



LEED Platinum Building Design & Construction

Etown Engineering and the Greenway Institute

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Introduction

The objective of this project was to design a sustainable LEED Platinum campus for Elizabethtown University through the creation of multiple environmentally conscious buildings and site layouts. The project focused on integrating principles of green architectural engineering, Sustainable site development, occupant comfort, energy efficiency, and environmentally responsible building systems. Through the use of architectural modeling and sustainable engineering concepts, the project demonstrates how modern educational facilities can minimize environmental impact while improving functionality and occupant well-being.

The proposed campus design process includes five primary components; the Art and Architecture Building, Elizabethtown Theater, Blue Jay Perch, Sustainability Building, and Residential Dorms. The campus layout also incorporates roadways, pedestrian walkways, parking, and green spaces to support accessibility, circulation, and environmental sustainability.

Throughout the design process, our team incorporated concepts from multiple lectures including thermal comfort, passive solar heating, passive cooling, natural lighting, HVAC systems, indoor air quality, acoustics, and building envelope design. The goal of the project was not only to create visually appealing buildings, but also engineer spaces that reduce energy consumption, improve indoor environmental quality, and support long-term sustainability goals associated with LEED Platinum certification.

Site Plan Overview



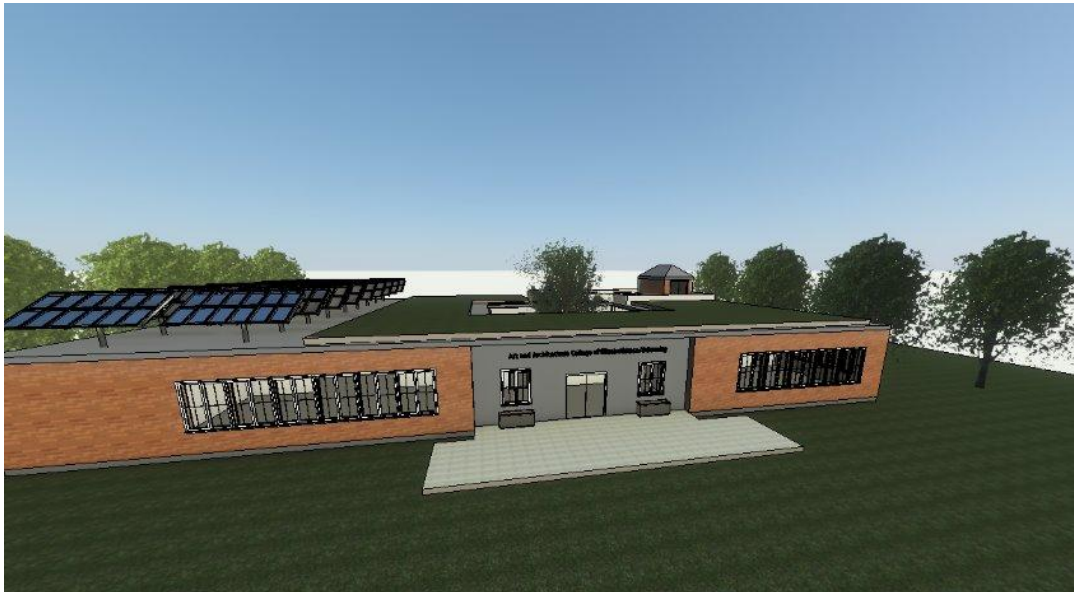
This image presents a conceptual site plan for the extension of the Elizabethtown College campus. It illustrates the proposed placement of the new buildings, circulation paths, and parking

lots in relation to the existing site features. The layout organizes five primary buildings (shown in blue) connected by a network of pathways (highlighted in orange). The buildings are labeled as follows:

1. Art & Architecture Building: Located on the southwestern portion of the site, positioned near existing athletic fields, suggesting accessibility and visibility.
2. Elizabethtown Theater: Placed centrally, acting as a key gathering and performance space within the development.
3. Blue Jay Perch: Situated slightly northwest of the theater, likely serving as a smaller social or observational space.
4. Sustainability Building: Positioned near the center of the site, reinforcing its role as a hub for environmentally focused initiatives.
5. Residential Dorm: Located on the eastern edge, somewhat separated from the main academic cluster to provide a quieter residential environment.

The site is integrated into its natural and built surroundings. Notably, a large solar panel field to the north suggests an emphasis on sustainability and renewable energy, which aligns with the inclusion of the Sustainability Building. The placement of structures appears to respect existing topography and nearby residential areas, creating a balance between campus expansion and community context.

Architecture Building



The Art and Architecture Building was designed to support creative collaboration, studio learning, and architectural education while maintaining a strong focus on sustainability and occupant comfort. Large windows and open interior spaces allow for increased natural lighting, reducing the need for artificial lighting during daytime hours.

The building exterior incorporates sustainable materials and modern architectural elements that maximize both aesthetics and environmental performance. The structure was designed to create an inviting atmosphere while also improving energy efficiency through insulation, glazing selection, and passive solar strategies.

Daylighting and Solar Design

The Architecture and art building was carefully designed to take advantage of seasonal sunlight conditions and passive environmental control strategies. South-facing windows allow winter sunlight to enter the building, providing both natural heating and daylighting benefits during colder months. This reduces reliance on artificial lighting and mechanical heating systems.

Thermal mass elements, including concrete floors and walls, absorb heat during the day and slowly release it over time, helping stabilize indoor temperatures. This strategy improves occupant comfort while reducing energy consumption associated with heating and cooling.

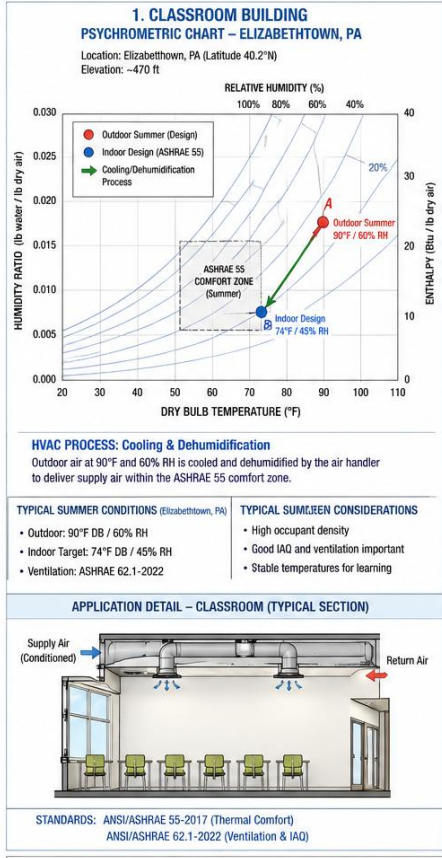
Natural ventilation strategies are incorporated through operable windows that allow fresh air circulation during spring and fall seasons. The overall building shape supports both cross ventilation and stack ventilation, helping move warm air upward and out of the structure while drawing cooler air inward.

To reduce overheating during summer months, roof overhangs and exterior shading devices help block excessive solar heat gain and reduce glare within studio spaces. The high summer sun angle naturally limits the amount of direct sunlight entering the windows during hotter periods of the year.

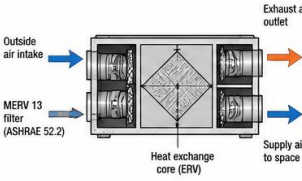
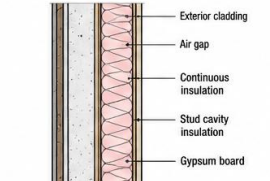
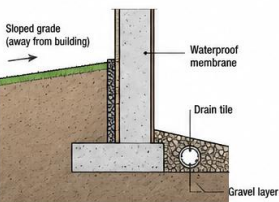
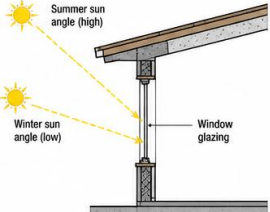
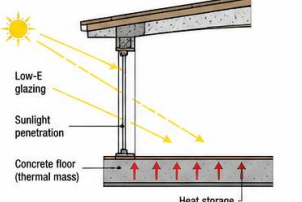
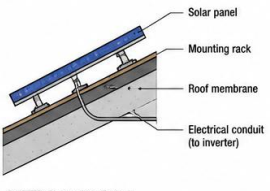
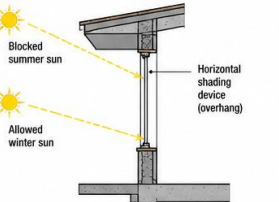
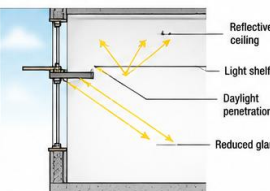
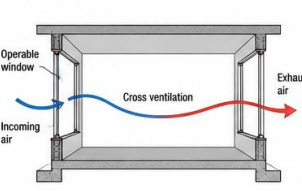
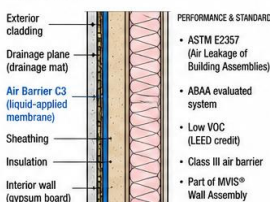
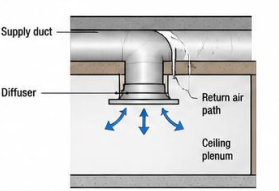
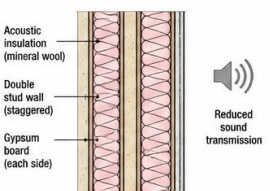
The combination of thermal mass and night ventilation further improves passive cooling performance by allowing stored heat to dissipate during cooler nighttime conditions. During periods of extreme heat and humidity, mechanical cooling systems are used to maintain comfortable indoor conditions.

Large windows throughout the building provide consistent natural daylight for studio environments, creating productive and visually comfortable workspaces. In addition, rooftop solar panels generate renewable energy that helps offset the building's electrical energy demands.

Psychrometric Chart



Sweets Catalog

<p>1. AIR QUALITY — ERV + FILTRATION DETAIL SECTION - ERV UNIT AND DUCT CONNECTIONS</p>  <p>Outside air intake → MERV 13 filter (ASHRAE 52.2) → Heat exchange core (ERV) Supply air to space → Exhaust air outlet →</p> <p>STANDARDS: ANSI/ASHRAE 62.1 (Ventilation for Acceptable IAQ) ASHRAE 52.2 (Filter Rating) SWEETS: ERV System / Air Filtration Unit</p>	<p>2. THERMAL COMFORT — INSULATED WALL WALL SECTION</p>  <p>Exterior cladding Air gap Continuous insulation Stud cavity insulation Gypsum board</p> <p>STANDARD: ANSI/ASHRAE 55-2017 (Thermal Environmental Conditions for Human Occupancy)</p>	<p>3. CLIMATE & SITE DESIGN — FOUNDATION DRAINAGE FOUNDATION WALL SECTION</p>  <p>Sloped grade (away from building) Waterproof membrane Drain tile Gravel layer</p> <p>Why: Prevent moisture intrusion and protect the structure.</p>	<p>4. SOLAR GEOMETRY — SUN ANGLE WINDOW BUILDING SECTION</p>  <p>Summer sun angle (high) Winter sun angle (low) Window glazing</p>
<p>5. PASSIVE SOLAR HEATING — THERMAL MASS SOUTH-FACING WINDOW SECTION</p>  <p>Low-E glazing Sunlight penetration Concrete floor (thermal mass) Heat storage</p>	<p>6. ACTIVE SOLAR — PV PANEL ROOF DETAIL ROOF SECTION</p>  <p>Solar panel Mounting rack Roof membrane Electrical conduit (to inverter)</p> <p>SWEETS: Photovoltaic System</p>	<p>7. PASSIVE COOLING — SHADING DEVICE WINDOW SECTION WITH OVERHANG</p>  <p>Blocked summer sun Allowed winter sun Horizontal shading device (overhang)</p>	<p>8. LIGHTING — LIGHT SHELF DETAIL SECTION THROUGH WINDOW</p>  <p>Reflective ceiling Light shelf Daylight penetration Reduced glare</p>
<p>9. NATURAL VENTILATION — OPERABLE WINDOW CROSS VENTILATION SECTION</p>  <p>Operable window Incoming air → Cross ventilation → Exhaust air →</p>	<p>10. BUILDING ENVELOPE — AIR BARRIER (Air Barrier C3) WALL SECTION</p>  <p>Exterior cladding Drainage plane (drainage mat) Air Barrier C3 (liquid-applied membrane) Sheathing Insulation Interior wall (gypsum board)</p> <p>PERFORMANCE & STANDARDS</p> <ul style="list-style-type: none"> • ASTM E2357 (Air Leakage of Building Assemblies) • ABAA evaluated system • Low VOC (LEED credit) • Class III air barrier • Part of MVIS® Wall Assembly 	<p>11. HVAC TECHNIQUES — CEILING DIFFUSER CEILING SECTION</p>  <p>Supply duct Diffuser Return air path Ceiling plenum</p>	<p>12. ACOUSTICS — SOUND INSULATED WALL WALL SECTION</p>  <p>Acoustic insulation (mineral wool) Double stud wall (staggered) Gypsum board (each side)</p> <p>Reduced sound transmission</p>
<p>All details are diagrammatic and based on typical assemblies. References: ASHRAE Standards, AIA Graphics Standards, SWEETS Catalog Building: LEED v4 BD+C New Construction – Elizabethtown University</p>			

ChatGPT assisted architectural detail

Blue Jay Perch



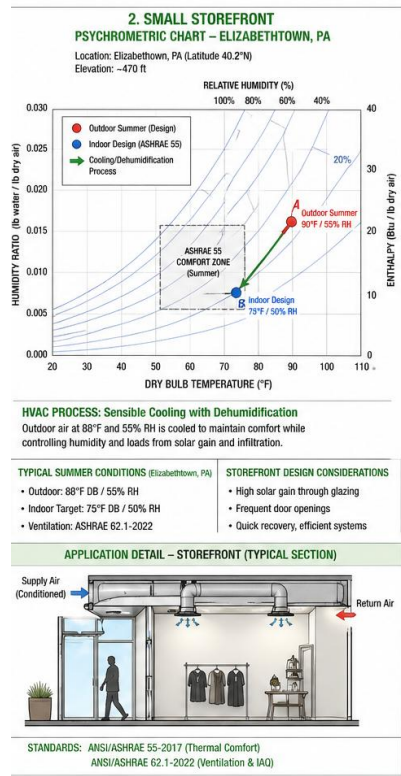
This building is a small retail store located on campus that serves students, faculty, and visitors with quick food, drinks, and grab-and-go items. It is designed as a compact, highly visible building that encourages foot traffic and creates a casual social hub within the campus environment.

Solar/Thermal Analysis

The Blue Jay Perch was designed to maximize natural light while carefully controlling heat gain throughout the year. Large glass facades bring daylight deep into interior spaces, reducing the need for artificial lighting during the day. In winter, low-angle sunlight penetrates further into the building and supports passive solar heating, while interior floors store this heat as thermal mass and slowly release it over time.

In the summer, higher sun angles increase heat gain through the glazing, so shading elements like overhangs and exterior fins are used to reduce overheating and glare. Daylighting is balanced with thermal comfort strategies and passive cooling methods such as shading and natural ventilation to help regulate indoor temperatures, although mechanical cooling may still be required during peak summer conditions. The building can also support active solar energy systems through roof-mounted panels, integrating energy generation into its design approach.

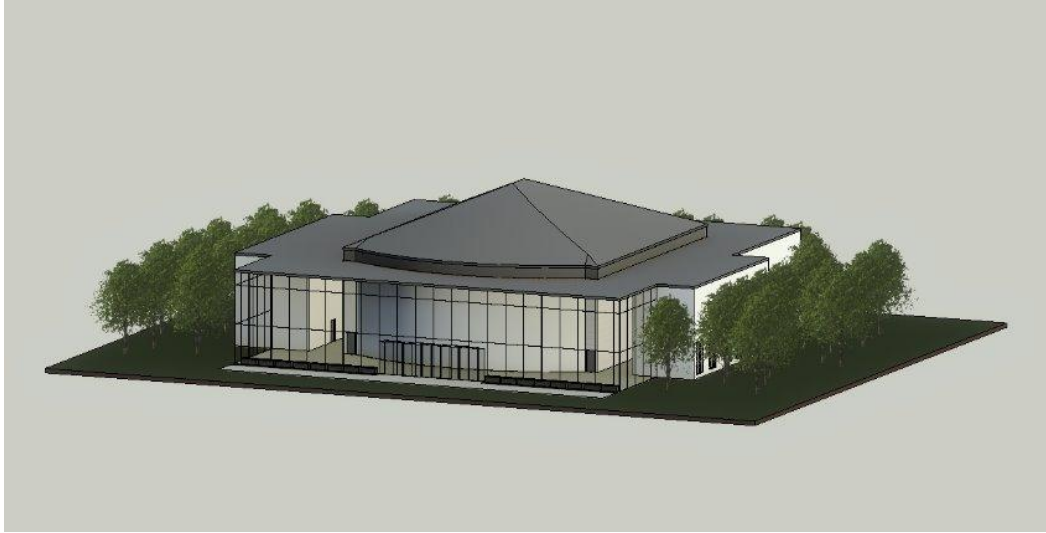
Psychrometric Chart



ChatGPT-assisted image

This psychrometric chart represents summer conditions in Pennsylvania, where outdoor air enters the building at approximately 90°F and 60% humidity. The HVAC system cools and dehumidifies the air through a cooling coil, reducing both temperature and moisture content. The air conditioned is delivered to indoor spaces within the ASHRAE 55 comfort zone (approximately 74°F and 45% RH), ensuring occupant comfort and preventing excess humidity that could lead to mold or poor air quality.

Theater/Auditorium Building



The Elizabethtown Theater was designed as a performance and gathering space that emphasizes acoustics, occupant comfort, and energy-efficient operation. The theater includes architectural features intended to improve sound quality while maintaining a visually modern and sustainable design.

The exterior and roof systems were designed to support insulation and reduce thermal losses. The use of sustainable materials and strategic building orientation contributes to overall energy efficiency.

Solar/Thermal Analysis

The theater design heavily incorporates solar geometry and passive environmental control strategies to improve energy efficiency and occupant comfort throughout the year. A seasonal solar-angle facade design allows low-angle winter sunlight to penetrate deeply into the south-facing glazing, naturally heating interior spaces during colder months. During summer months, the higher sun angle is blocked by the sloped-roof overhangs, reducing overheating and unwanted solar heat gain.

Thermal-mass flooring systems absorb winter sunlight entering through the tall glazing and slowly release stored heat over time. The passive solar heating strategy helps stabilize indoor temperatures and reduce heating demands.

The theater also integrates active solar heating through roof-mounted solar thermal panes installed along the multi-slope roof system. Insulated roof penetrations and glycol loop routing help transfer collected solar energy efficiently throughout the building systems.

Exterior vertical shading fins positioned on the tall, glazed facade reduce peak summer cooling loads while also controlling glare during shoulder seasons. Operable exterior louvers further improve thermal control by blocking intense western afternoon sunlight during cooling seasons.

The polygon roof geometry supports advanced daylighting strategies through clerestory glazing that reflects diffuse light deeper into interior spaces. Daylight shelves and high-transmittance glazing systems redirect incoming sunlight upward to reduce interior contrast ratios and improve visual comfort.

Roof light wells incorporated into angles roof planes allow diffuse northern daylight to enter the building without significantly increasing solar heat gain. Automated glare-control shades integrated with solar sensors help regulate daylight levels and improve occupant comfort near curtainwall systems.

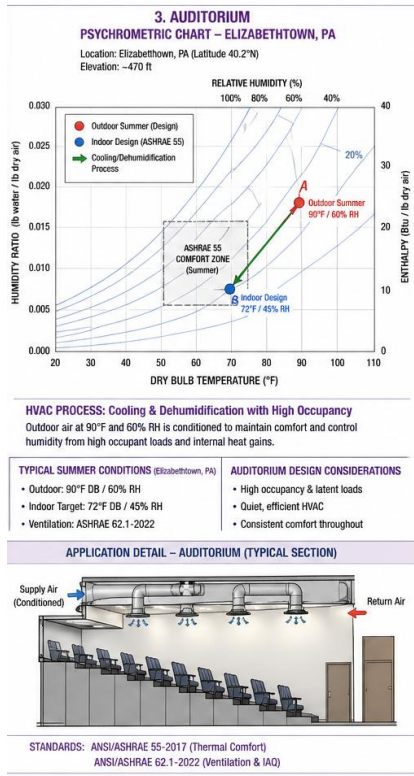
To reduce winter heat losses, insulated shades and low-emissive glazing systems minimize conductive heat transfer through large, glazed surfaces. The building geometry, glazing orientation, and roof slopes were carefully designed to respond differently to seasonal solar conditions, including solstice and equinox sun paths.

Acoustic and Interior Comfort

Acoustical design was a major consideration in the theater. Interior materials and wall assemblies help reduce sound transmission and improve audio quality during performances and events. Acoustic engineering principles help create an immersive experience for occupants while minimizing external noise disturbances.

Thermal comfort and ventilation systems were also considered to accommodate large occupant loads within the theater space. Efficient HVAC systems and ventilation strategies improve air circulation while maintaining comfortable indoor conditions.

Psychrometric Chart



Chatgpt assisted image

Theater Architectural Details

Air Quality and Health – Fresh air enters the theater through an energy-recovery ventilator. The system filters out pollution before the air reaches people inside.

Thermal Comfort and Health – The seating layout of the theater is designed so air is evenly distributed across the audience space, this helps maintain consistent comfort levels throughout the auditorium.

Climate and Site Design – The theater is positioned on the site to respond to environmental conditions like wind direction, sun exposure, and surrounding landscape. This placement helps reduce energy loads while improving natural comfort around and inside the building

Solar Geometry – The design of the theater responds directly to the sun's changing angles throughout the year. This allows the building to take advantage of natural light when helpful and limit unwanted heat gain during warmer months.

Passive Solar Heating – In the theater, south-facing glazing allows winter sunlight to enter and warm interior surfaces like floors and seating platforms. These materials store heat and slowly release it, helping keep the space comfortable with less mechanical heating.

Active Solar Heating – The theater incorporates solar thermal systems on the roof that support the HVAC system by preheating incoming air. This reduces overall energy demands while still maintaining comfortable indoor conditions.

Passive Cooling and Shading – The theater uses deep overhangs and carefully shaped forms to block harsh summer sun. Combined with natural airflow paths, this helps reduce overheating and supports passive cooling strategies.

Natural and Artificial Lighting – Natural daylight enters the theater through skylights and high windows, reducing the need for artificial lighting during the day. At night or low-light conditions, LED systems maintain consistent visibility and comfort.

Smart ventilation – The theater includes operable windows controlled by sensors that respond to temperature and air quality changes. This allows the building to adjust ventilation automatically, improving air freshness without constant mechanical input.

Building Envelope – The exterior walls of the theater are designed with multiple layers that regulate heat flow. This envelope helps keep indoor temperatures stable by reducing heat loss in winter and heat gain in summer.

HVAC System – The HVAC system is carefully zoned to distribute conditioned air efficiently across different parts of the theater. Ductwork and controls are organized to support both audience comfort and energy efficiency.

Acoustics – The interior surfaces of the theater are designed to manage sound reflection and absorption. This ensures that performances are clear and evenly heard throughout the auditorium without excessive echo or distortion.

Art and Architecture Building LEED Scorecard

LEED v4 for BD+C: New Construction and Major Renovation				Project Name:	
Project Checklist				Date:	
Y	7	N			
1			Credit	Integrative Process	1
0 0 0 Location and Transportation 16					
16			Credit	LEED for Neighborhood Development Location	16
1			Credit	Sensitive Land Protection	1
2			Credit	High Priority Site	2
5			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
1			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
2			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
6			Credit	Indoor Water Use Reduction	6
2			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
6			Credit	Enhanced Commissioning	6
18			Credit	Optimize Energy Performance	18
1			Credit	Advanced Energy Metering	1
2			Credit	Demand Response	2
3			Credit	Renewable Energy Production	3
1			Credit	Enhanced Refrigerant Management	1
2			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
5			Credit	Building Life-Cycle Impact Reduction	5
2			Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
2			Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
2			Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			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
3			Credit	Daylight	3
1			Credit	Quality Views	1
1			Credit	Acoustic Performance	1
0 0 0 Innovation 6					
5			Credit	Innovation	5
1			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
106	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					

Conclusion

This project demonstrates how sustainable architectural engineering principles can be integrated into the design of a modern college campus. Through careful consideration of site planning, daylighting, thermal comfort, HVAC systems, acoustics, and energy efficiency, the proposed campus design supports the goals of LEED Platinum certification.

The Art and Architecture Building, Elizabethtown Theater, and Blue Jay Perch each contribute unique sustainable features while collectively forming a cohesive and environmentally responsible campus environment.

By incorporating passive and active sustainability strategies, the project reduces environmental impact, improves occupant comfort, and demonstrates the value of sustainable engineering in modern building design. The final design reflects the integration of architectural creativity and engineering analysis to create a campus that is both functional and environmentally conscious.