Leadership in Energy and Environmental Design at Johnson Space Center

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The designs of all new construction and major renovation of facilities at the Johnson Space Center (JSC) meet the Leadership in Energy and Environmental Design (LEED) criteria. This criterion ensures energy and material efficiency and sustainability are inherent in all new construction.

To make certain JSC meets NASA Headquarters' minimal LEED Silver requirements, the architect-engineer firm performing the design, project manager, and project team performed an LEED design charette at the pre-design stage. This charette calls for an item-by-item review of the U.S. Green Building Council's LEED Project Scorecard to determine which LEED points are reasonable to accomplish within the scope of a project and which are open possibilities.

As a project progresses through its 30%, 60%, and 90% design review, we reexamine the scorecard to determine which points must be dropped out or might be added due to the latest engineering design data. At the 30% stage, we justify by a life cycle cost analysis the design concept proposed by the architect-engineer. This analysis is adjusted and refined as the project progresses to its final stage.

This process has enabled JSC to design and construct the following LEED buildings over the past 4 years:

LEED Certified

Building 27: The Astronaut Quarantine Facility

Designed to LEED Silver

Building 207A: Gilruth Recreation Center facility addition (construction complete, LEED certification pending)

Building 29: Constellation Avionics Integration Laboratory (under construction, total building refurbishment)

Building 265: Source Evaluation Board office additions (under construction, building addition)

Designed to LEED Gold

Building 2 North: Office of Communications and Public Affairs (under construction, total building refurbishment)

Building 26: The Center for Human Space Flight Performance and Research (under construction)

Building 12: Offices (in design, total building refurbishment)

Building 20: New Office Building (under construction)

The two most unusual LEED facilities are the Astronaut Quarantine Facility (Bldg. 27) and The New Office Building (Bldg. 20). We will describe these below.

Building 27: The Astronaut Quarantine Facility

Building description

JSC's single-story, 12,000-ft^2 Astronaut Quarantine Facility uses sustainable features; it earned the LEED Certified rating by the U.S. Green Building Council (figure 1). Prior to space flight, astronauts live in this facility to receive daylight and nightlight conditioning from high-output lights that modify their circadian rhythms to match the upcoming sleep/wake flight schedule. This circadian rhythm lighting consumes significant energy and produces a considerable heat load that the air-conditioning system must remove.

Fig. 1. *Building 27: The Astronaut Quarantine Facility.*

Features included in the project

Faced with the challenge of optimizing building energy performance, the design team oriented the Astronaut Quarantine Facility to maximize daylight harvesting and installed an ENERGY-STAR-compliant, highly reflective roof. The design includes high-efficiency, variable-speed

heating, ventilation, and air-conditioning (HVAC) equipment and the use of an energy recovery system with an enthalpy wheel and preconditioned outside air (figure 2).

Designers used energy-efficient windows and added insulation on the exterior walls (figure 3). Low-flow restroom fixtures, including waterless urinals, dual-flush valves, and flow restrictors on the faucets, were installed.

Native plants and adapted species (figure 4) are seeded around the facility to reduce maintenance and water use, and condensate water acts as the primary irrigation source.

As designed, the Astronaut Quarantine Facility is expected to reduce potable water consumption for landscape irrigation by 50%, be 55% more energy efficient then ASHRAE [American Society of Heating, Refrigeration, and Air-conditioning Engineers] 90.1 specifies, and divert greater then 50% of all construction waste from disposal.

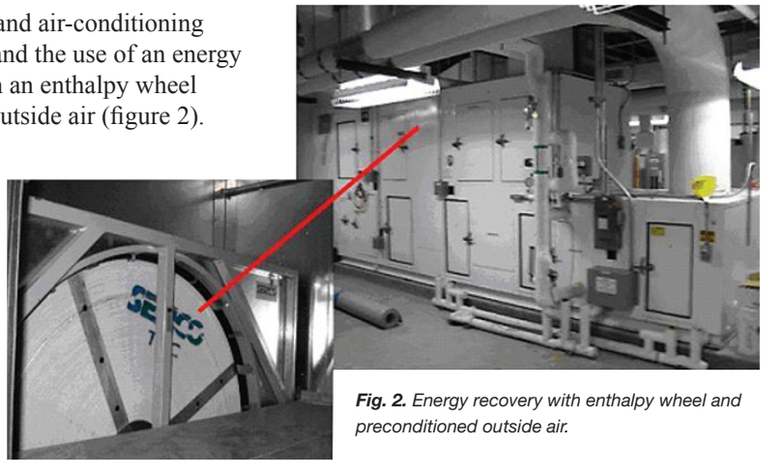

Fig. 2. *Energy recovery with enthalpy wheel and preconditioned outside air.*

Fig. 3. *Efficient building shell – minimum windows, added insulation, efficient windows.*

Fig. 4. *Native plants and adapted species.*

Building 20: The New Office Building

Building description

JSC's newest facility (figure 5), the New Office Building, is a three-story, 83,000-ft^2 office building employing numerous sustainable features. In the design JSC originally strove for an LEED Gold rating but, because of improvements and innovation during facility construction, the center hopes it will earn its first Platinum LEED rating by the U.S. Green Building Council. The New Office Building is presently being constructed to support JSC's multi-year building refurbishment program to provide "flex" space for employees temporarily relocated due to refurbishment of another building. The main design decisions for the building centered on creating a highly flexible space that could be altered quickly at minimum cost. Additionally, designers meant to create a highly sustainable facility using the "less-is-more strategy" (i.e., a very efficient building design reduces the programmed building area and the amount of finishes where applicable).

Fig. 5. *Building 20: The New Office Building.*

Features included in the project

As with Building 27, the design team oriented the New Office Building to maximize daylight harvesting and installed an ENERGY-STAR-compliant, highly reflective roof. Low-flow restroom fixtures, including waterless urinals, dual-flush valves, and flow restrictors on the faucets, will be installed. Native plants and adapted species are seeded around the facility to reduce maintenance and water use, and condensate water is used as the primary irrigation source.

Faced with the extra challenge of optimizing building energy performance for a facility anticipated to undergo significant change over the coming years, the design team installed a high-efficiency underfloor HVAC system for flexibility.

The project design team, in striving to win JSC's first LEED Platinum rating, included such extras as Solarban® 70 energy-efficient windows (figure 6), built-in solar shading barriers, solar hot water heating for the restrooms, ultraviolet lighting in air handlers to reduce microbial growth, and a detention pond and structural controls to manage and improve storm water runoff.

As designed, the New Office Building is expected to reduce potable water consumption for landscape irrigation by 54%, use 34% less water than a building that just meets baseline fixture performance requirements of the Energy Policy Act of 1992, be 55% more energy efficient then ASHRAE 90.1 specifies, and divert greater then 90% of all construction waste from disposal.

Facility occupants will benefit from a building designed to provide natural daylight to all office spaces.

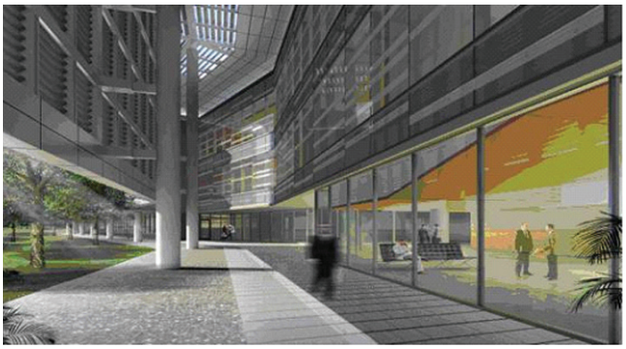

Fig. 6. *High-efficiency glazing and solar shading reduces energy use by 54% compared to typical office.*

Natural light in the stairwells, bicycle racks, and showers was included to encourage employee health and fitness. Project construction is scheduled so that occupancy should begin in the winter of 2009/2010.

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