Project 2 LEED Platinum Building Design & Construction of New School for Elizabethtown College

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Contents

Drawings

Figure 1. Elizabethtown College Eastern-Campus New Development

Pictured above is our drawing for the proposed new development on the eastern part of Elizabethtown College campus. The development includes an academic, multipurpose, and greenhouse building. It also features a Japanese garden attached to the greenhouse. The proposed new development has pedestrian safety features including sidewalks along the entire site and crosswalks across roads. The new road through the site connects Campus Road and Spring Road together.

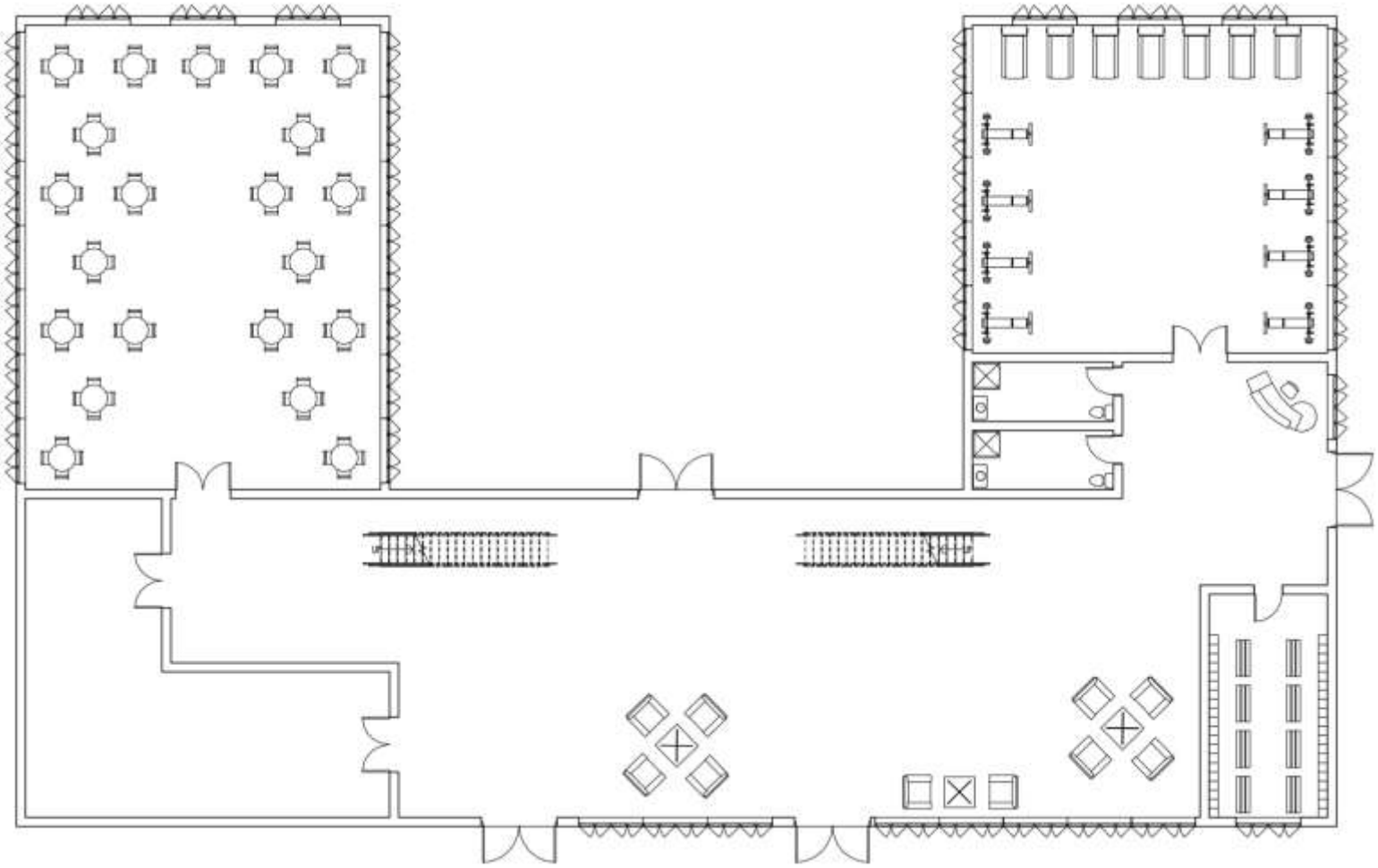

Figure 2. First Floor Plan of Multipurpose Building

Figure 2 illustrates the first floor in the proposed multipurpose building. We chose a U-shaped building for better sunlight, so each room is guaranteed nature light. All the windows on this floor are automated through a computer that monitors the air quality, carbon dioxide, and indoor and outdoor temperatures. A mobile phone application will be accessible to staff in the building to control their specific areas as well. There are four entrances to the building allowing easy access to the neighboring academic building, parking lot, and surrounding sidewalks.

The West Wing includes a dining room with a Jays Nest type convenience store. The middle area of the building incorporates study or hang out areas. There are currently a few tables and chairs but there are room for more. The East Wing is the gym area, featuring a fully equipped gym, single pod-style bathrooms, and a locker room. The gym will be extremely like the Bowers Fitness Center as it has a check-in desk where students will scan their college identification card to be granted access. The gym also mimics the single pod-style bathrooms that contain a toilet, sink, and shower for gym users or the student population to use as their pleasure. The bathroom and locker room do not have windows for privacy purposes. The first floor has stairs that go up to the other three floors.

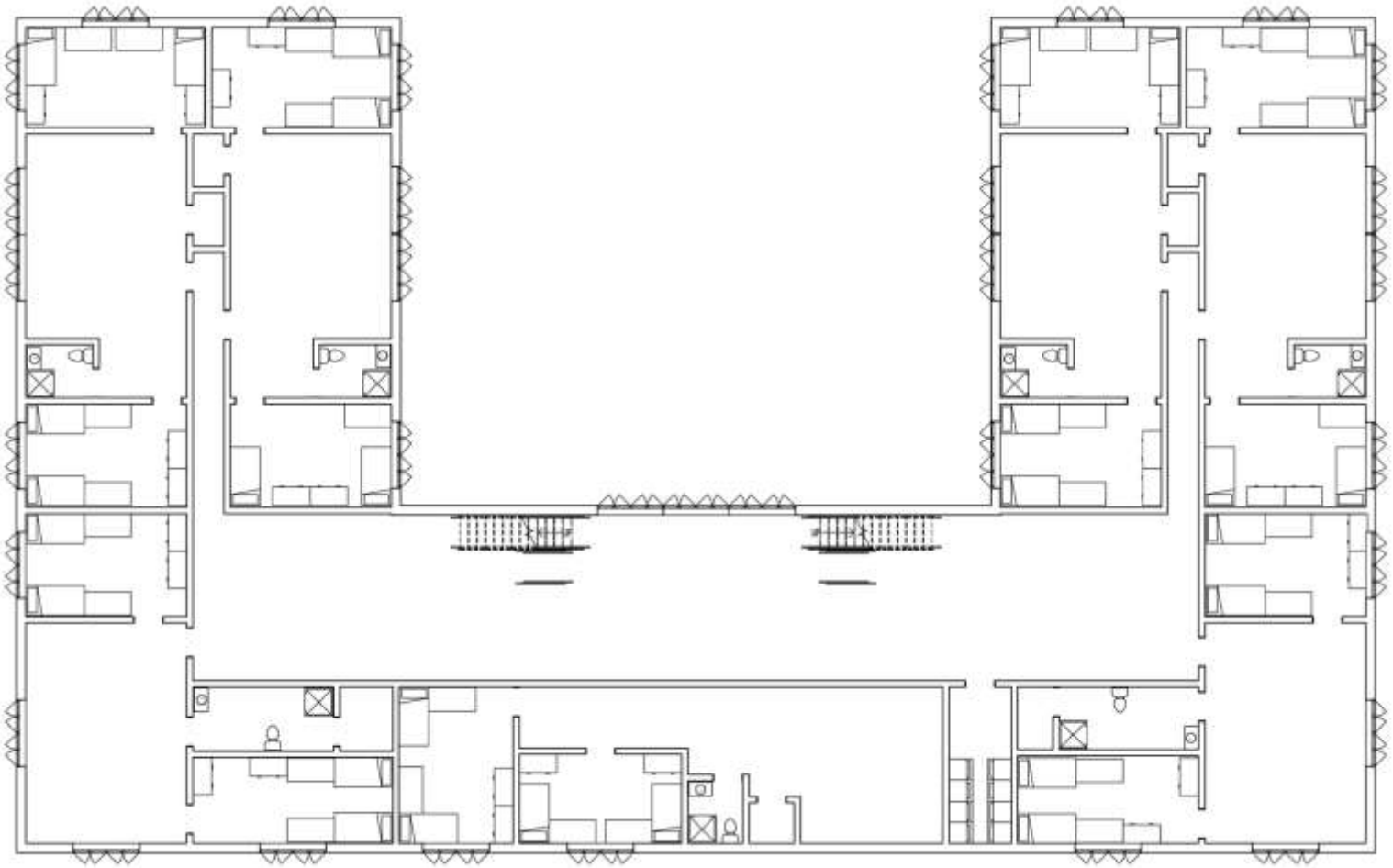

Figure 3. Second through Fourth Floor Plan of Multipurpose Building

Figure 3 illustrates the apartment style floor two through four of the multipurpose building. Each floor contains seven independent living units that hold four students, where the entire building holds 84 students. The floor also has six washing machines and dryers so there will always be available laundering services on each floor. Since this building will be the newest, it will only be reserved for rising seniors as the amenities are the nicest on campus. Each apartment has two double rooms that contain two twin beds, two desks, and two wardrobes. There is a bathroom with a shower stall, toilet, and sink as well. A kitchen, living area, and closet are also included in each apartment. Bedrooms and living spaces have windows that are not automated. Manual windows allow for each student to control their apartment temperature. Closets and bathrooms do not include windows for privacy reasons.

Urban Design

Our design's main priority was creating parking spaces to accommodate students not living in the multipurpose building along with safe paths back to the main part of campus. This is a crucial step as the design is on the edge of campus and there are students that would need easy access both by car and path to get from the new buildings and the current ones. Our goal is to use the solar panels as the main feature with a road and walking path alongside the gate around the panels. This path creates access to the parking, the buildings, the greenhouse, the neighborhood past the solar panels, and the main part of campus. These paths incorporate views of green spaces and pedestrian-friendly sidewalks, while encouraging interaction and safe movement. For safe travel, we have incorporated two crosswalks. Campus Road is a highly traveled road, so a crosswalk is mandatory to ensure that pedestrians are secure. Another crosswalk is along the proposed road where it is crossing a parking lot. Other sidewalks are around the proposed development, allowing students to travel from the main campus, the multipurpose building, academic building, the parking lots, and connects to Spring Road.

There was strategic thought behind the location of each building and their uses for the community. We wanted to keep the greenhouse separate from the other buildings to get the most sunlight possible and allow for a more open space where it can encompass the natural environment around. For the other two buildings, it was important to us to keep them close and create a welcoming environment for students to be there. This created a hub center within this smaller part of the campus that has everything a student would need within these two buildings from classes to recreation to food to housing. This then in turn allows students to be able to get what they need along with having easy access to the main part of campus just a walk or bike ride away. Keeping an area that is solely for sustainability and creating a clean footprint around it will help the nearby community flourish. Developing closer towards the community in previously open spaces could cause neighborhood backlash, so this area is a place where the community surrounding will feel like they are not losing green space.

Air Quality

Air quality in these buildings is important to keep everyone healthy, living and being surrounded by many other students and faculty for long periods of time each day. In the multipurpose building, the windows will allow for 6 air changes per hour on the apartment floors and 8 per hour in the gym and food area. The other buildings will also have windows that allow for 6 air changes per hour. This will allow for the air to be constantly circulating, creating an environment that is safer with many college students getting sick and still needing to be in class to learn the material. Especially in today's time with COVID still present, having a higher air exchange rate is important for the health of the community. The previous standard of 3 air changes per hour is no longer recommended as it is not sufficient enough to limit the number of cases within the community. This has been changed to reflect the knowledge we now have of particles in the air and how

bacteria and viruses spread from person to person through the air. With the new recommendation of 6 to 9 air changes per hour for higher concentrations of people in an area we wanted to be at the higher end of the range.

Thermal Comfort

There are many different things within relative humidity and specific humidity changing the feel of the actual temperature. The biggest idea we wanted to design was with heating and cooling keeping the moisture content the same. This happens as heating a room lowers the relative humidity, but it stays in line from the original temperature. The opposite happens when cooling, as the temperature decreases the relative humidity increases as it moves left on the figure but stays in the same line keeping the moisture content the same. Staying away from the dew point is key in keeping the moisture content lower so there is no accumulation of water on windows and other high moisture areas in a house normally. Measuring relative humidity is quite easy with a wet bulb as it is a digital gage of the moisture content in a room using the difference between the two thermometers one dry and one with a wet "sock" over it. Reading the percentage of relative humidity from the wet bulb on the chart is much harder as there are an additional set of lines diagonal adding an additional layer to read through.

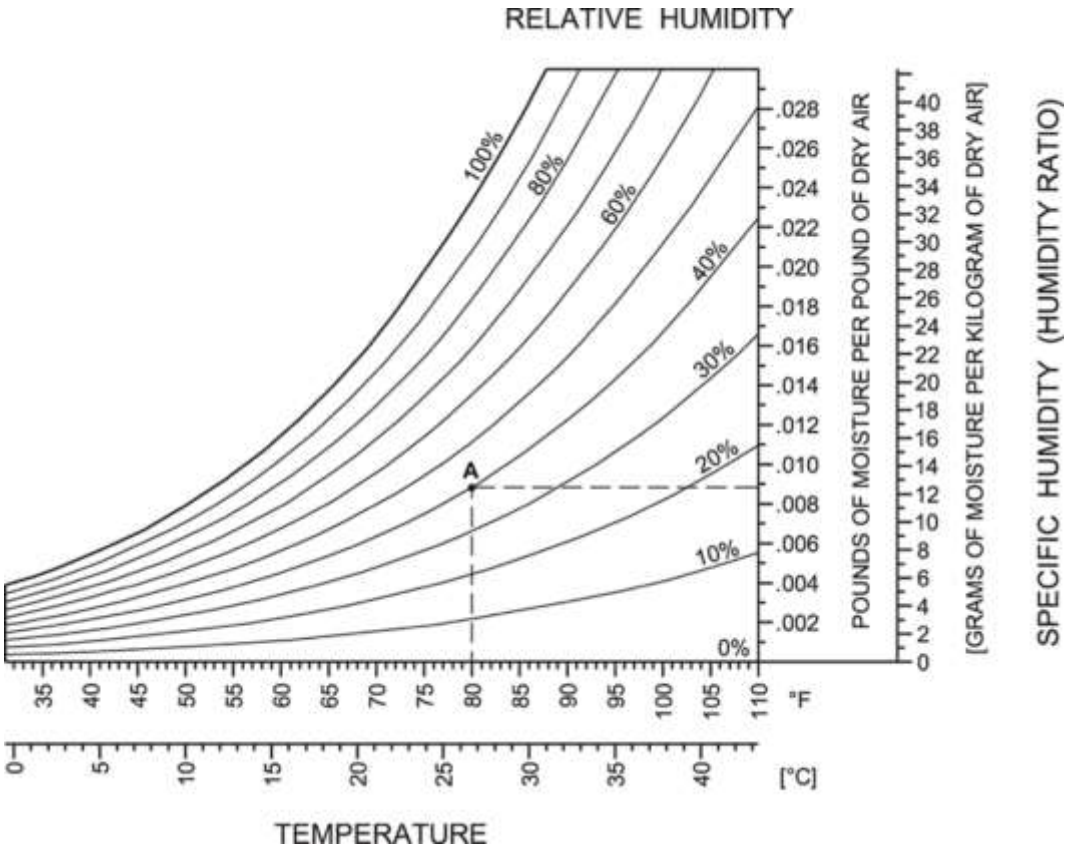

Figure 4. Figure 5.4A from *Heating, Cooling, Lighting: Sustainable Design Strategies Towards Net Zero Architecture 5th Edition*

Climate and Site Placement

There are major differences between the areas available to build on from hills to plains. We decided to work within the plains by the solar panels. This area is mostly flat allowing for lots of sunlight and room for easy access to all buildings. This area is also not at the top of a hill, but also not at the base of the hill for optimal weather conditions. Limiting the weather's impact on the buildings allows for better control of the temperature inside the building. Having better control allows for an easier time maintaining a constant temperature which lowers the cost of electricity powering heaters and air conditioning units that are needed keep everyone comfortable inside.

To protect from excess wind, being a flat area, the academic building is close to the multipurpose building to have mutual wind protection. Clustering buildings together is one of the best and most cost-effective ways to have some protection from the elements, especially wind. This provided a block from wind to the other building and vice versa depending on the direction. These buildings will be positioned in more of an L shape to allow easy access to each other, but not too far from each other to still be clustered together.

To address the problem of keeping out the winter cold and the room heat in we are decreasing the surface area to volume ratio. To achieve this, we are building multi story buildings for the academic building and multipurpose building. The academic building will have 3 stories all which house classrooms for learning. The multipurpose building will have the gym and food area on the first floor and 3 additional stories of apartments above.

Solar Paths

Looking at the maps, having trees surrounding the buildings will cause some problems with the path of the sun. We have decided to remove some of the trees surrounding certain sides of the building to free up the sun’s path to these buildings. The south sides of the buildings will be free of trees up to a certain distance allowing for the sun to reach the buildings to warm the inside up more as that is the side the sun would be hitting most of the time without removing any extra trees as that is also a main component in creating a sustainable area. With the way the area is laid out, the front of the buildings is mostly facing north with the back facing south. This then allows for windows covering the backside of the buildings giving views of the tree line.

Passive Solar Heating

Passive Solar Heating can come in many different forms. Including concrete floors around our building made the most sense to us as this is a good and economical way to add passive solar heating. Allowing the sun to reflect off the ground in front of the building where there are windows allows for the sun to heat the building directly. The heat then gets stored and then is released when the difference in the temperature is high.

	Advantages	Disadvantages
Direct gain	Promotes the use of large picture windowsLeast expensiveMost efficientCan effectively use clerestoriesDaylighting and heating can be combined, which makes this system very appropriate for schools, small offices, etc.	Possibly too much light, which can cause glare and fading of colorsConcrete floor slabs must not be covered by carpetsOverheating can occur if precautions are not takenFairly large temperature swings must be tolerated (about 10°F [6°C])
Trombe wall	Gives high level of thermal comfort Good in conjunction with direct gain to limit lighting levelsMedium costGood for large heating loads	More expensive than direct gainLess glazing will be available for views and daylightingNo wall hangings or other insulating coverings permitted on Trombe wall
Sunspaces	Very attractive amenityExtra living spaceCan function as a greenhouse	Most expensive systemLeast efficientCannot be occupied when too hot or cold

Figure 5. Figure 7.4 from *Heating, Cooling, Lighting: Sustainable Design Strategies Towards Net Zero Architecture 5th Edition*

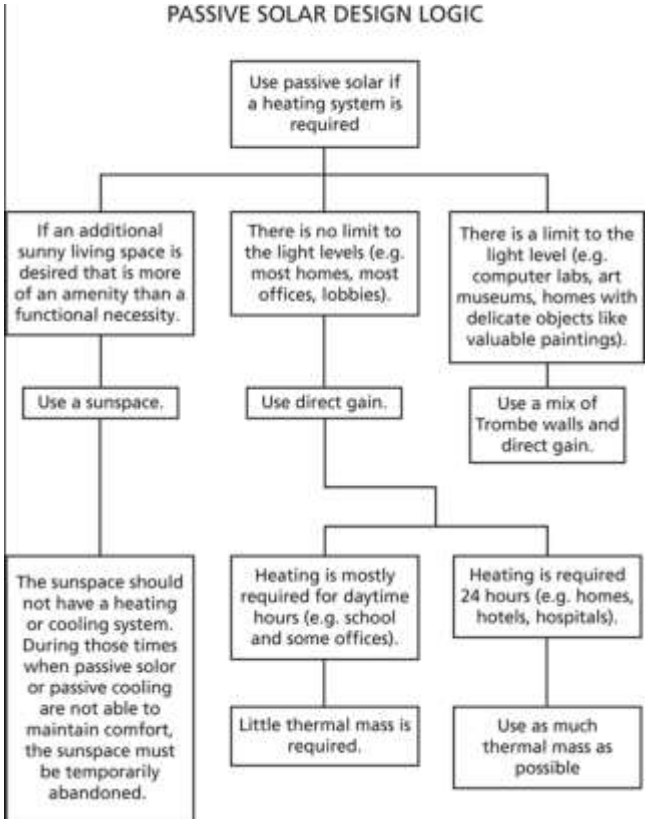

Figure 6. Figure 7.13 from *Heating, Cooling, Lighting: Sustainable Design Strategies Towards Net Zero Architecture 5th Edition*

Active Solar Heating

Active Solar Heating is good to have in places with flat land where the sun has a larger direct line to the buildings. In the building's area, there are lines of solar panels that generate energy the school uses. This is a great cost-effective way to lower the cost of energy that the building could use. Since there are active solar panels right in front of the building which we will have some of the generated energy directed towards the building there is no need to add additional solar panels to the field.

Shading

Shading is important when deciding the placement of buildings and their orientation. We plan on taking trees down, but we will put them in locations where it will shade part of the building allowing for a cooler building with less power usage. We do not want trees around on the south side of the building because it can be problematic as they shade active solar, PV arrays, and block desirable daylight in the summer. If there must be trees on the south side, we will trim the lower branches to form a high canopy to expose south-facing windows to the sun. Even without leaves trees can block 30 to 60 percent of sunshine which we do not want on the prime side of the building for sun to enter through the windows. To maximize summer ventilation, we will place bushes away from the building but not too far as we want some winter wind protection.

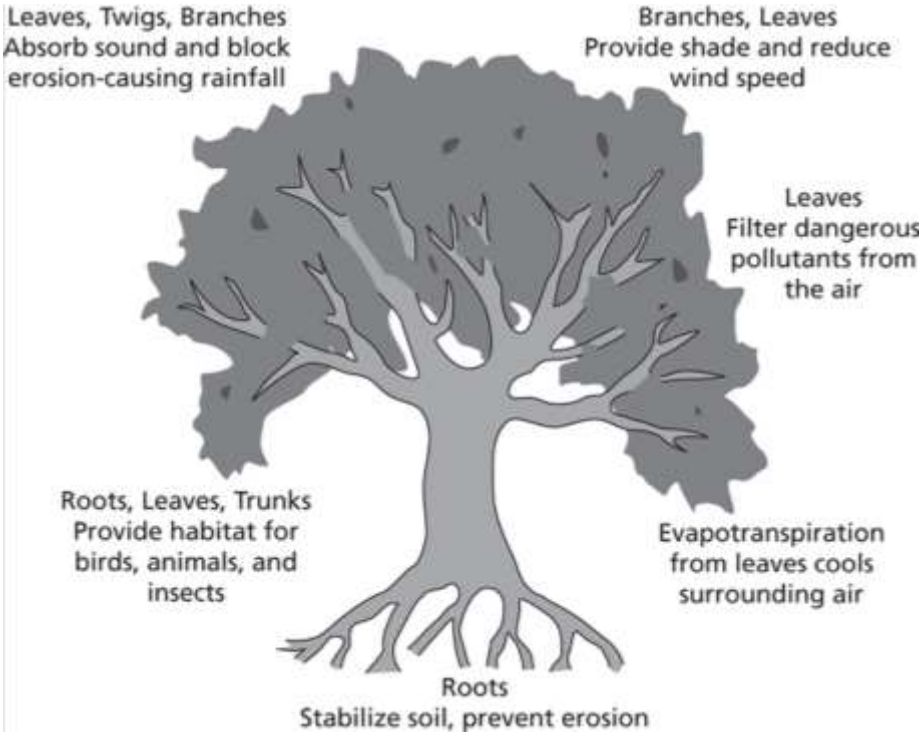

Figure 7. Figure 10.10A from *Heating, Cooling, Lighting: Sustainable Design Strategies Towards Net Zero Architecture 5th Edition*

Lighting

Natural and man-made lighting will be used throughout the buildings in different ways. The natural lighting will be through windows that surround all sides of the building, especially the south side, to capitalize on longer direct sunlight. Incorporating skylights for the top floor will be key to keep a bright atmosphere in the living room areas of the apartments. Man-made lighting throughout the building will be ceiling lights with the addition of outlets for each student to use a lamp within the apartments. It is important to have cool lights to have a white hue to the light instead of an orange hue to keep that bright atmosphere.

Ventilation

Ventilation is important to incorporate to save energy and regulate the building. The first floor will have automated windows that are controlled by a computer. The apartment floors will have manual windows that each resident will be able to control as they need. The automated windows will perform nighttime purging to save energy since the HVAC will be turned off. Only the outside air will run through the first floor and go up the stairways to promote healthy and clean air. With nighttime purging and automated windows, carbon dioxide will be reduced, students will feel at ease, sickness will lessen, and the temperature of the building will be cooled.

Thermal Envelope

Insulation is an important piece of a building to have an energy efficient building. Too much heat loss will make the heater work extra to keep the building at a comfortable temperature. This also works the other way with too much cool air escaping through the walls, ceiling, and the ground will force the AC unit to work extra not being cost efficient. To combat this problem having a gap between the insulation and the drywall will allow for the air to get trapped within the building and not escape as easily.

HVAC

There are three different heating systems: air, water, and electricity. We want to use the water heating system as it is the most comfortable and has the best MRT. Using a water heating system allows for the compact pipes to be used which can easily hide behind walls. The pipes that run under the floor allow for good radiant heat to warm the floor, which is nice to have for the apartment floors. Also having a water heating system gives easy with zoning, which is important with apartment style rooms and having people wanting different temperatures between rooms.

Acoustics

Acoustics is constantly a problem when it comes to dorm rooms where there are a lot of different noises and sounds. This is also the case with students in the gym being loud and playing music. Soundproofing the ceiling is the best option to keep the sound and music from the gym going to the first floor of the apartments. Adding soundproof walls as well between each apartment is

necessary as too much sound travels between apartments causing disturbances at night or in the morning when others want to be loud at less than reasonable times.

LEED Development

LEED v4 for BD+C: New Construction and Major Renovation
Project Checklist

Project Name: Jacquelyn Nickel and Rachel Murphy
Date: April 28th, 2024

Y	?	N			
			Credit	Integrative Process	1

0	0	0	**Location and Transportation**		16
14			Credit	LEED for Neighborhood Development Location	16
		0	Credit	Sensitive Land Protection	1
1			Credit	High Priority Site	2
4			Credit	Surrounding Density and Diverse Uses	5
5			Credit	Access to Quality Transit	5
1			Credit	Bicycle Facilities	1
1			Credit	Reduced Parking Footprint	1
		0	Credit	Green Vehicles	1

0	0	0	**Sustainable Sites**		10
Y			Prereq	Construction Activity Pollution Prevention	Required
1			Credit	Site Assessment	1
2			Credit	Site Development - Protect or Restore Habitat	2
1			Credit	Open Space	1
3			Credit	Rainwater Management	3
1			Credit	Heat Island Reduction	2
1			Credit	Light Pollution Reduction	1

0	0	0	**Water Efficiency**		11
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
2			Credit	Outdoor Water Use Reduction	2
5			Credit	Indoor Water Use Reduction	6
1			Credit	Cooling Tower Water Use	2
1			Credit	Water Metering	1

0	0	0	**Energy and Atmosphere**		33
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
4			Credit	Enhanced Commissioning	6
14			Credit	Optimize Energy Performance	18
1			Credit	Advanced Energy Metering	1
1			Credit	Demand Response	2
2			Credit	Renewable Energy Production	3
		0	Credit	Enhanced Refrigerant Management	1
1			Credit	Green Power and Carbon Offsets	2

0	0	0	**Materials and Resources**		13
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
4			Credit	Building Life-Cycle Impact Reduction	5
2			Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
		0	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
1			Credit	Building Product Disclosure and Optimization - Material Ingredients	2
1			Credit	Construction and Demolition Waste Management	2

0	0	0	**Indoor Environmental Quality**		16
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
2			Credit	Enhanced Indoor Air Quality Strategies	2
3			Credit	Low-Emitting Materials	3
1			Credit	Construction Indoor Air Quality Management Plan	1
2			Credit	Indoor Air Quality Assessment	2
1			Credit	Thermal Comfort	1
2			Credit	Interior Lighting	2
2			Credit	Daylight	3
1			Credit	Quality Views	1
1			Credit	Acoustic Performance	1

0	0	0	**Innovation**		6
4			Credit	Innovation	5
0			Credit	LEED Accredited Professional	1

0	0	0	**Regional Priority**		4
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1

0	0	0	**TOTALS**	Possible Points: 110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

Figure 8. LEED Development Chart

Our goal for the neighborhood development is Platinum status. To achieve this, we needed to hit at least 80 points on the list of different criteria. Through all the different criteria provided from the "LEED: New Construction and Major Renovation," we determined what was most crucial for us to include in our designs. We also did not include what did not fit within our plan. After careful consideration, we achieved 94 of the 110 possible points. Figure 8 illustrates how we rated ourselves. Only the most important and highly ranked categories will be highlighted for our designs.

The proposed buildings are close to the highways but further away from campus compared to other dorms. To make this a preferred location and competitive, our new construction includes a gym, a

convenience store, and apartment-style housing. These three amenities are essential for all college students on a campus, and we have concluded that we deserve 14 of the 16 available points. We rated ourselves a five out of five for access to quality transit since there is a new road that connects Campus Road to Spring Road. The new site also is only a few minutes from a highway and other main roads. Optimized performance will be essential in our new buildings. Having automated windows will save energy and that allowed for a rating of 14 of 18 points. Other categories were rated highly based off our proposed design which allows our buildings to be LEED Certified as Platinum status.