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ABSTRACT

The purpose of this project is to outline a potential design for a retirement village. The village must have at least three LEED gold buildings. In pursuit of final design, the two of us have spent quite some time researching land sites, demographics, green architectural design ideas, and LEED credentials.

Figure 1: Desired LEED accreditation

We wanted to ensure that our buildings all meet the LEED-gold standards while also providing a safe, visually appealing, and comfortable retirement facility for future residents. This meant that we had to delve into the specific details of our site and the surrounding region.

SITE LOCATION/TOPOGRAPHY

After conducting research about different locations throughout the country, we decided to design our village in Scottsdale, Arizona. The first major contributing factor for the location choice was overall climate. It is important that our village is located in an area that will be comfortable for retired individuals who are likely 60 years of age and older. This led us to begin to research warm regions such as Florida, Texas, California, Arizona, and the Carolinas. We decided to rule out Florida and the Carolinas because of the prevalent humidity. Extreme humidity can greatly reduce comfort. Arizona can get quite hot, however, the humidity is almost none existent. This makes the heat very tolerable. Also, 60-75 percent of days are sunny days (dependent upon month). Sunny regions are proven to have positive effects on overall mood.

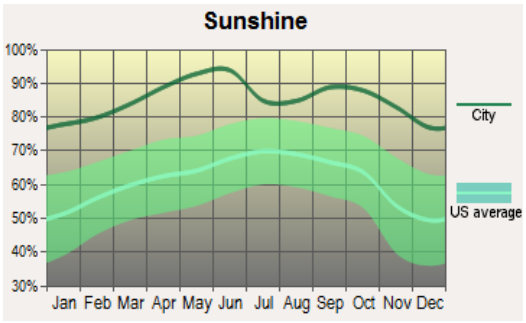

Figure 2: Daily sunshine in Scottsdale, Arizona

The second factor that we examined when choosing the location of our village was median age. The last thing we wanted to do was design a retirement facility in the middle of an area that is comprised of all young adults. It is important that our residents feel comfortable in the area that they live in.

Other factors that we considered were safety (crime rates), availability of land, and land topography. We wanted to ensure that we could find a piece of land that is around 5 acres and is relatively flat.

Figure 3: Birds Eye View of Property

We were able to find a piece of land that is flattened, undeveloped, and is 200,376 square feet. The development will be on N 74th Street, Scottsdale, Arizona, 85266. This location has an average temperature of 72.5 degrees Fahrenheit. According to Dr. Rudge of London Metropolitan University, the most comfortable temperature for people over 65

years of age is 69.8 degrees Fahrenheit. To avoid health issues in elderly residents, it is critical to maintain temperatures between 64 and 75 degrees Fahrenheit. Scottsdale is an ideal climate for an older community to live in.

DEMOGRAPHICS

One of the most important sets of data that we had to analyze was the demographics of the area that we planned to build upon in Arizona. We discovered that there was an even distribution of men and women and the average age is 44.7 years. The population is on the older side and isn't bias to one gender, which is good for retirement purposes.

Figure 4: Sample Image of our proposed property

The average yearly household income in Scottsdale Arizona is $69,000. This is significantly higher than the rest of Arizona, which has a yearly average household income of $48,000. This is good sign because it generally correlates to lower crime and higher standards of living. The crime index in Scottsdale Arizona is 163. This is incredibly low compared to the average crime index in the rest of the country, which sits at 291 currently. These are aspects of residential areas that older citizens tend to value highly.

LOCAL SERVICES/CONVENIENCES

One of the key components of a successful retirement community is the availability of surrounding amenities and services. We had to do some research about the location we chose to make sure that things such as public transportation, groceries stores, healthcare services, shopping malls, gas stations, airports, trains, and other services are available to residents.

Figure 5: Our Property Relative to Phoenix, Arizona

In terms of transportation, there is an airport in both Scottsdale and Phoenix, Arizona. Phoenix, Arizona is approximately 12 miles west of Scottsdale. There are three Amtrak stations in Phoenix. In regards to healthcare, there are numerous hospitals, nursing homes, dialysis facilities, and home health centers. There are two libraries in Scottsdale that are available to the public. There are multiple groceries stores within a two-mile radius.

For the residents that enjoy playing golf, gambling, swimming, shopping, walking through parks, visiting spas, and watching movies, there is plenty to enjoy in Scottsdale.

BUILDING SITE LAYOUT

Our site currently stands as a leveled residential lot. The construction status right now is raw land. This is perfect for our village because the land is ready to be built on. There is also plenty of space and some natural vegetation to take advantage of. All the utilities are on or near the property already. There is currently water, electricity, and gas on site. Sewage would need to be added.

The buildings will be set up in order. The buildings to the far left and far right will be residential buildings. The third building will split the two residential buildings and will serve as a visual centerpiece upon entrance of the property. (see Figure 6) To the direct sides of the central building are two parking lots that are hidden from the main street. Our design fits within the 200,376 square feet that our property contains.

Figure 6: View from above our Village

We did some research and discovered that Bermuda grass is capable of growing in Arizona. To increase the curb appeal of the property, we installed Bermuda grass and various plants.

Figure 7: Property Entrance Western View

In regards to LEED, all three buildings were design using LEED V4 for Neighborhood Development.

FIRST RESIDENTIAL BUILDING

Figure 8: Northern View of Building One.

The first residential building (far left in figure 6) is a three-story, 24,324 square foot building containing 12 units. Each of the three floors feature 4 single bedroom units with mirrored layouts.

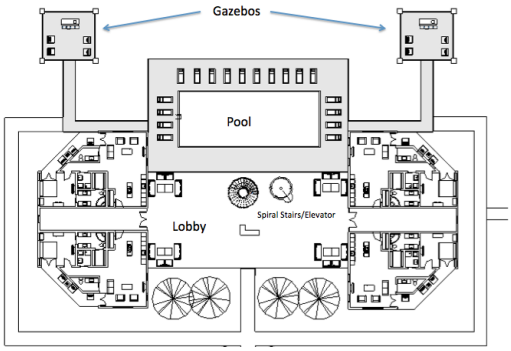

Figure 9: Building #1 Floor plan

The living quarters are located at each of the four corners of the main building. Each unit has its own private balcony.

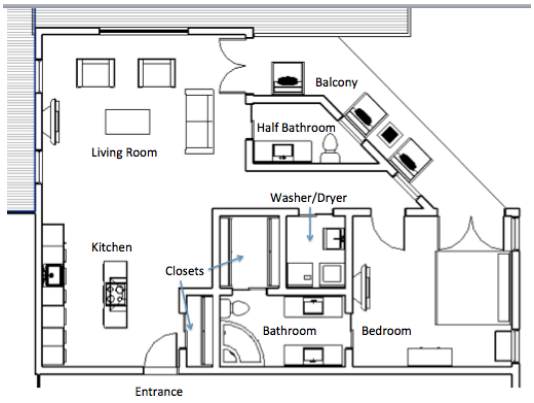

Figure 10: Closer view of Single Unit

The image above provides a better view of a sample unit from the first building. Each unit has a full kitchen with a coat/shoe closet. The kitchen area opens up to the living room area that comfortably sits five people. Just down the hall sits the washer and dryer room that is directly adjacent to the half bathroom. At the end of the hall are doors to the balcony and bedroom. The master bathroom and walk-in closet are both within the master bedroom living quarters. Each unit is approximately 1,600 square feet.

Figure 11: Building One Rendered Living Room

The lobby of the first residential building contains multiple lounges and a front desk. An elevator allows for access to all three floors and the roof level. Each floor has a lobby with lounge chairs, tables, and televisions. The green roof/resident patio features outdoor seating and a gazebo to relax in.

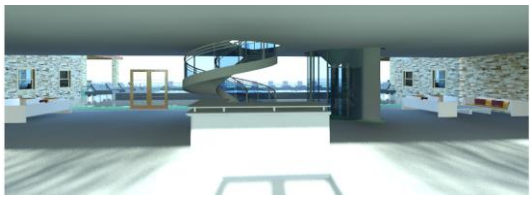

Figure 12: Building One Rendered Lobby

All floors within the unit are hard wood and the walls are painted in neutral tones. Stonewalls are featured in the units to tie in the outside theme of each building. These walls also help to keep the units cooler throughout the hot summers by retaining excess heat. To further maximize thermal efficiency, we will be installing thermal windows. Each glass window on the property will be a Heritage Thermal Break Window. These windows are durable, aesthetically pleasing, and they provide maximum thermal efficiency by implementing the latest polyamide thermal break.

The entire building will feature an automated HVAC system that will adjust the heating and cooling system to maintain comfort while limiting energy consumption. The center strip of the roof, as previously mentioned, features a thermal mass consisting of Bermuda grass that is capable of growing in extreme heat. This green roof will also help maintain internal building temperatures at comfortable levels. The roof will have numerous layers, each with a specific purpose.

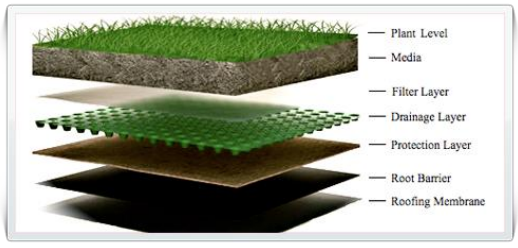

Figure 13: Green Roof Layers (Used in Revit)

The front of the building (southern side) has large windows guarded by white ash trees (capable of surviving in warm climates). This will help to break up the intense southern light during daytime hours.

Through the back of the lobby are doors to the outdoor pool area. Two outdoor gazebos feature lounge chairs and fans for the residents to utilize when the weather is nice.

CENTRAL BUILDING

Figure 14: Rendered Central Building

The smallest of the three buildings (approximately 6,533 square feet), the central building, sits at base of the village. The entrance features an extended pavilion that allows for residents to drive up and drop off others without getting wet on rainy days.

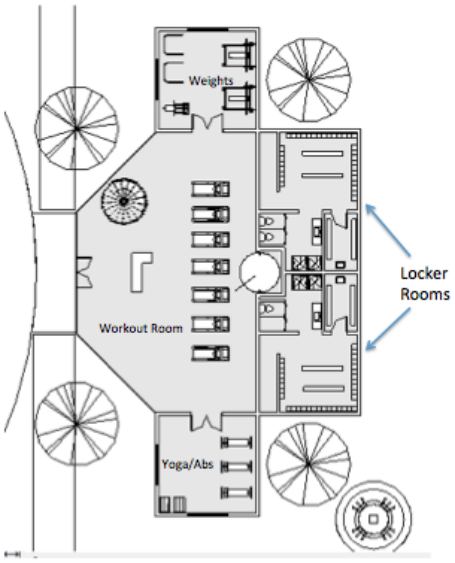

Figure 15: First Floor Central Building

The main doors to the building open up to the workout area with an open ceiling view to the second floor. The exercise facility consists of a main room with treadmills and benches. Two side rooms can be used for stretching or

abdominal exercises. There are also pull down machines, free weights, and stationary bicycles. Like the first building, the central building features hardwood floors, spiral staircases, and large glass panes to maximize light efficiency.

Figure 16: First Floor Exercise Area

There are two locker rooms on the first floor. Both rooms contain lockers, benches, bathrooms, and a spa.

Figure 17: Second Floor Rendered Interior

Up the elevator or stairs that are adjacent to the entrance takes residents to the second floor. A bridge walk way allows for a view to the lower level. There are two rooms on this floor. The first is a room for residents to play board games or cards. There is a felt table and a television for side entertainment. The second room holds a grand piano for those who enjoy playing or listening.

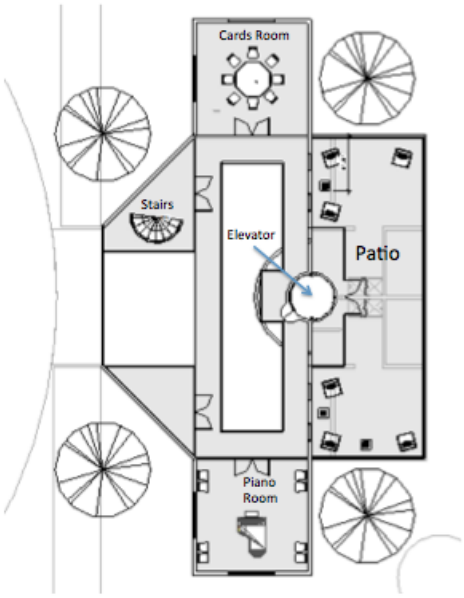

Figure 18: Second Floor Central Building

The back doors of the second floor open up to an elevated porch with dining tables and lounge chairs.

Figure 19: Southeastern View of Central Building

This building is intended to be a gathering place for residents who can gather for special occasions. At the same time, this building provides a spa and contains exercise equipment downstairs. We wanted this building to be able to incorporate both nice gathering areas inside and outside, as well as exercise and spa facilities.

SECOND RESIDENTIAL BUILDING

Figure 20: Southwestern View of Cactus Building

The second resident building (38,688 square feet), on the right side (southern side) of the property, also contains 12 units. However, these units each have two bedrooms.

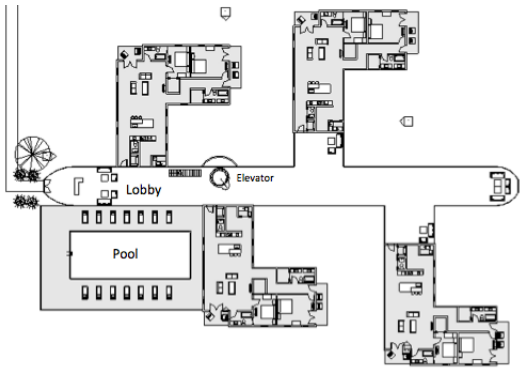

Figure 21: Cactus Building Layout

Each of the four branches of the cactus shape are units. The lobby opens up on the southwestern side to a 5 ft deep swimming pool. Because of the location, we decided to design this building in the shape of a cactus. The central hallway contains large windows (see Figure 17 for windows) that allow for maximum natural light to reduce energy consumption. This building features a full size elevator and a set of stairs. Each floor has a lobby with lounges and televisions.

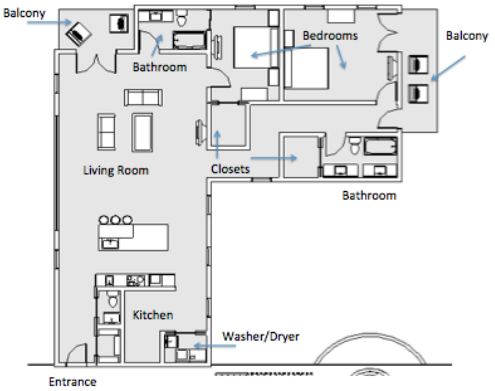

Figure 22: Sample Unit in Cactus Building

Each unit opens into the kitchen area. Beyond the kitchen (that contains the washer and dryer room), is the living room. From here the first balcony, the guest bedroom, and both bathrooms are accessible. The master bedroom and attached balcony complete the units. Each two-bedroom unit in this building contained a little over 2,000 square feet.

Figure 23: Lobby Western Entrance

The interior design of these units, much like the units in the adjacent building, have an open, modern vibe. The cool colors and light exterior shades help to keep the building at comfortable temperatures throughout the year.

Figure 24: Interior Unit Living Room

ARCHITECTURAL STYLE

Our communities architectural style could best be described as a combination of Spanish and colonial style architecture. We

We wanted to stick to the roots of the region and use local materials and styles when designing our buildings. We decided to use red Spanish clay tiles that are made locally for the roofs of our buildings.

Figure 25: Example of Spanish Colonial Style

A basic off white stucco was used for the top half of the exterior walls of each building. Below the stucco we changed it up a bit to add some contrast. The multi-colored stone exterior was applied to the lower halves of the buildings and was also used in the design of the bridge. This bridge allows for safe walking access across the property. These features help us to meet the necessary LEED requirements.

GREEN DESIGN FEATURES

The first green design feature that we implemented was a green roof on the first residential building. As previously stated, this roof is comprised of multiple layers and will not only serve as a nice natural habitat and resident hang out area, but it will also help to improve energy consumption by stabilizing internal temperatures. During rare spurts of heavy rain, this roof will also help reduce run off and will allow for the recycling of rainwater through a filtration system beneath the bottom layer. The layers of the Revit designed green roof can be seen in Figure 13.

	Function	Material	Thickness	Wraps	Structural Material	Variable
1	Structure	Grass	0' 2"			
2	Structure	Earth	0' 4"			
3	**Core Bound**	**Layers Abo**	**0' 0"**			
4	Structure	Air Infiltra	0' 1"			
5	Structure	Plastic -	0' 2"			
6	Structure	Laminate	0' 1"			
7	Structure	Moisture	0' 1"			
8	**Core Bound**	**Layers Belo**	**0' 0"**			

Figure 26: Green Roof Layers

Also, as stated earlier, large thermal windows are featured in each of the three buildings. These windows reduce lighting costs and provide plenty of natural light for residents. The windows will be purchased locally from Thermal Windows Inc. This group is located just 50 miles southeast of our location and has a huge assortment of thermal windows to choose from.

On the southern side of the largest building is a roof mounted solar array. We used pvwatts.nrel.gov to find the ideal angle to keep our modules at in order to allow for the maximum amount of solar energy absorption. We discovered that in Scottsdale Arizona, the optimal tilt of the south facing solar panels is approximately 32 degrees.

Figure 27: Example of Roof-Mounted Solar Array

We calculated that our current array can supplement approximately half of the cactus building's energy. There is also more space available on the main portion of the building's roof that could support a much larger array. Granted, this would increase start up costs and increase the inverter size.

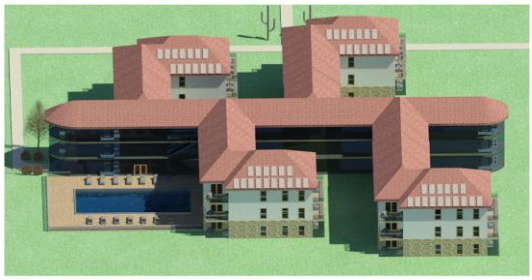

Figure 28: Solar Array on Cactus Building

Each building will be equipped with fluorescent, power saving bulbs with motion sensor bulbs in specific rooms. They will also all have automated HVAC systems to reduce energy consumption.

Many of our building materials, such as the stone, stucco, roof tiles, windows, and paints are all locally produced and locally sold (within 60 mile radius).

LEED COMPLIANCES

In order to achieve the desired goal of designing three LEED gold buildings, we needed to earn a total of 60-79 overall points.

Central Building

When reviewing the LEED checklist, we broke down the list by sections. In the first section, Smart Location and Linkage, we determined that we fulfilled the point requirements for numerous sub categories; For example, we installed bike racks and small trails throughout our campus. We also met the requirements for green vehicles by adding parking specifically these vehicles. Because of our proximity to Phoenix, we were able to score 24/28 points.

In the second section, Neighborhood Pattern and Design, we scored 27/41 possible points. Our design implemented walkable streets (with safety bridge), transit hubs, and easy access to recreational facilities. These points can also be attributed to our use of local and recycled materials that are used throughout the property (windows, stucco, roof tiles, etc.). Our interior lighting and large windows, clean building materials, and quality views all helped earn our central building points.

In the third section, Green Infrastructure and Buildings, we scored 9/30 points with our design. The only place that we plan to not earn points is in the cooling tower water use section. This is because there is simply not enough rainfall in Scottsdale, Arizona. The rainwater we do collect will be used to reduce our indoor/outdoor water use. To supplement our efficiency, we plan to monitor the water consumption around the clock. By reducing the overall power consumption by 40 percent, we earned points. We accomplished this by designing the central building to need absolutely no artificial lighting during day time hours. Also, the more we can save with our solar array, the more we can earn towards LEED. We earned all the points for renewable energy production because of our solar panels.

In the final category, Innovation, we scored all 5 points. The way we designed the central building to utilize the space for numerous activities and allow for an open feeling earned us these points. We also implemented features such as glass encased elevators and spiral stair cases that help to save space while improving aesthetics.

Overall we scored 62 points. This will be rewarded with a gold accreditation. See Appendix for check sheet.

Resident Buildings

For simplicity purposes, both residential building features are being described in this section. The only differences between the buildings, in terms of LEED credentials, are the green roof (residential building one), and the solar array (residential building two). All other variables, such as interior design materials, layout patterns, and special features are all the same. However, we did complete separate checklist sheets for both buildings.

In the first sections, both buildings earned 10 points. Access to quality transit, bicycle facilities, and a convenient location helped earn these points.

In the Neighborhood Pattern and Design categories we earned point for walkable streets, a compact development, tree lines,

and shaded areas (specifically from southern light).

In the Green Infrastructure and Buildings section, we earned points for our solar orientations, indoor and outdoor use of recycled water, and light pollution reduction. We also used local materials, some of which are recycled. These features helped both residential buildings achieve a higher ranking in the LEED check sheets.

Also in this section, we earned points for having the green roof and solar array (as previously mentioned). These special features helped both buildings to earn points in renewable energy production, heat island reduction, and reduced parking footprint sections.

The final section is Innovation. Again, because of the shape of the buildings and their unique interior and exterior features, we were able to score 5 points per building.

As a result, both buildings scored 72 points on the checklists. This will again earn our buildings LEED gold accreditation.

THREE BUILDING LEED SCORES

Central Building: 62
First Residential Building: 72
Cactus Residential Building: 72

Figure 29: Central Building Checksheet

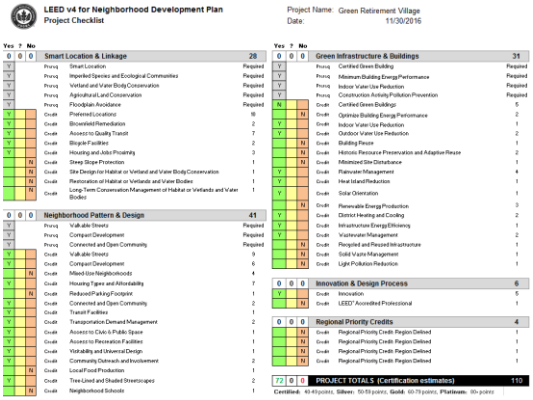

Figure 30: First Residential Building Checksheet

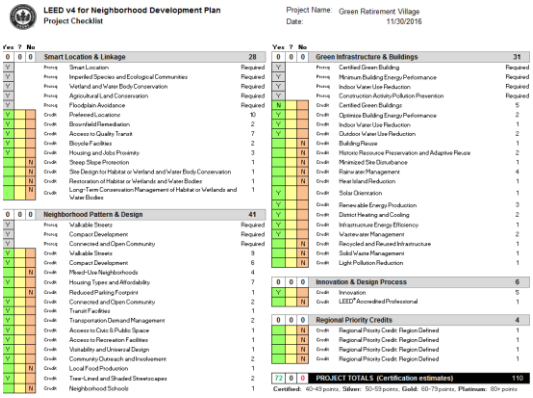

Figure 31: Second Residential Building Checksheet

CONCLUSION

Over the course of the past few months, we have designed and developed a green retirement village for citizens of Scottsdale, Arizona. The design features that we implemented helped all three buildings earn LEED-gold certification.

Annotated Bibliography

"Efficient Hot Water Distribution System | U.S. Green ..." N.p., n.d. Web. 21 Oct. 2016.
-We used the U.S. Green Building Council website to look up many of the requirements for the LEED Project Checklist. These things included Location and Transport, Sustainable Sites, Water Efficiency, and more. It was very help in order to see if we would be able to receive a point practically.

"Green Roof Benefits - GRHC WEBSITE." *Green Roof Benefits*. N.p., n.d. Web. 20 Oct. 2016.
-We were able to use this website to see the benefits of using a green roof. There are many benefits that we want to use for a home built in Scottsdale Arizona. For instance, if there is a large storm then the green roof will prove very beneficial by reducing the amount of rain water. It will also provide better insulation for your home, all while being made of recycled materials.

"Property Listing Scottsdale Arizona." N.p., n.d. Web.
-We used this site in order to find a property that would be sufficient for adding the three buildings. We wanted to make sure that it had optimal space. This lot offer 4.6 acres, and more importantly it is relatively flat. This means that we will not need to tear up much land in order to start construction.

"PVWatts Calculator." N.p., n.d. Web. 20 Oct. 2016.
-We wanted to make sure that we oriented the solar panels for the houses correctly. In order to do this, we had to calculate at what angle they would receive the most sun. To calculate these, we need to know the peak sun hours of Scottsdale Arizona. This website takes in the longitude and latitude of the area in order to find where it is in reference to the equator.

Rudge, Janet, *Dr. Moderating Home Temperatures for Older People's Health*. N.p., n.d. Web.
-When we were looking at the average temperature of Scottsdale Arizona we wanted to make sure that the temperature was not going to affect any of the residents' health. We wanted to make sure that they were as comfortable as possible. This publication proves that the temperature will not be an issue.

"Scottsdale Arizona - City-Data.com." Scottsdale, Arizona. N.p., n.d. Web. 20 Oct. 2016.
-This website offered us a lot of data that we used throughout our report. It had everything from the population to how sunny it is compared to the US average. It also showed all Healthcare facilities within a 15-mile radius, and showed that their crime rate was significantly less than that of the United States.

"The Ultimate Guide to Building Automation | Control Solutions." N.p., 22 Jan. 2015. Web. 20 Oct. 2016.
-We used this website to guide us in the right direction when it came to the building automation. We wanted to make sure that we had an automated hvac system that would be able to vary temperatures between rooms. We also want to have light sensors in each of the rooms in the central building. As for the residential buildings we will have light dimmers, and sensors on exterior lighting.