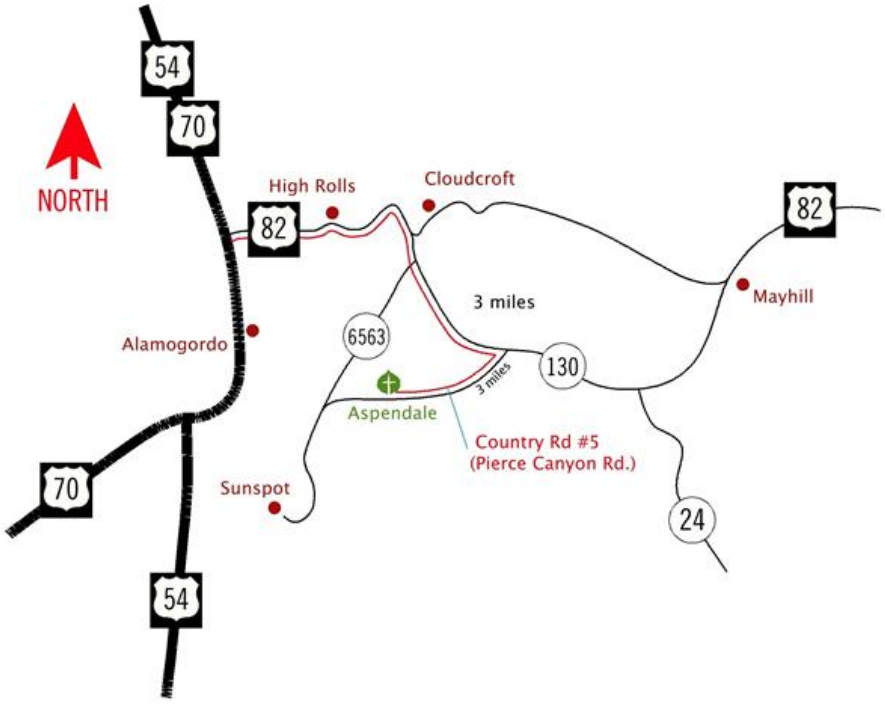


Figure 3: Map of location of Aspendale Mountain Retreat Center

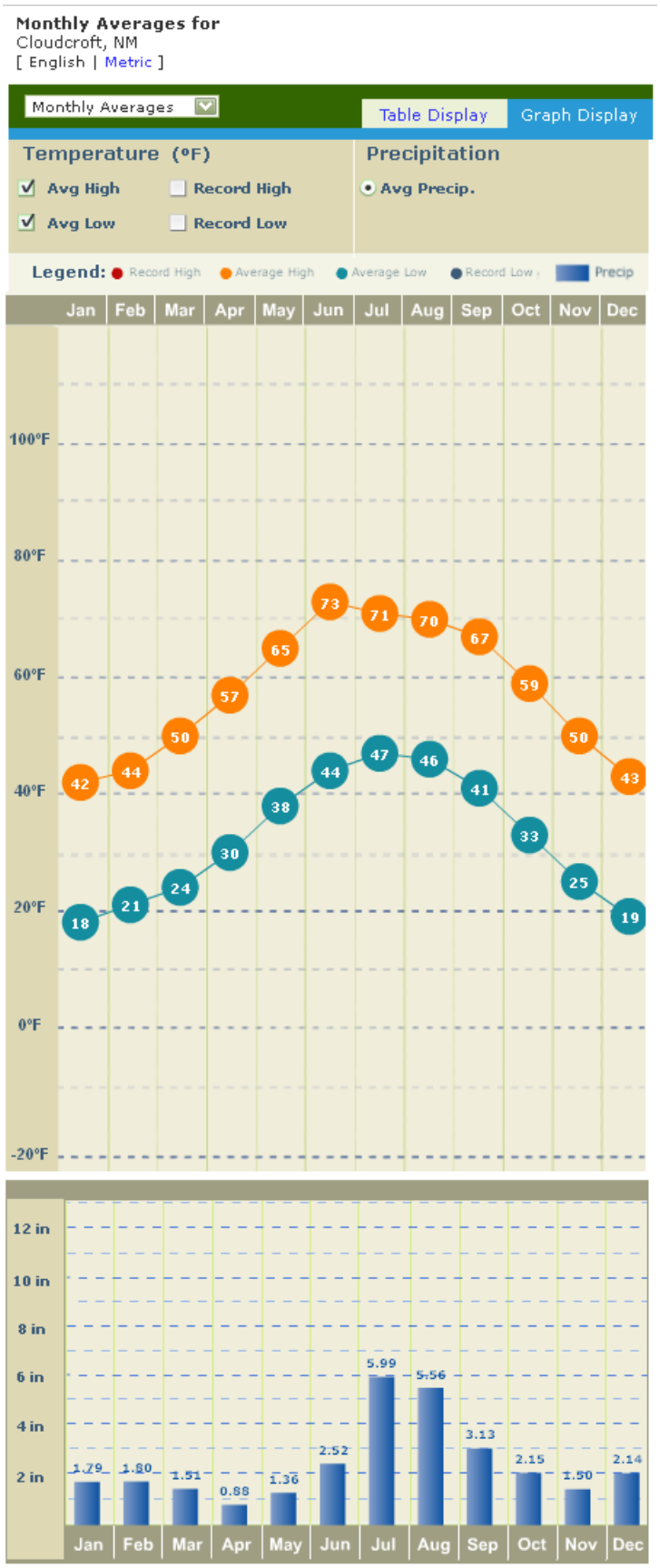


Figure 4: Average Monthly Temperature Highs and Lows and Average Rainfall for Cloudcroft, NM

Cloudcroft, New Mexico

Average Monthly Rainfall and Snowfall (inches)

Month	Average Rainfall	Average Snowfall
Jan	1.68	14.3
Feb	1.90	14.5
Mar	1.54	11.4
Apr	0.84	2.3
May	1.35	0.6
Jun	2.21	0.0
Jul	6.10	0.0
Aug	6.04	0.0
Sep	3.11	0.0
Oct	1.78	3.1
Nov	1.58	6.3
Dec	2.33	18.3
Annual	30.46	70.9
Winter	5.92	47.2
Spring	3.74	14.4
Summer	14.34	0.0
Fall	6.46	9.4

Figure 5: Monthly Average Rainfall and Snowfall for Cloudcroft, NM

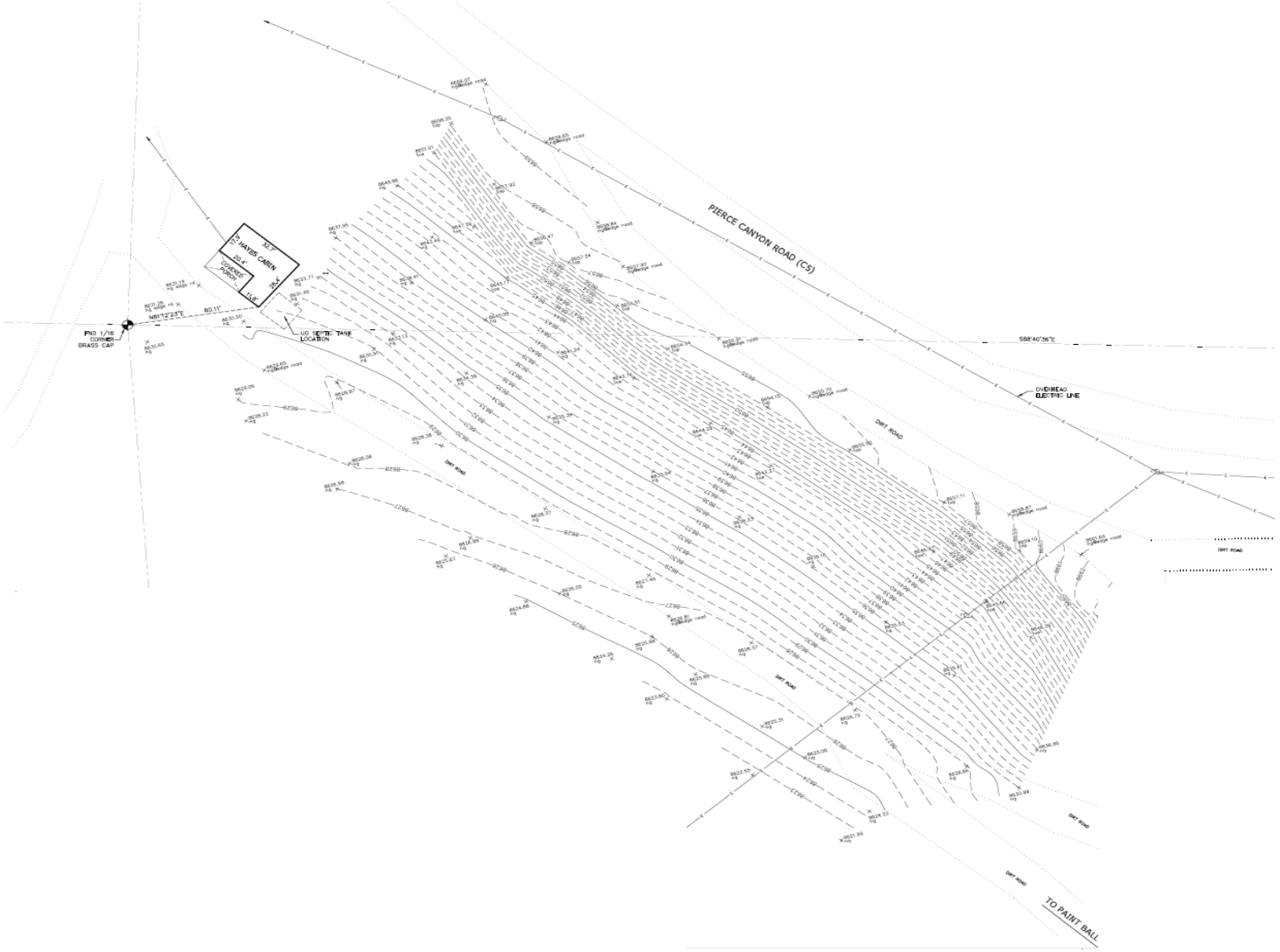


Figure 6: Zoomed in Topographical map (Original Below)

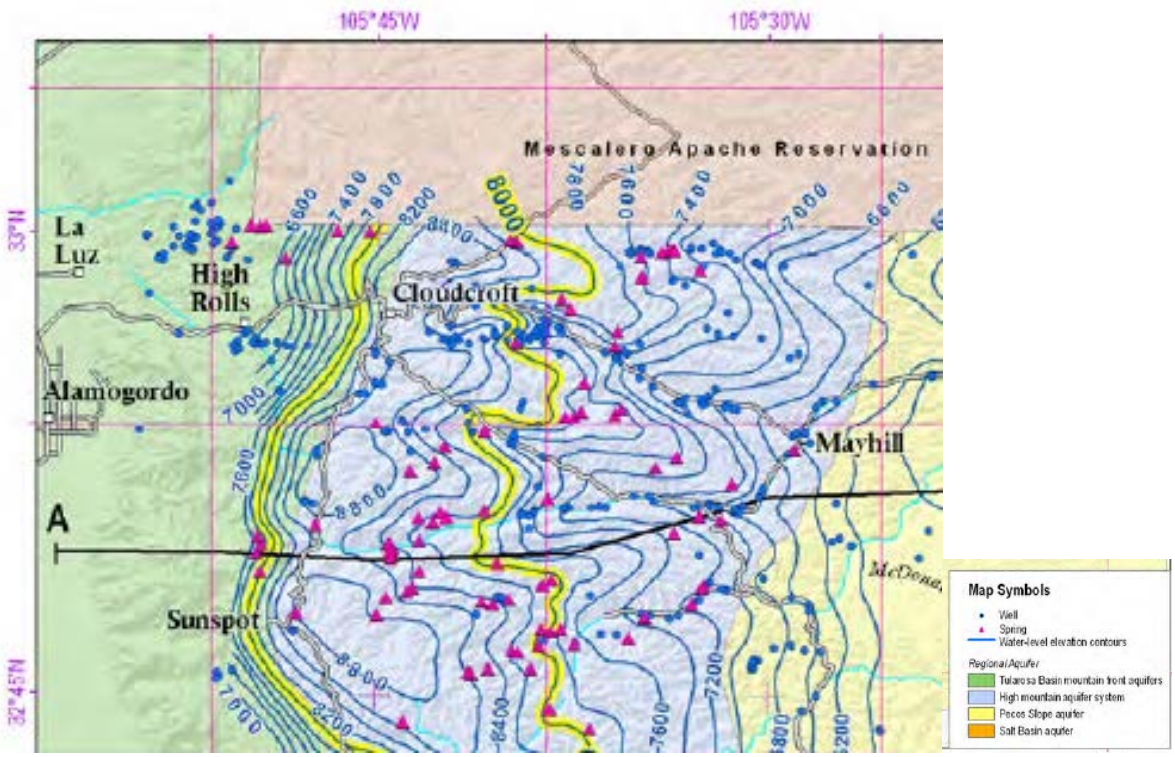


Figure 7: Sacramento Mountain Hydrology Study, water level elevations

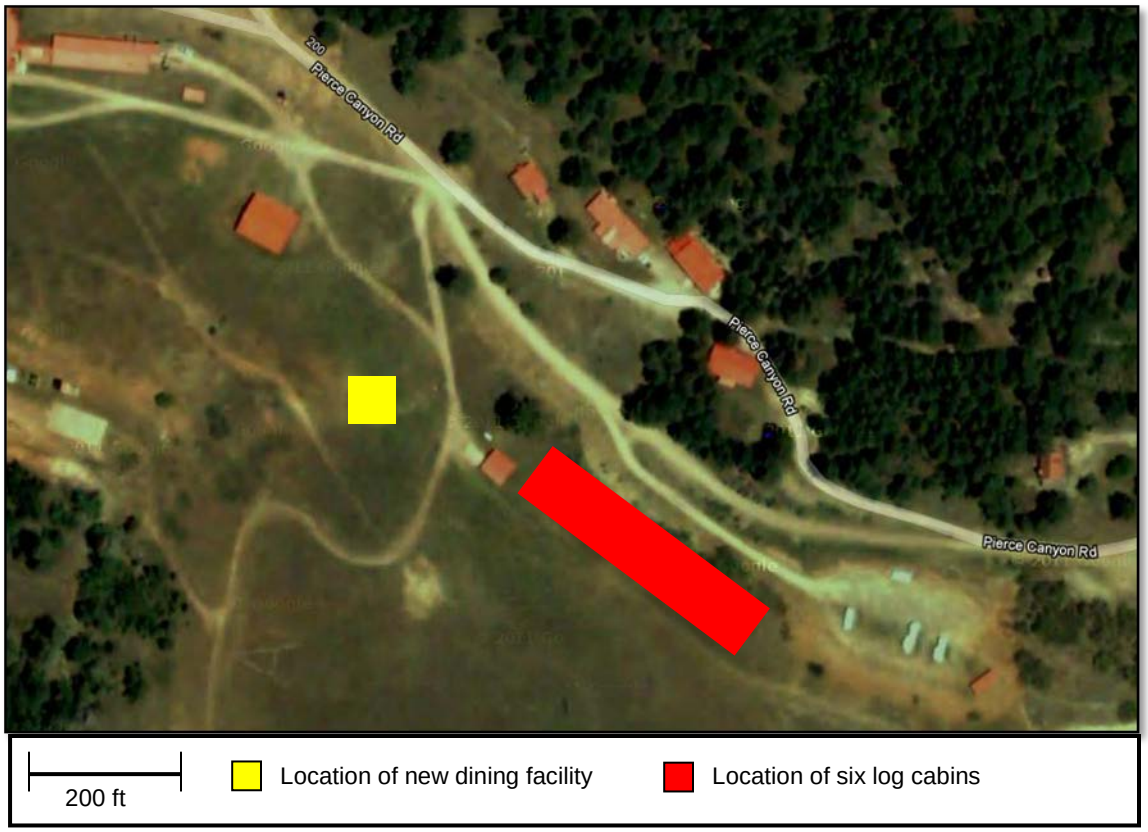


Figure 8: Map of Aspendale Mountain Retreat Center defining approximate location of new dining facility and six log cabins.

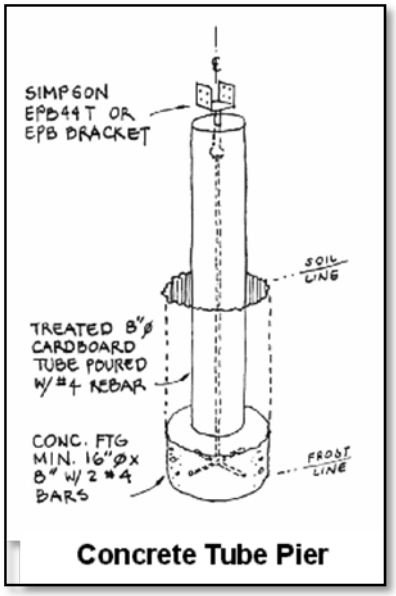


Figure 9: Concrete Pier and Beam Footing

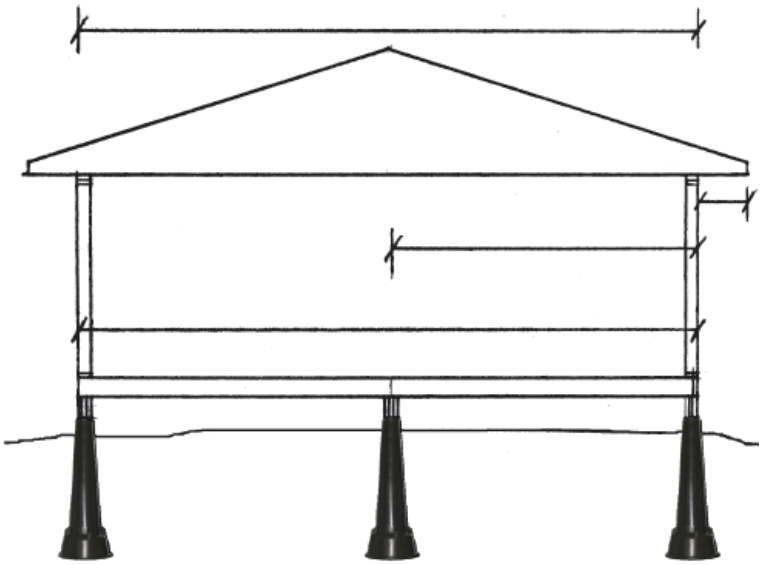


Figure 10: Alternative Footing

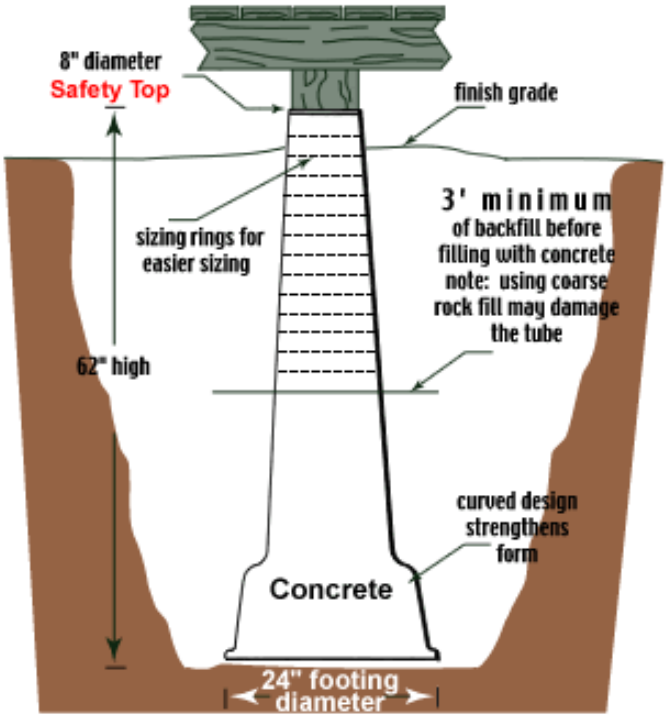


Figure 11: The Footing Tube

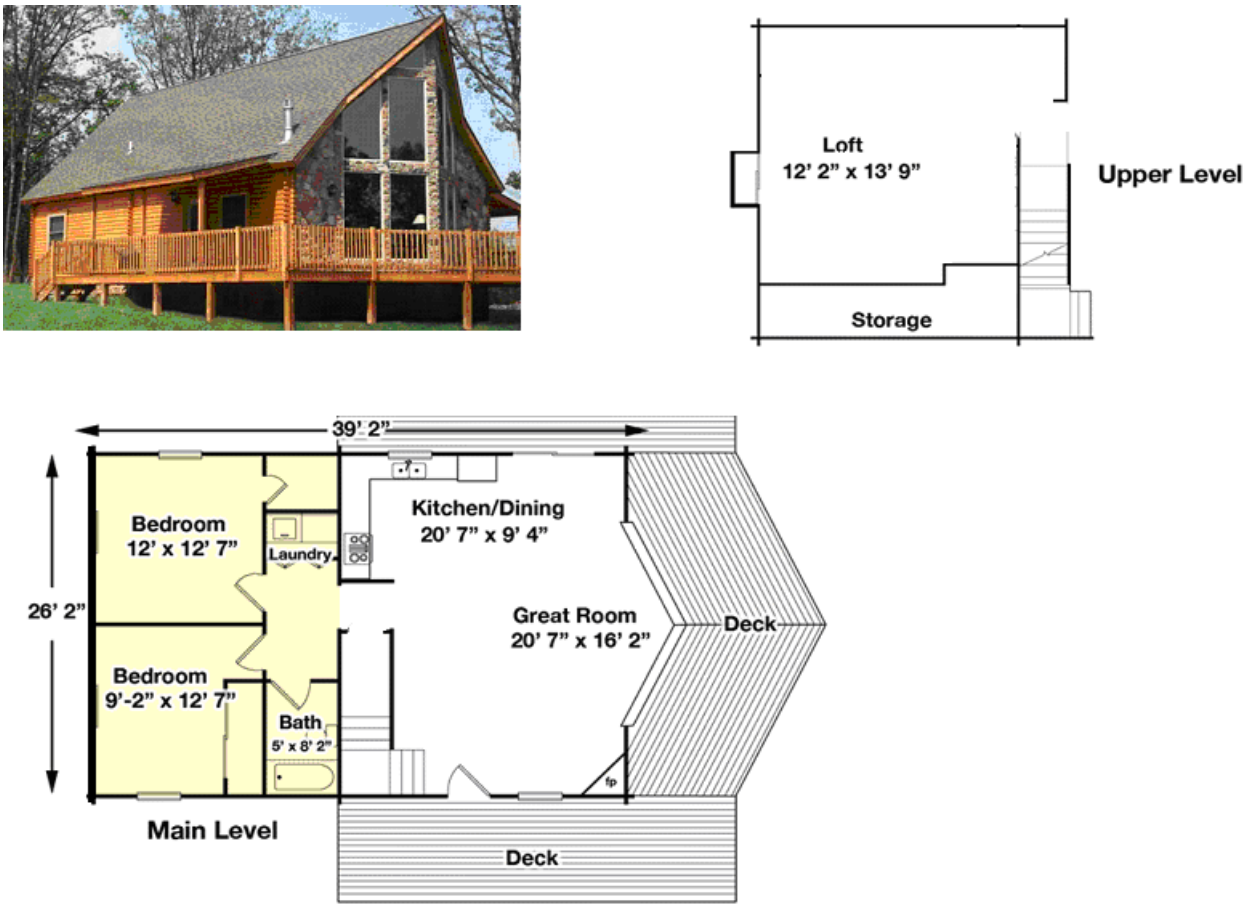
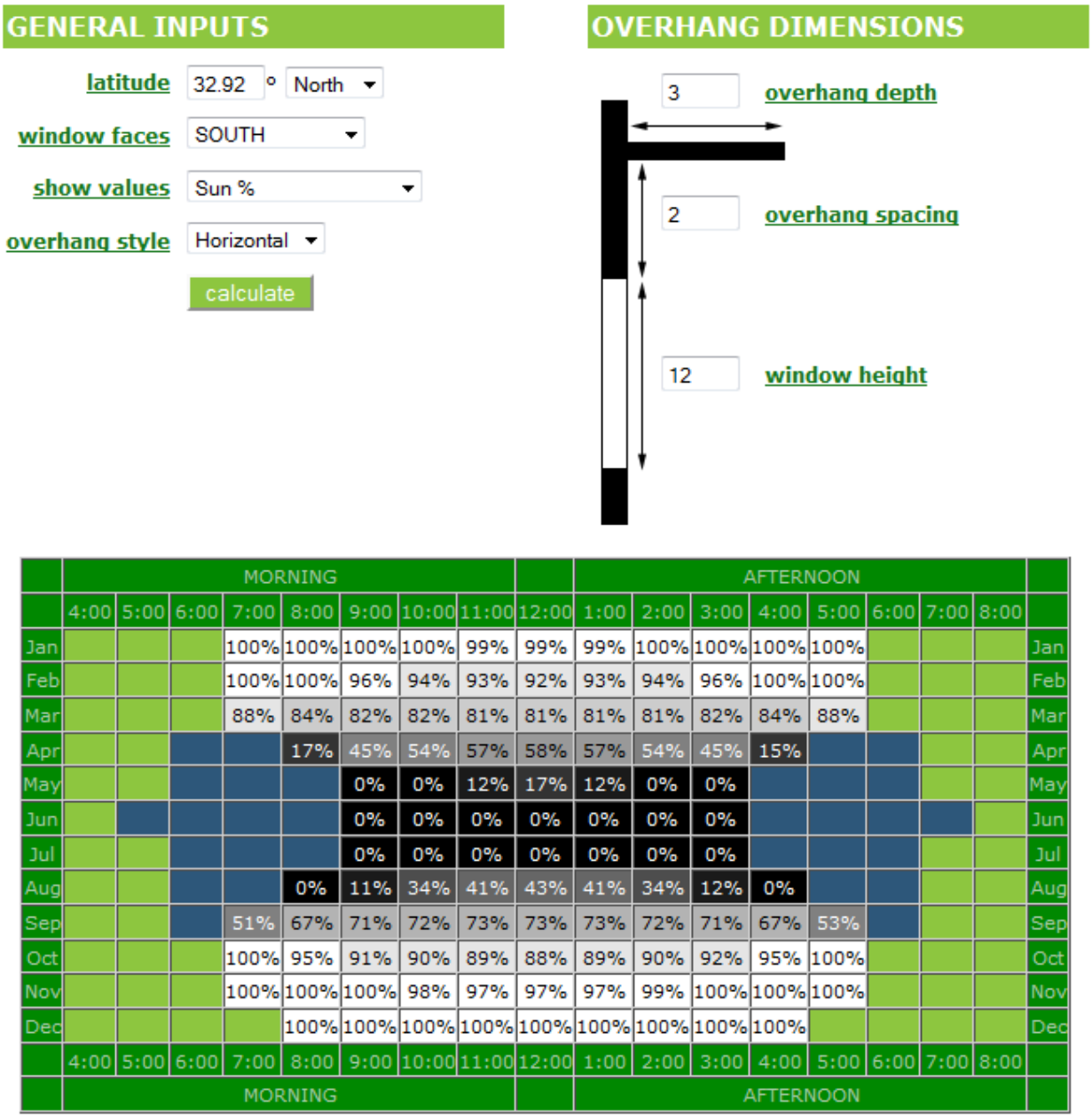


Figure 12: Alpine Ridge Cabin Design and Layout



	MORNING									AFTERNOON								
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	
Jan				100%	100%	100%	100%	99%	99%	99%	100%	100%	100%	100%				Jan
Feb				100%	100%	96%	94%	93%	92%	93%	94%	96%	100%	100%				Feb
Mar				88%	84%	82%	82%	81%	81%	81%	81%	82%	84%	88%				Mar
Apr					17%	45%	54%	57%	58%	57%	54%	45%	15%					Apr
May						0%	0%	12%	17%	12%	0%	0%						May
Jun						0%	0%	0%	0%	0%	0%	0%						Jun
Jul						0%	0%	0%	0%	0%	0%	0%						Jul
Aug					0%	11%	34%	41%	43%	41%	34%	12%	0%					Aug
Sep				51%	67%	71%	72%	73%	73%	73%	72%	71%	67%	53%				Sep
Oct				100%	95%	91%	90%	89%	88%	89%	90%	92%	95%	100%				Oct
Nov				100%	100%	100%	98%	97%	97%	97%	99%	100%	100%	100%				Nov
Dec					100%	100%	100%	100%	100%	100%	100%	100%	100%					Dec
	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	
	MORNING									AFTERNOON								

Figure 13: Passive Solar Required Design for Optimum Sun

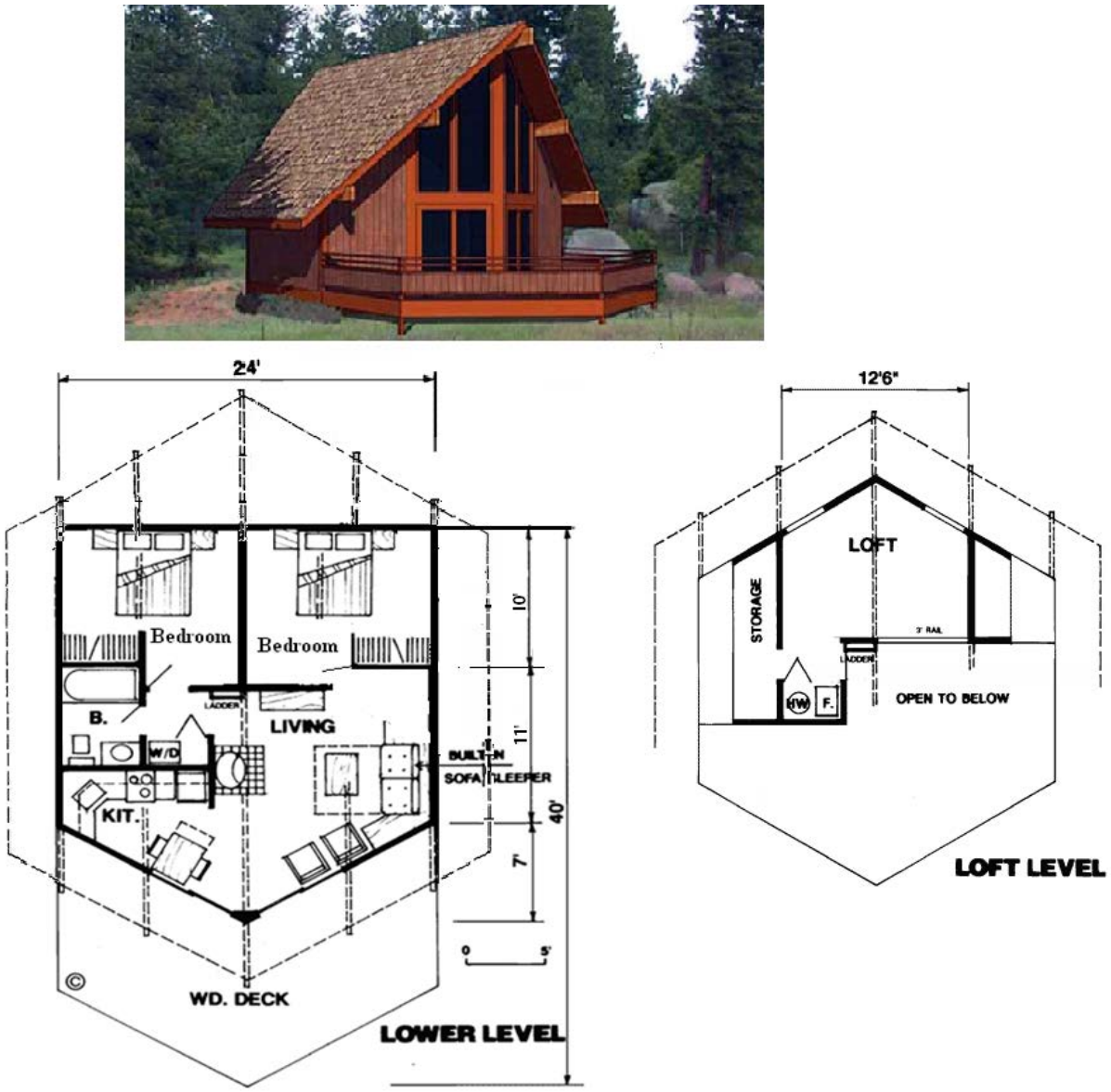


Figure 14: Hexagonal Cabin Design and Layout

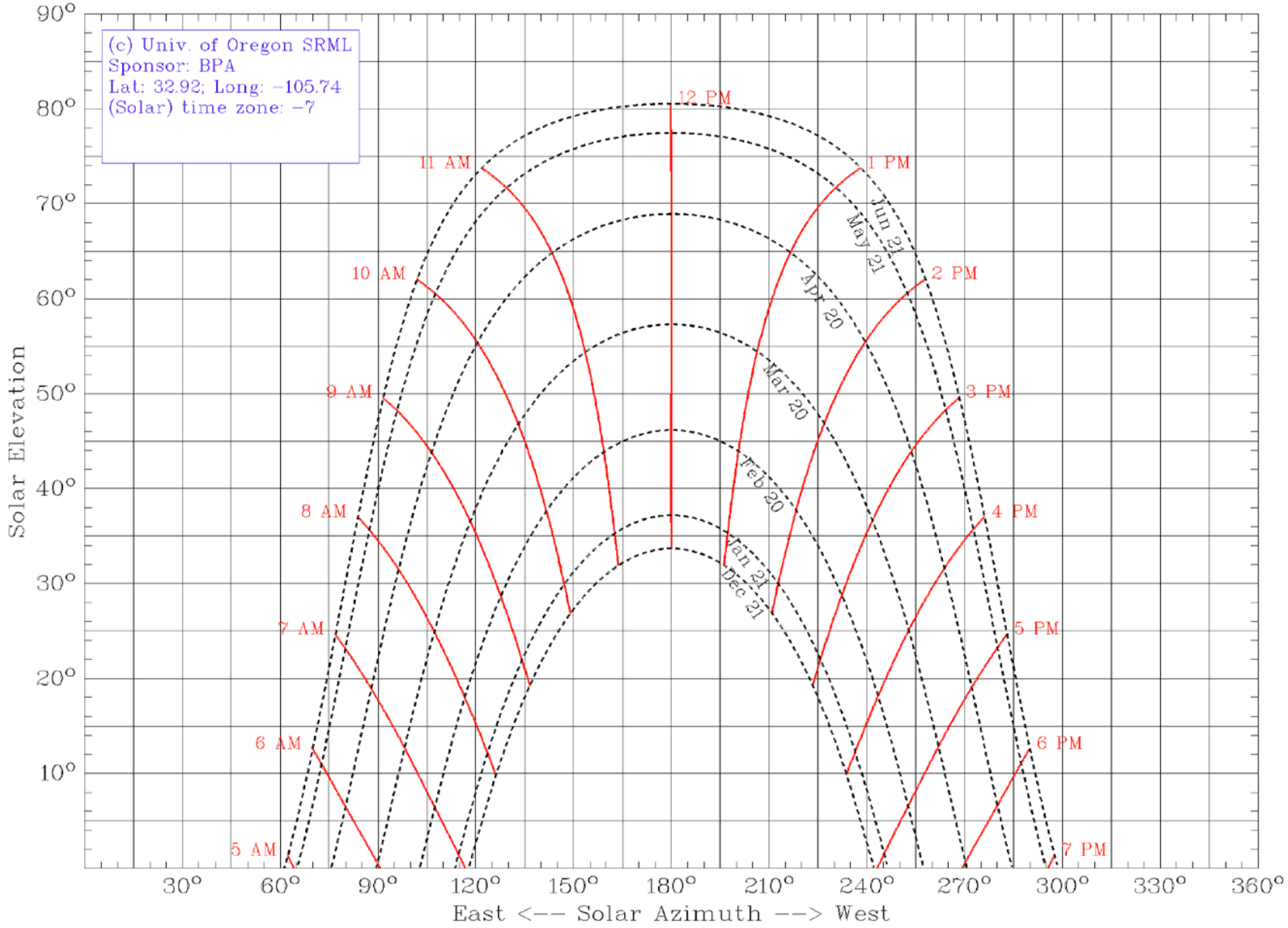


Figure 15: Solar Angle of Sun with respect to site location

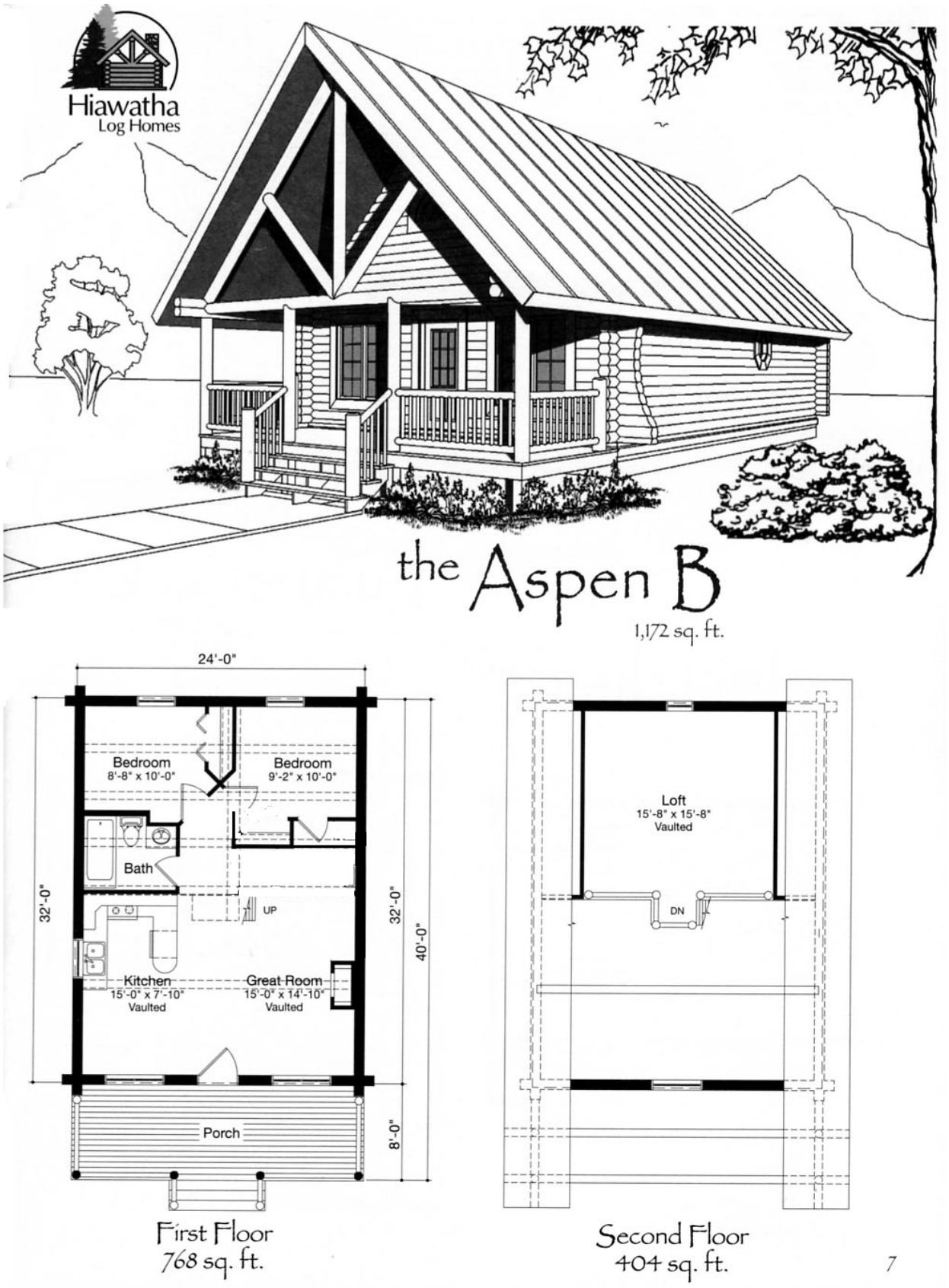


Figure 16: Aspen B cabin design and floor plan

Figure 17: Eco-Friendly California Cabin Design and Layout

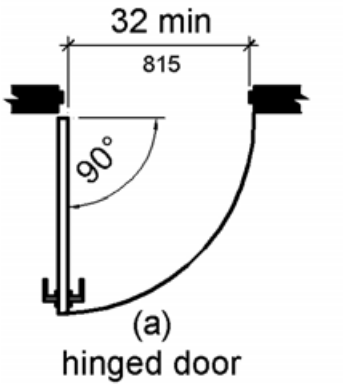


Figure 18: Door minimum requirements

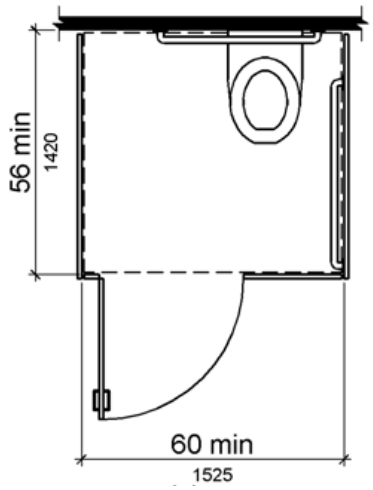


Figure 19: Clearance around a water closet

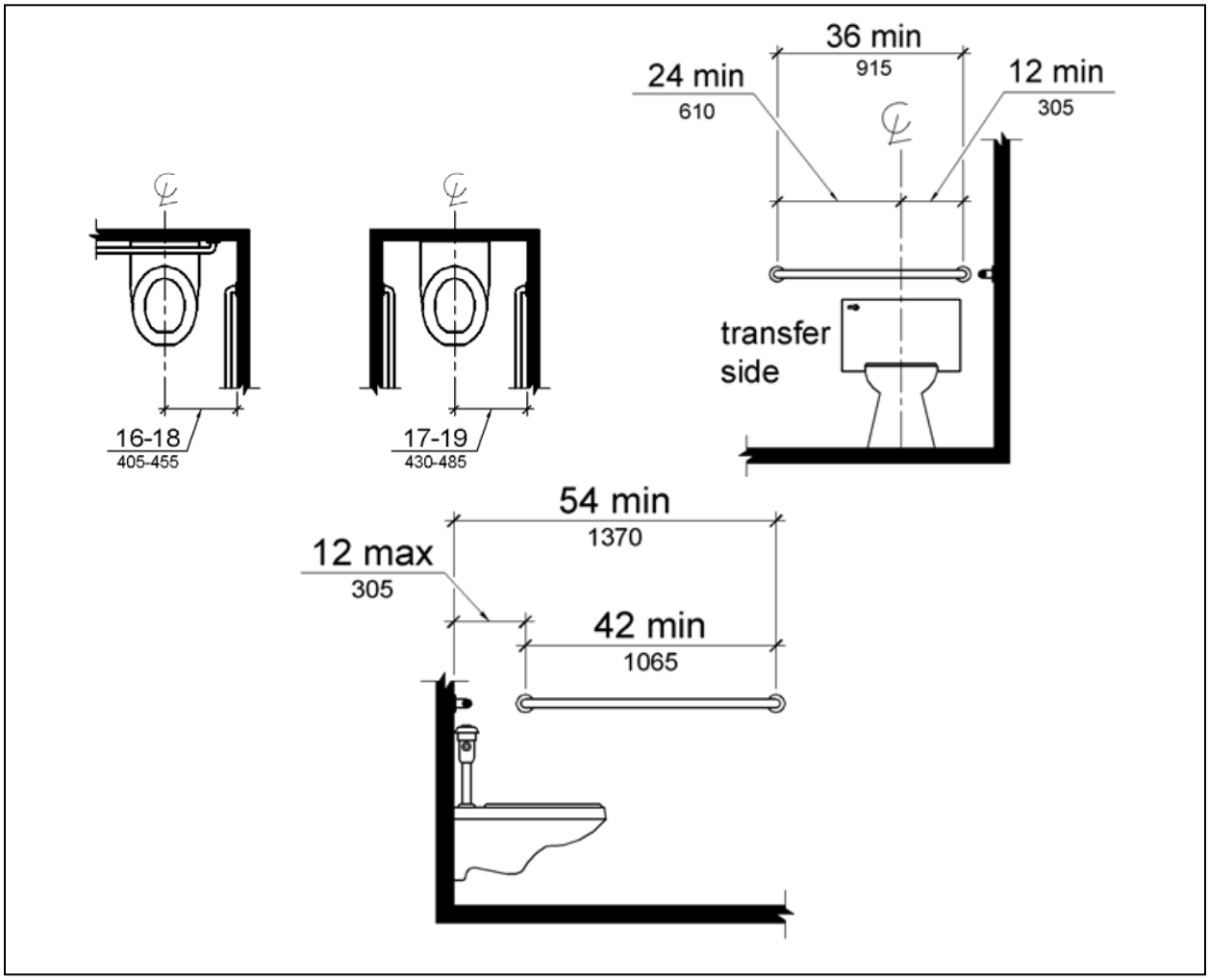


Figure 20: Lavatory facility specifications

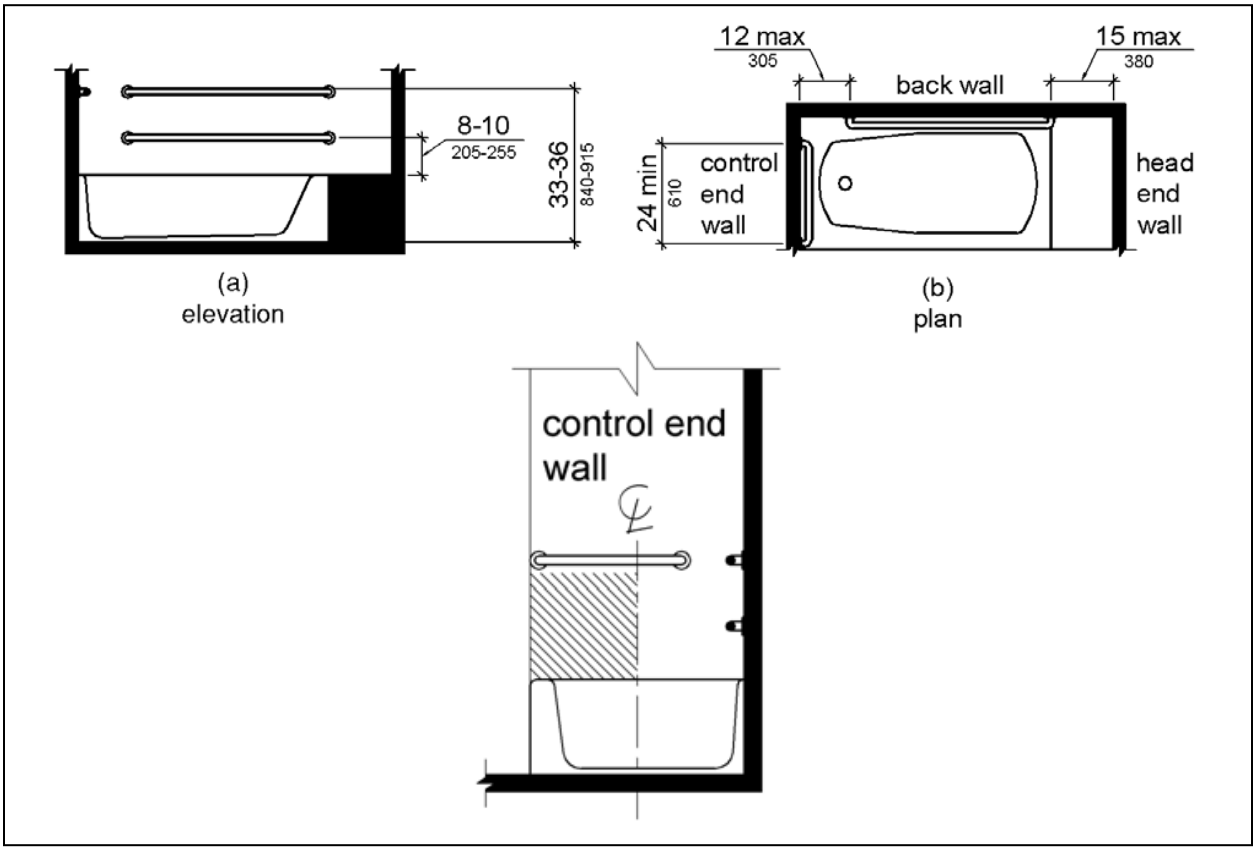


Figure 21: Bathtub specifications

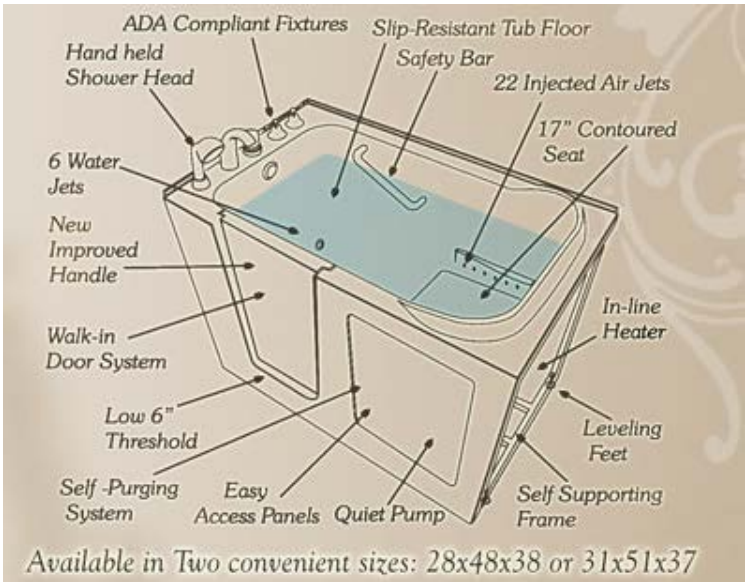


Figure 22: Hydro ease handicap accessible bathtub from Remain Active

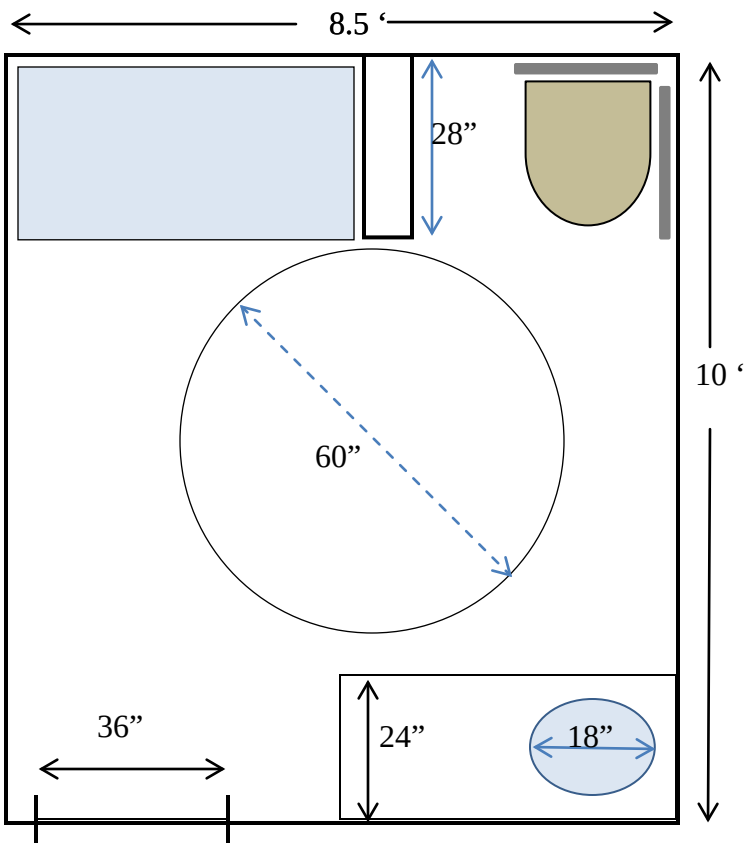


Figure 23: Modifications made in bathroom

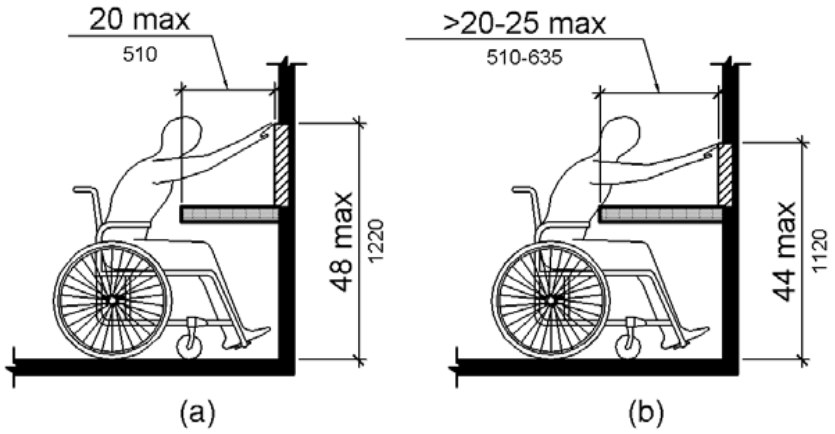


Figure 24: Reach over an obstruction

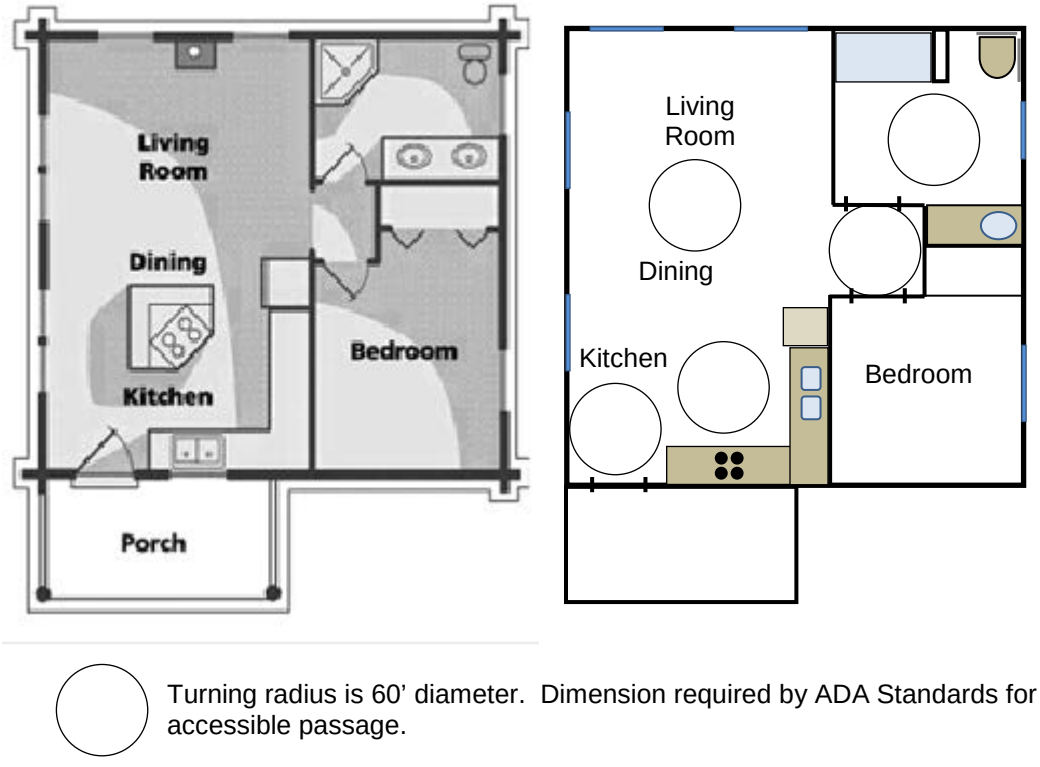


Figure 25: Changes made in handicap accessible cabin

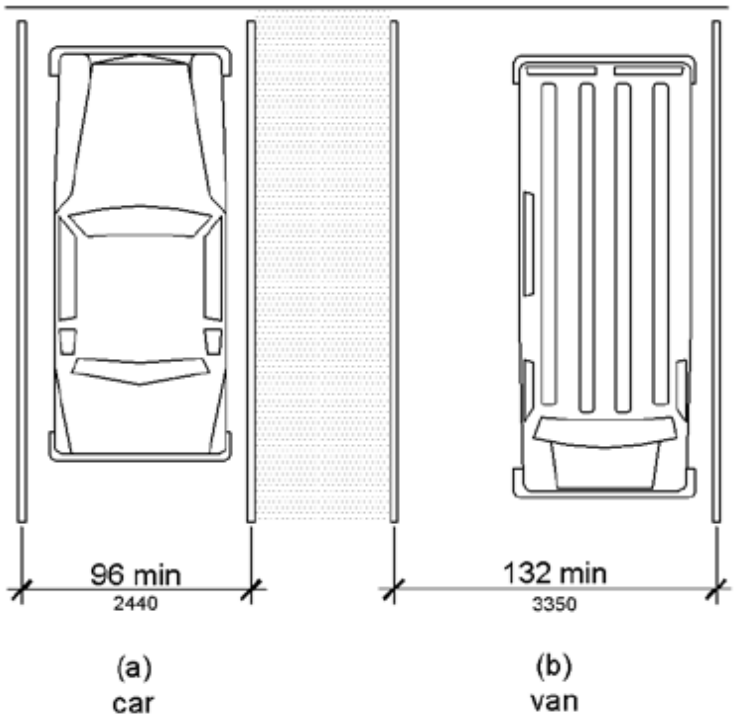


Figure 26: Dimensions for Parking Lot

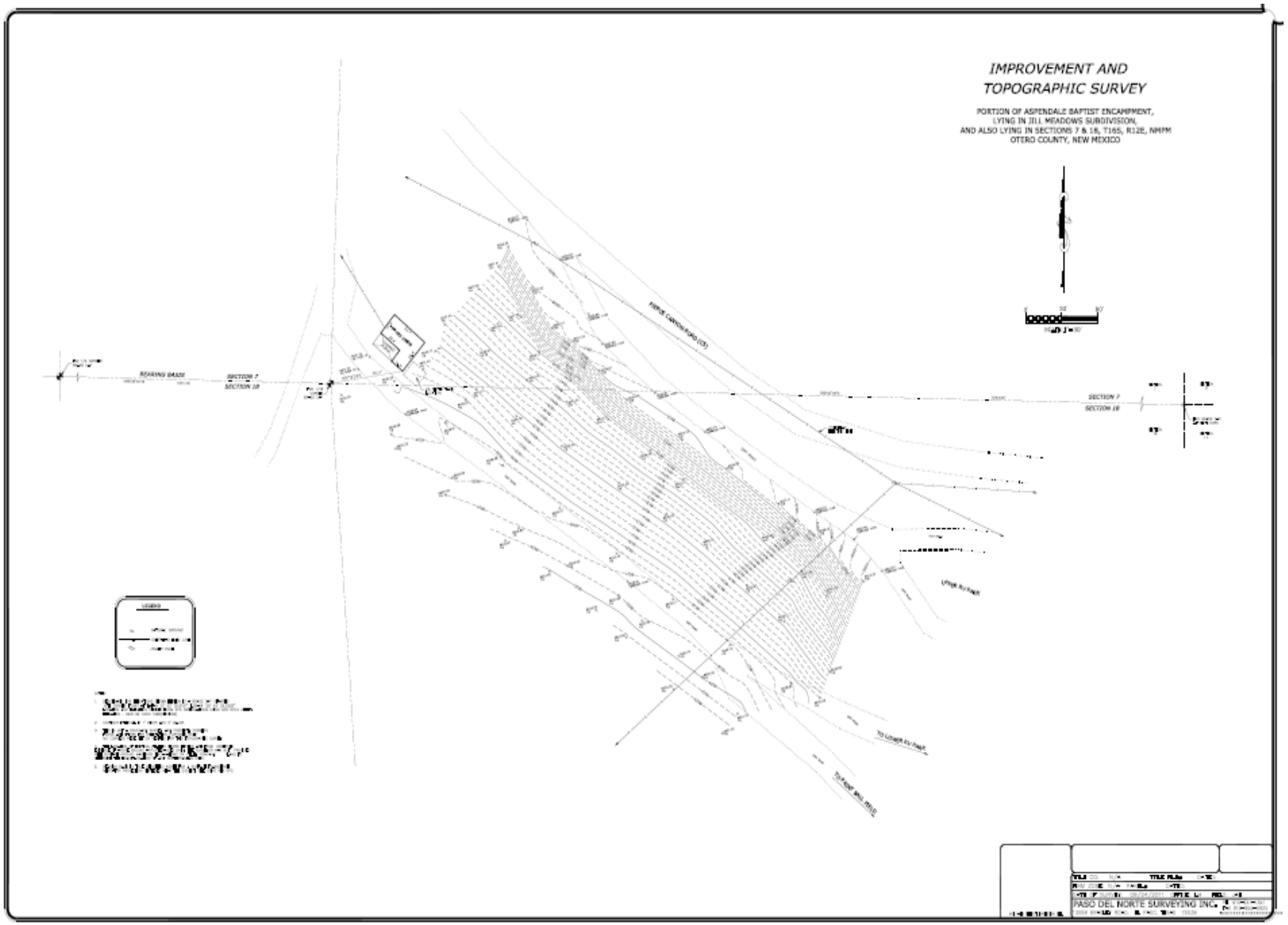


Figure 27: Topographic Profile of Cabin Site (J.Eby, personal communication, October 31, 2011)

Acknowledgments

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