Arch 464
ECS
Spring 2016

Name____

Quiz #2

"The Big Chill, Hot Water, & More"

Stanford University's Central Energy Facility viewed from the northeast. The CLT panels on the east and north edges are set at an agle to mount PVs for electricity generation.

For this problem you are the water use consultant for Stanford University, which has experienced an unexpected influx of visitors to the Central Energy Facility since its openning last year. One of the university's goals is to be efficient and sustainable as well as to educate. Recognizing the role of water in sustainability and energy efficiency, they have decided to expand the educational role of the visitors' center and office building (the L-shaped building at the northeast corner) to address issues of water use and treatment. The completed building is sited in a landscape of bark-o-mulch and small trees and shrubs. Your role is to suggest green, educational, and poetic alternatives for water use and treatment throughout the office/visitors' center building and on the adjacent site.

Context. Palo Alto which has a mild coastal climate with about 18 inches of rain each year, most falling November through March, with virtually none from June to September. The building is connected to city water supply and sewers.

Description. See more at: *<http://www.architecturalrecord.com/articles/11538-stanford-university-central-energy-facility.>*

READ THE ENTIRE QUIZ BEFORE YOU BEGIN!

Stanford University Central Energy Facility Palo Alto, CA

Power Play: A state-of-the-art complex fuels a campus while serving as a teaching tool.

Stanford University's Central Energy Facility has a lot of serious technology, but much of it is presented in the lively hues more typical of a children's museum. Doubling as a teaching tool, the low-slung building showcases the university's innovative new heating and cooling system with ample glazing and equipment painted in vibrant shades, like orange and aqua, so that visitors can clearly see which parts carry hot water and which ones cold. At night, the bright red surface of a hot-water storage tank is lit so it glows like a giant ember at the heart of the complex.

"We worked to make architecture out of something that, at first glance, didn't have a lot of potential," says ZGF principal Toby Hasselgren. "Stanford has an obligation to be efficient and sustainable in its operations, but it also has a mission to educate. Why not do both?" adds Joe Collins, partner at ZGF.

In 2009, the school began considering alternatives to its aging gas-fired power plant. An earlier technology for conserving energy, its cogeneration plant generated electricity and used the by-product heat to warm its buildings. However, a careful analysis revealed that yet more efficiencies could be gained. During much of the year, the campus needed nearly as much heating as it did cooling (since incoming air had to be cooled first to remove humidity and then reheated to comfortable temperatures, particularly at night). This meant that excess heat discharged during evaporative cooling could be reused, instead of lost to the atmosphere. So the school designed an extensive heat-recovery loop, which they say is the first such system on this scale. Reducing the campus's total energy use by a third, the nearly $500 million system includes a 22-mile network of pipes and three giant holding tanks for hot and cold water. (The university also switched to an off-site solar farm as its primary source of energy.)

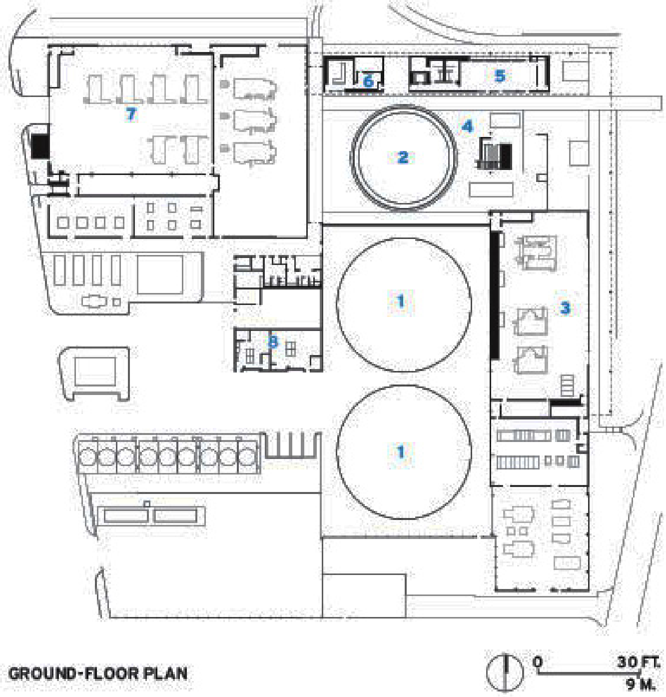
Of course, the tanks, related machinery, and offices could have been housed in a nondescript facility. But, given the radical switch in energy use that the project represented, campus architect David Lenox saw the benefit in highlighting it rather than hiding it from view. ZGF, which had previously designed a stem-cell research building at Stanford, was hired to create an appropriately outward-facing design.

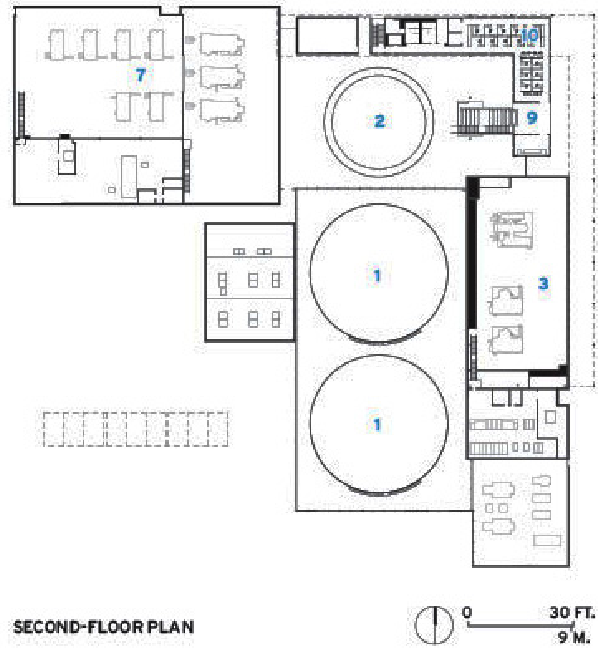
On the nearly three-acre site, the architects designed a surprisingly grand complex of buildings organized around the water tanks. The Central Energy Facility faces the main campus to the east and is aligned with its grid. Its centerpiece is the hot-water tank, nearly 70 feet in diameter and protected by a 64-foot-tall screen whose stainless steel and aluminum perforated panels shimmer in the sun. Meanwhile, the two larger cold-water tanks have been lowered 25 feet below grade to reduce their visual impact.

The two main volumes that house the heat-recovery equipment are simple steelframed structures with cast-in-place concrete walls, integrally colored as a nod to the university's historic sandstone buildings. A welcoming canopy of solar panels, supported by steel pipe columns, unifies the front and wraps around the corner. To the northeast is a two-story, 10,000-squarefoot L-shaped building for staff and visitors. On its ground level, a large conference room, which often serves as the starting point for tours of the facility, doubles as an extra classroom. A courtyard offers another prime spot to congregate, with its bleacher seating looking out onto the hot-water tank. At the top of this stair, a spacious breezeway provides a protected outdoor space for small gatherings and leads to the offices for the 16-person staff, in a narrow, 25-footwide bar with daylight flooding through its glass curtain walls.

The architects' creative material palette lends the complex a visual richness. The "people" building is clad in weathering steel, a nod to the site's former agrarian life. The use of maple on the soffits, as well as the cross-laminated timber underpinning the solar panels, provides a warmth and subtly suggests that this is a safe place to be, with no threat of combustible gases. Finegrained metal screening adds a sense of lightness. The two larger cold-water tanks are delicately masked by perforated box-ribbed aluminum, while the courtyard is shielded from the sun by a trellis topped with steel grating. "Power plants are typically the worst part of a campus—they're ugly and smelly," says Joe Stagner, executive director of Stanford's department of sustainability and energy management. "When people come here, they are immediately disarmed. As with the rest of campus, the investment in architecture has helped to make a good impression; it helps to open minds and excite the imagination."

—Lydia Lee, AR March 1, 2016





1 CHILLED-WATER STORAGE TANK
2 HOT-WATER STORAGE TANK
3 HEAT-RECOVERY CHILLERS
4 ENTRY COURTYARD
5 CONFERENCE ROOM
6 CONTROL ROOM
7 CHILLERS AND HOT-WATER GENERATORS
8 WORKSHOPS
9 BALCONY
10 OFFICE

The visitors' center/office building brackets the hot water storage tank (2) on its north and east sides. It features stacked men's and women's rooms on the north side adjacent to the ground floor conference room (5) and second floor office (10).

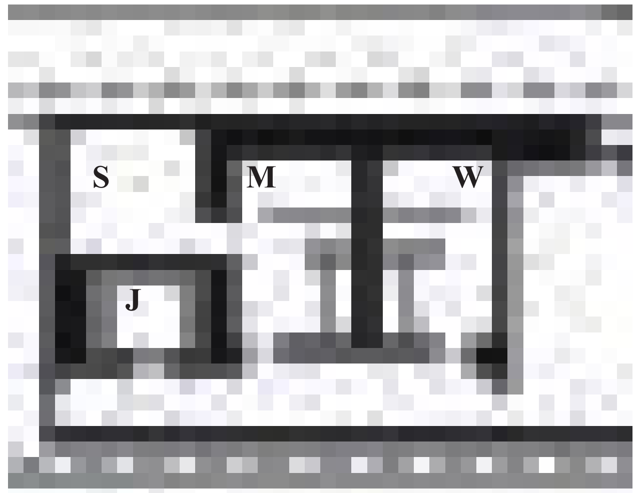
Entry to the visitors' center/office building is through the courtyard (4) that faces east. Angled to face the sun, CLTs form an arcade on the east side of the building and support PV panels.

3 pts. 1. **Describe three** strategies to improve and demonstrate management of **stormwater** on the site while providing educational opportunities. Use the photos below to **illustrate** your ideas. **Fully explain each** for its merits, aesthetics, and limitations on this site.


4 pts. 2. **Describe two options** to demonstrate alternative means to deal with **black water on site**. On the typical plan below or on page 3 show where each would be located in the building or on the site. **Critique each** for its merits, aesthetics, and limitations in this building and **explain** your choice of the better of the two options for attaining the university's educational goals for water treatment.

Ground floor plan. Tours and presentations for visitors start in the conference room (5) and they have access to the bathrooms between it and the control room (6).

3 pts. 3. **Show** your recommended fixtures for all four rooms on the schematic plan below. **Describe** each and **explain** its role in water conservation and water education.



Bathroom schematic. Ground floor and second floor bathrooms have the same configurations and are stacked. Both are accessable to the public. Key: S = shower; M = men; W = women; J = janitor.