Arch 463
ECS
Fall 2019

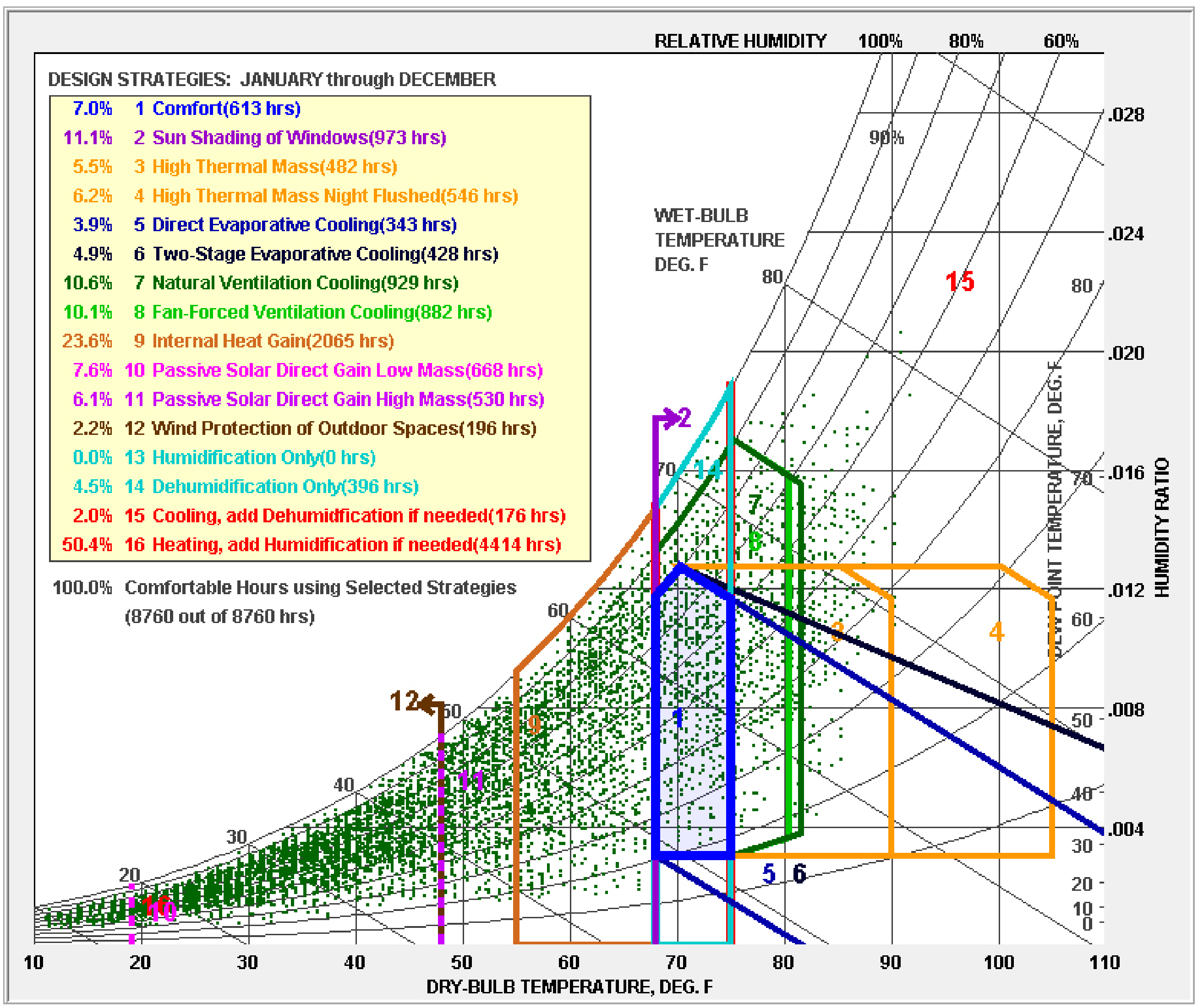
Name________________________________

Quiz #4

"Among the 2019 Top Ten"

For this problem you are an aspiring green architect. You're trying to understand the 2019 AIA COTE Top Ten winner—the Frick Environmental Center by BCJ architects—so that you can use it as a precedent for a local science center at Virgil Phillips Park.

Frick Park is in Pittsburgh, PA, whose weather data is plotted on the Climate Consultant Psychrometric Chart below.



Photos and drawings: Bohlin Cywinski Jackson web site

Frick Environmental Center

Bohlin Cywinski Jackson (BCJ)

By delicately balancing passive and active systems, this environmental center teaches the public about sustainable design through its net-positive energy and carbon design.

Frick Park—the 644-acre green space nestled among the hilly neighborhoods east of downtown Pittsburgh—has long acted as an oasis in the dense industrial city, but has always lacked a gateway. In 2011, the city of Pittsburgh and the Pittsburgh Parks Conservancy invited Wilkes-Barre, PA–based Bohlin Cywinski Jackson (BCJ) to design a new environmental center to act as a locus for the park's education and advocacy efforts and to teach visitors about energy-efficient design. "The mission was to make sustainability a part of the park experience," says senior associate Patricia Culley, AIA. "We wanted the building to be a platform to make nature itself a *part of that mission."*

The three-story center, which is free to the public, occupies the same footprint as the park's former education center, to minimize ecological disruption. Located on the side of a hill, visitors enter at the top floor and immediately find themselves amid the treetops of the surrounding forest.

The building relies on a number of passive heating and cooling strategies, beginning with a high-performance, highly insulated exterior wall clad in black locust—a locally sourced wood that does not require sealant or staining. "We tried to be creative with the systems we were going to use," Culley says. "First, that meant designing a good envelope, and then looking at systems that are super-efficient."

The firm also incorporated a number of passive strategies, like roof overhangs, natural ventilation, and a red light/green light system that lets occupants know the best time to open windows. Photovoltaic shading, located in the parking lot, provides much of the energy. The center's predicted net energy use intensity (EUI) was just 2 kBtus per square foot per year—60% below average for similar structures, and the actual net EUI came in at -0.7 kBtus per square foot per year—an energy surplus, which is sent to the grid.

For all the energy savings, water is also an essential part of the center's sustainability agenda. Low-flow fixtures and minimal irrigation reduce demand, but the architects wanted to do more—not just to save water, but to show visitors how it sustains a place like Frick Park. "The water story is a huge component in this site," says senior associate Robert Aumer, AIA.

After decades of neglect, the site had experienced significant erosion, which the designers addressed by adding 7,000 plants, including 200 new native trees. With careful landscaping to reduce the hillside grade, the BCJ team was able to restore a significant amount of the site's luster with minimal artificial irrigation.

The center sits astride two watersheds, and the architects were careful to make sure that stormwater falling on the building was diverted evenly. Rain that falls on the north side is captured in a 15,000-gallon underground cistern, and is used for flushing toilets and other non-potable needs. In fact, Aumer says, while local laws prevent the use of rainwater for drinking, the site has enough capacity to meet potable water demand as well, should the laws change.

Rain falling on the south side plays a very different role: Water flows off the roof in a sheer curtain, called the Rain Veil, which is visible from inside the center. The runoff then passes through the Rain Ravine, an installation by artist Stacy Levy that mimics the sandstone-lined creek beds found in the park, giving visitors an up-close view of the region's water ecology.

BCJ was conscious of making the building's systems, for water and energy alike, easy to use for staff and visitors. "So many times we've seen this—you deliver a sophisticated system that the maintenance crew refuses to operate," Culley says. "We're proud that our building is simple to maintain."

—C.R., *Architect* magazine Nov 2019

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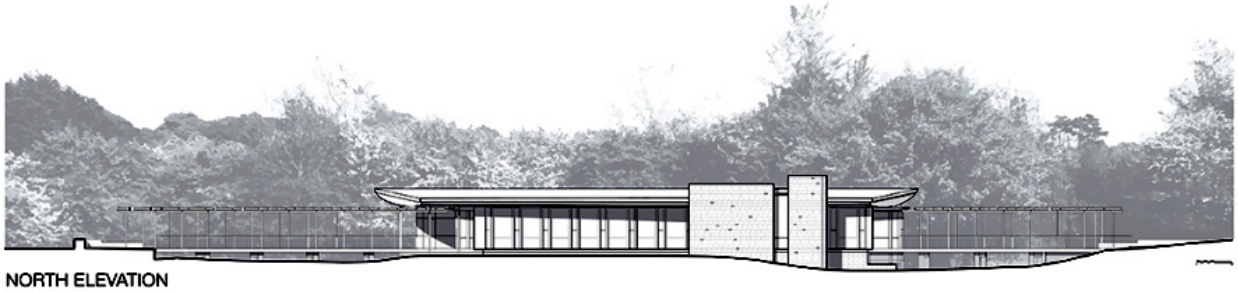
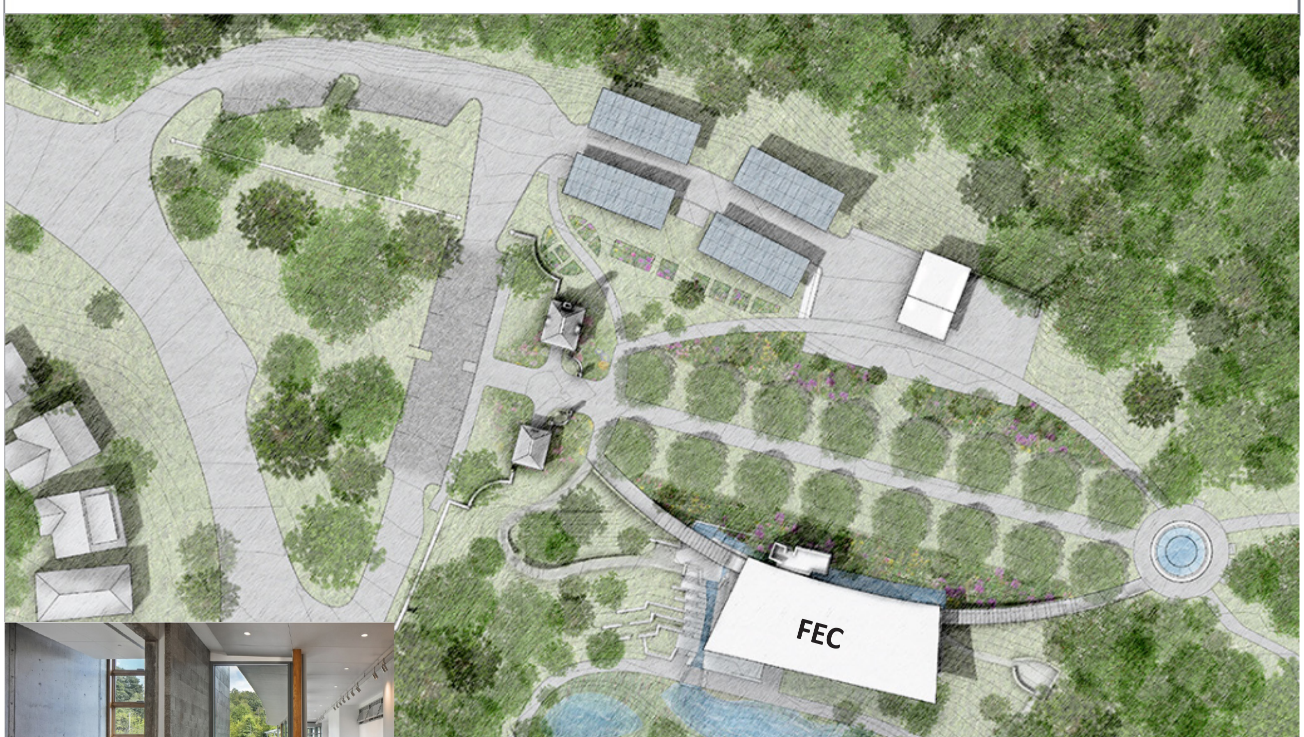


NORTH ELEVATION

Southwest corner

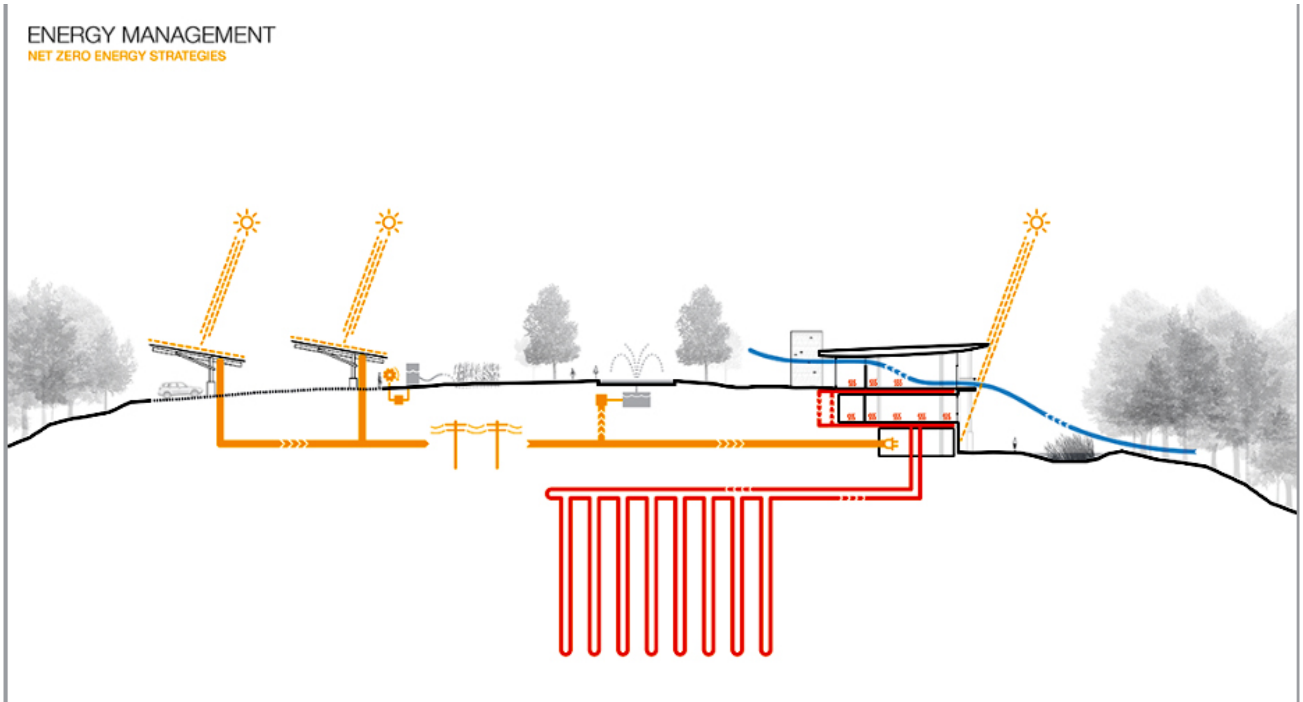
SOUTH ELEVATION



North hallway looking east

3 pts

1. The architects have posted the unlabeled diagram below on their web site. Use you knowledge of passive and energy-conserving HVAC systems to answer the questions.



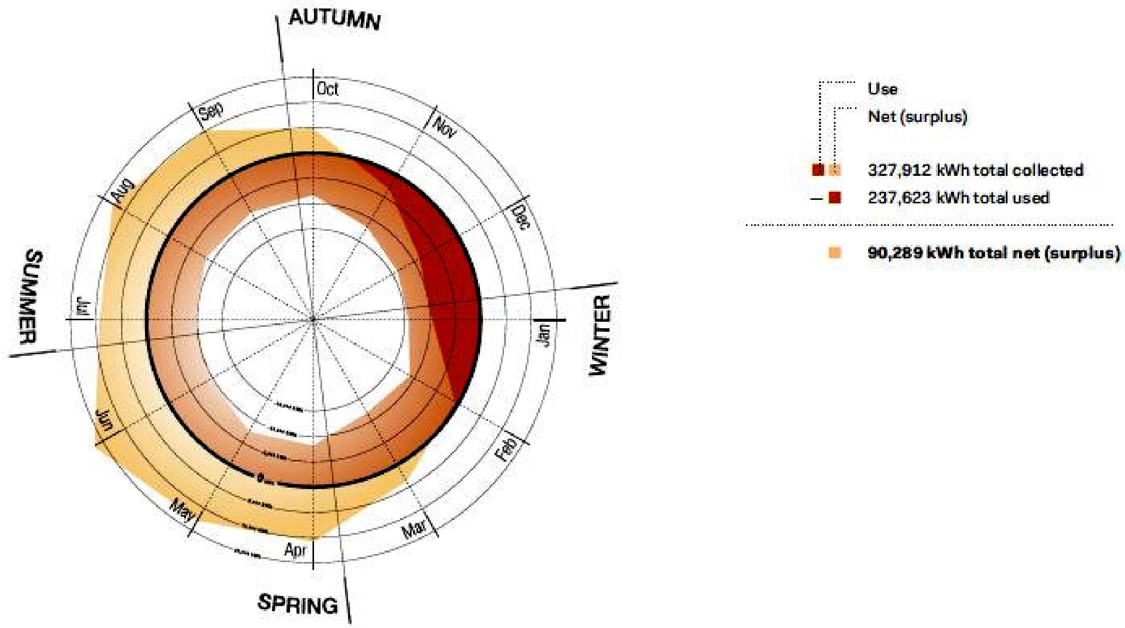
a. On the diagram above **label** two passive systems and **explain** their appropriateness for Pittsburgh's climate.

b. On the diagram above **label** the energy-conserving HVAC system and **explain** its benefit over other similar systems.

2 pts

2. The site features PV shading arrays over the parking lot as represented in the diagram on page 4. The arrays are large enough to provide a bit more electricity than the building consumes on an annual basis. The black circle in the diagram below represents 100% of daily energy consumption throughout the year.

Energy Use Diagram



a. Explain the diagram in terms of timing of energy production, consumption, and surplus.

b. Discuss the significance of these results in terms of Pittsburgh's climate.

3 pts

3. The following are the published energy performance values for the Frick Center:

ENERGY

Mandatory Metrics

Predicted Consumed EUI: 30 kBtus per square foot per year
Predicted Net EUI: 2 kBtus per square foot per year
Predicted Net Carbon Emissions: 6 pounds per square foot per year
Predicted Reduction from National Average EUI for Building Type: 60%
Predicted Lighting Power Density: 0.7 W/sq ft

Encouraged Metrics

Actual Consumed EUI (Site EUI): 23 kBtus per square foot per year
Actual Net EUI: -0.7 kBtu per square foot per year
Actual Net Carbon Emissions: -0.18 pound per square foot per year
Actual Reduction from National Average EUI for Building Type: 101%

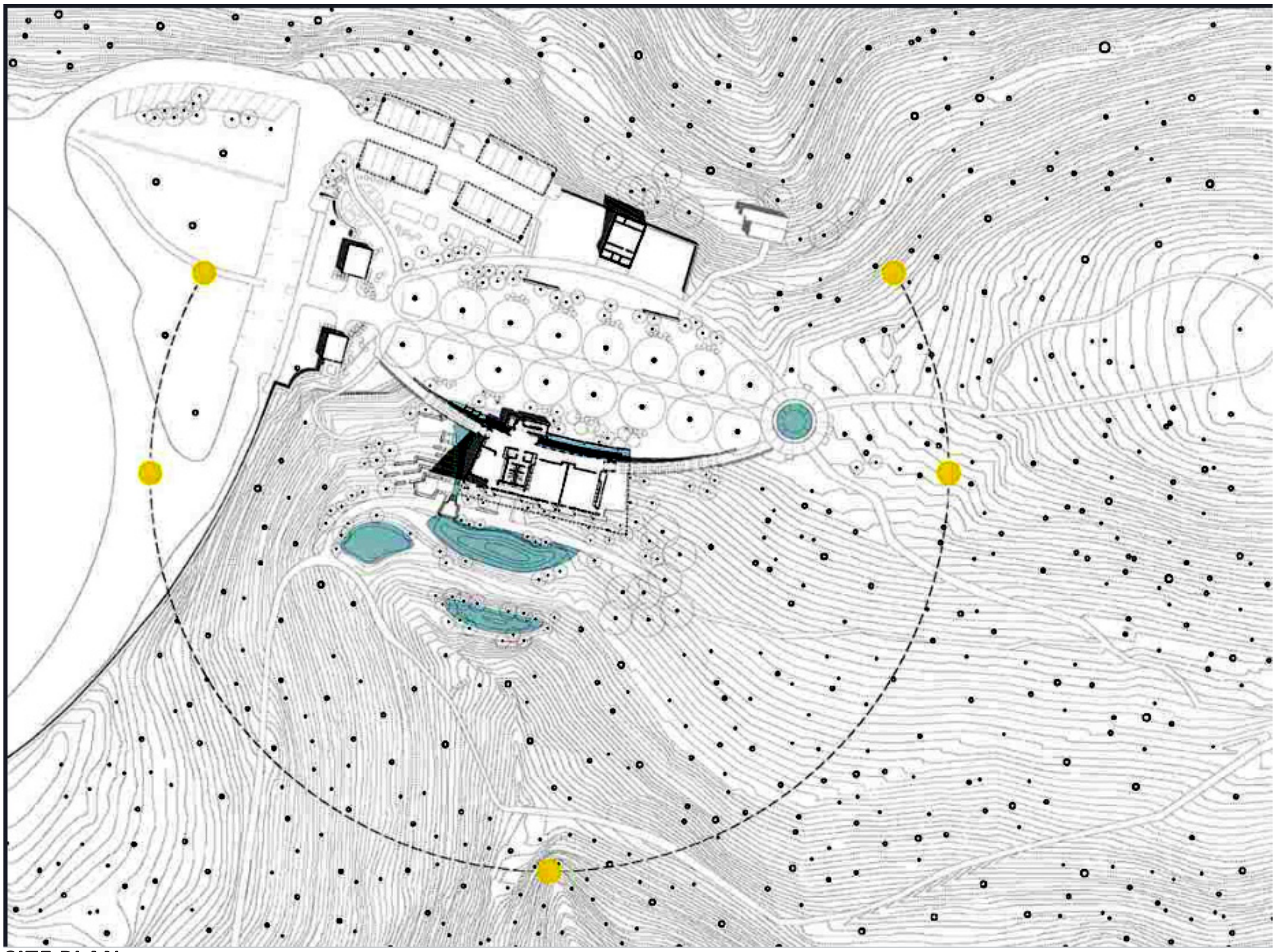
a. **Explain** why there is a difference between predicted consumed EUI and predicted net EUI.

b. Is it accurate to state, "The center's predicted net energy use intensity (EUI) was just 2 kBtus per square foot per year—60% below average for similar structures?" **Explain why not**.

c. **Theorize** why the actual consumed EUI is less than the predicted consumed EUI.

2 pts

4. The site plan below seems to indicate special solar event at sunset on the summer solstice. What is that event and why doesn't happen? **Explain!**



SITE PLAN