ENERGY PERFORMANCE GOALS

The energy performance goals for this building were in no way modest. The client and design team set the goal of 50% lower energy use as compared to a Title 24 compliant laboratory building. This was achieved while meeting a modest construction budget and providing an exceedingly comfortable work environment.

Daylighting and Lighting Systems

Daylighting serves as the center's primary task light and provides 100% of the light required for the major part of the day. While the initial siting studies suggested a fatter building facing east and west to define a new courtyard and circulation spine, the design team shifted new greenhouses onto the courtyard and lengthened and rotated the main building to ensure ideal orientation and a narrow, forty-foot depth for daylighting and solar control. These efforts, coupled with exterior solar shading and interior lightshelves, allow controlled daylight and create a space that is intimately tied to diurnal cycles with superior visual comfort and direct views to the outside from all workspaces. Ambient electric lighting is provided by direct-indirect pendants, with important wall surfaces also washed with light. Lab modules are served with a single T5HO lamped fixture, along with movable under-shelf task lights. Most lighting has occupancy sensors and is dimmed with photo-controls.

Lab HVAC Systems & Energy Savings Strategies

Laboratory HVAC systems are extremely energy intensive. Typically they use from five to ten times more energy than offices spaces. This is due to the 24-hour per day operation and the use of 100% outside air. In the past there has been the misconception that energy efficiency was not possible on laboratory HVAC due to the stringent safety requirements of laboratories. This project, as well as some other notable ones, shows that laboratories can be efficient, affordable and safe. Some of the features that were built into the laboratory HVAC systems include:

1. Low face velocity air handlers and low pressure drop design – The supply air handling system was designed with a total static pressure of 2.0 inches. This compares to typical designs that use 5.0 inches. The fan energy is therefore 60% lower.

2. Exhaust Heat Recovery – A heatpipe is used to recover heat from the general laboratory exhaust air. Beyond annual energy savings, the heatpipe system significantly decreased the peak heating load requirements, allowing a downsizing of the boilers and offsetting some of the first cost.

3. Cascading Air Flows – In order to lower the amount of outside air required air was supplied to non-critical (no chemical use) laboratory areas and then cascaded through to critical areas (fume hood rooms) before being exhausted. This saved approximately 20% of the total air flow and thus ventilation fan and conditioning energy.

4. Ventilation Setback – A modest setback of non-critical laboratory areas ventilation rates is allowed at nighttime hours if lighting systems are off and the space is unoccupied. The fume hood areas are not set back.

5. Separation of Ventilation and Sensible Heating Systems – Most laboratories use 100% outside air systems to provide additional cooling to areas of high cooling loads. This laboratory area employs an in-slab heating and cooling system. This allows for smaller air handling systems driven only by safety requirements, reducing ventilation rates by 18%.

6. Highest Quality Air Filtration – All air that enters the laboratory passes through 95% efficient filters. Many of the areas in the lab have HEPA filtration systems. Several occupants of the building prefer to work in the lab areas during hay fever season due to the excellent air quality.

Office HVAC Systems & Energy Savings Strategies

Through an exhaustive integrated design effort the design team strived to design a building that would maximize daylighting in the offices areas while minimizing the need for cooling and heating systems.

1. Naturally ventilated offices – Office spaces are equipped with operable windows for occupant-controlled natural ventilation. The roof slopes up to south facing operable clerestories, and casement windows open to the west to enhance ventilation from prevailing NW breezes. The height of the clerestories encourages stack effect ventilation on windless days. Occupants can access the outside air temperature and interior air temperature at the thermostat located in the space, allowing them to make intelligent decisions on opening the windows.

2. Radiant Heating and Cooling – The office areas are heated and cooled by radiant floor slabs. Radiant was selected due to its excellent match with naturally ventilated spaces and its superior user comfort characteristics. CFD modeling helped fine tune and optimize the radiant and natural ventilation systems. Even the 30-person conference room does not require fan based cooling.

3. Economizer Cooling Dense Server Room – Much of the research of the Center is computer modeling based. The building has a server room with several dense server clusters. The server room uses both a full economizer and a hot aisle/cold aisle configuration to minimize the cooling and fan energy use. The economizer also ultimately took the place of a conventional backup unit.

4. Lobby Katabatic Cooltower – Assisted by the windcatcher top, the cool tower evaporatively creates a cool breeze in the lobby area. On mild days, the lobby is open to the outdoors on three sides, making the cool tower a natural fit to efficiently condition this area. The katabatic winds are a natural phenomenon that is studied by the Carnegie Institute where air creates a breeze down the face of a glacier as it is cooled.

Common HVAC Systems & Energy Saving Strategies

The core of the heating and cooling system is a simple, elegant and innovative hydronic system that provides heating hot water and chilled water to the building.

1. Nightsky System – A combination of radiant and evaporative cooling produces chilled water via a rooftop mounted spray system that operates at night. Chilled water is stored in an insulated 12,000 gallon tank and used during the day for cooling. A chiller is connected to the system to serve as backup and for peak days. In the summer of 2004 the chiller only operated 65 hours.

2. Condensing Boilers – The radiant heating in the building is perfectly matched for the lower temperature condensing boilers that operate at 94%+ efficiency at design temperatures.

3. No Chemical Water Treatment – All rainwater is collected through the roof spray system, settled out in the tank, and filtered. The annual volume of rain water is enough to eliminate the need for any blowdown. Water to the roof spray comes from the chilled water tank, which is maintained at 50-70F, below the temperature that biological growth is a concern. To further insure complete safety, a UV sterilizer treats the water prior to it being sprayed on the roof.

Plug Loads and Building Size

Special attention was paid to reducing plug loads and building size in the programming and schematic design phases of the building. The single largest plug load in most laboratory buildings that have strong biology research elements are the -80 degree C freezers. These freezers are typically put in laboratory spaces and the heat they produce is removed with expensive 100% outside air laboratory HVAC systems. A decision was make to put most of these freezers in an adjacent unconditioned warehouse. This allowed for close to a 20% reduction in laboratory square footage. This reduced energy use, HVAC system size and construction costs.