HIGH PERFORANCE MECHANICAL SYSTEMS FOR HIGHER EDUCATION

TLCDARCHITECTURE

Above: Santa Rosa Junior College, Plover Conversion

"Energy is one of the few expenses a school can reduce without sacrificing educational quality."

- US Department of Energy

INDIRECT / DIRECT EVAPORATIVE COOLING

BASIC PRINCIPLES

This system has two major elements - traditional direct evaporative cooling at the intake and a closed loop heat pipe at the exhaust to extract waste heat and drive cooling cycles. The system is typically 100% outside air.

BEST APPLICATIONS

Hot dry climates with low humidity. Well adapted to California Valley and Coastal climates.

ENERGY PROFILE

Systems on higher education buildings have been able to function at 103º without additional chilled water. Sonoma State University Salazar Hall Renovation (heavy concrete mass) has been able to shut off central plant chilled water and is operating 42% under Title 24. Typical institutional energy savings are 10-15% under Title 24.

OCCUPANT COMFORT/INTERFACE

Adds some humidity to air which may be desirable in hot dry climates. 100% outside air does not recycle indoor pollutants.

COST & INSTALLATION PROFILE

Major supplier of IDEC units is DeChamps. These "boxcar" units can be roof, attic or ground mounted. Cost premium is 100% and expected payback is 5-15 years.

HIGHLIGHTED PROJECTS

Petaluma Campus Phase I: 70,000 gsf, penthouse mounted fan units. Installed 1994.

Petaluma Campus Phase II: 130,000 gsf, penthouse units on classroom buildings. Ground mounted central plant building feeding library through underground fiberglass duct system. Both types feed displacement ventilation systems with a combination of ducted and underfloor distribution. Installed 2007.

Plover Conversion SRJC: 35,000 gsf conversion of old library to student services. Underfloor distribution serves HVAC and electrical/data needs in retrofit. Some perimeter radiant ceiling panels at perimeter zones.

Salazar Hall Renovations SSU: 116,000 gsf conversion of library to classrooms, offices and labs.

Left: Napa Valley College, Central TES Plant

“Schools are a great place to teach the nation’s youth about energy and resource conservation.”

- US Department of Energy

THERMAL ENERGY STORAGE SYSTEMS

BASIC PRINCIPLES

Uses off peak power to generate ice or chilled water at off peak demand periods. Chillers typically run at night.

BEST APPLICATIONS

Can depend on electrical rate structures available. Applications can range from Central Plants to small/medium size applications (Ice Bear units). Can be retrofitted to smaller DX units.

ENERGY PROFILE

TES systems can reduce overall system energy costs 10% and eliminate electrical demand charges from 12 to 6 p.m.

OCCUPANT COMFORT/ INTERFACE

Little difference from traditional chilled water generation systems.

COST & INSTALLATION PROFILE

Cost reductions vary with rate structures but electrical costs for chillers can be as low as 1/3 of peak demand costs. Cost premium is 100% of the chiller component cost and payback is estimated at 10-15 years.

HIGHLIGHTED PROJECTS

Frank P. Doyle Library: **1**45,000 gsf, 108 tons of ice generated by 5 ground-mounted units in separate utility yard. Feeds low temperature distribution system. Installed 2006.

Napa Valley College Central Plant: Campus central plant generates 375 tons of ice in twelve 63,000 pound units. Distributes chilled water to new campus distribution network. Installed 2006.

DISPLACEMENT VENTILATION

BASIC PRINCIPLES

Air is introduced at occupant level through underfloor or perimeter duct systems. Air is 65º, ten degrees warmer than typical HVAC systems. Air moves along floor and convectively up to exhaust vents or natural outlets. Cooling is at occupant zone not at ceiling.

BEST APPLICATIONS

Large open high ceiling spaces such as libraries because of savings in not cooling upper regions of the volume. Classrooms and open office areas because of comfort and acoustical advantages. Not as well adapted to small office and highly subdivided spaces. Package rooftop units now available.

ENERGY PROFILE

Ten-degree difference in delivered air temperature is major advantage. Stratified heating and cooling results in less volume per square foot occupied. Increased economizer hours and downsizing of equipment because of delivery temperatures. Overall cooling load savings estimated at 40 %.

OCCUPANT COMFORT/ INTERFACE

Comfort: Warmer air is more comfortable to occupants. Greater degree of occupant control on raised floor systems with “salad spinners” that can be occupant adjusted without unbalancing system. Lower air velocity is less noticeable and more comfortable.

***Acoustics*:** Because of lower velocity and plenum distribution in raised floor systems ambient fan noise is greatly reduced. Especially beneficial in classroom and lecture environments.

***Health Benefits*:** Improved Indoor Air Quality. Air rises in columnar fashion around occupants and warm objects and is exhausted convectively - without the homogenization of room air as in typical HVAC systems. Pollutants and microbes are not distributed throughout room. Usually 100% outside air.

COST & INSTALLATION PROFILE

Raised plenum floor costs can be partially offset by reduced duct costs. With renovations in particular, raised floor provides data and power pathways that significantly reduce electrical remodel costs. High degree of future flexibility for power and data needs. Cost premium is for architectural raised floor, offset by reduced duct work.

HIGHLIGHTED PROJECTS

***Petaluma Campus Phase II*:** 130,000 gsf, 35,000 sf library and 55,000 sf classroom and dry lab building, 8,900 gsf life science and art labs. Hybrid IDEC and Displacement systems. Raised floor in library and classrooms (first floor and raked seating second floor) and ducted in upper floor rooms and wet/art labs.

Napa Valley College, Life Science Building: 20,000 gsf. Four life science labs, faculty offices and lobby. Ducted displacement system coupled with night flush system and TES chilled water supply. Central tower element provides for convective exhaust. Stratified cooling particularly efficient in tall day lit lobby.

Above: Santa Rosa Junior College, Frank P. Doyle Library, Low Temperature Diffuser in Ceiling

Low temperature systems have great utility in buildings with impacted or restricted spaces. The performance and occupant comfort feedback has been remarkable in the Frank P. Doyle Library.

LOW TEMPERATURE SYSTEMS

BASIC PRINCIPLES

Traditional ceiling delivery system with cooling air at 5-8° cooler (47°) than typical systems.

BEST APPLICATIONS

Duct requirements can be reduced as much as 35%. Good in renovations and new construction where floor-to-floor, plenum and chase spaces are limited. Cool delivery air requires non-condensing grilles (plastic). High velocity delivery from these specialized grilles prevents cold air drafts.

ENERGY PROFILE

Lower temperature air that is delivered is offset by reduced volume of air. Overall 58% reduction in fan horsepower compared to conventional systems.

OCCUPANT COMFORT/INTERFACE

Overall experience is that cooler delivery air is not an issue if properly distributed.

COST & INSTALLATION PROFILE

Reduced duct costs.

HIGHLIGHTED PROJECT

Frank P. Doyle Library, SRJC: 145,000 gsf, hybrid system with TES chilled water supply is performing at 10% below Title 24. Comfort level and evenness of occupied spaces is excellent.

Above: The Living Learning Center of University of Oregon

This space uses an incredibly simple concept: only run the system when the users need it or when CO_2 sensors launch the ventilation system. Coupled with natural ventilation utlizing a unique sliding door and loover panel, this classroom complex is elegantly simple in its design.

DEMAND CONTROLLED VENTILATION

BASIC PRINCIPLES

Room ventilation controlled by CO_2 Sensors or Occupant Controlled timing devices. Room exhaust adjusted by CO_2 level or actual use.

BEST APPLICATIONS

Intermittently occupied rooms and rooms with large changes in occupant load. Naturally ventilated buildings.

ENERGY PROFILE

Fans operate by demand, not constant operation or time clocks.

OCCUPANT COMFORT/ INTERFACE

Classroom example had one hour time switch that allowed teach to activate vent fans. Overrides from CO_2 senor to maintain minimum ventilation.

COST & INSTALLATION PROFILE

Additional costs of sensors and time switches offset by reduced fan loads coupled with operable windows or loovers this allows users a high degree of control.

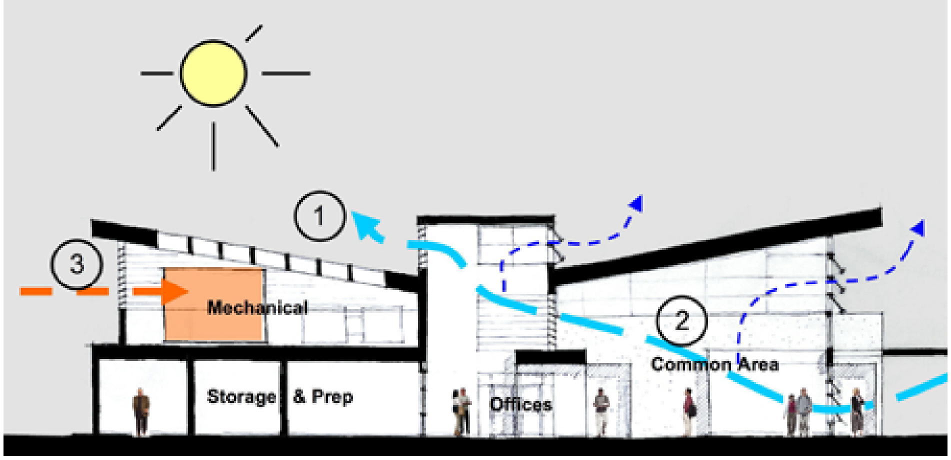
HIGHLIGHTED PROJECTS

Living Learning Center, University of Oregon Architects: ZGF, Portland: Classrooms have one hour time switch coupled with unique sliding glass door louver system for natural ventilation. When rooms are not occupied or natural ventilation is working, the fans are not on.

Above: Napa Valley College, Life Science Building

Night cooling strategies are ideally ladapted to California coastal climates which may have a 30-50 degree diurnal temperature swing. Works best in high mass systems.

NIGHT / MASS COOLING SYSTEMS



Above: Building Section Diagram
1. Night Cooling & Natural Ventilation
2. Day Lit Common Space
3. Deep Building Overhangs for Shading

HIGHLIGHTED PROJECTS

Napa Valley College, Life Science Building: 20,000 gsf. Four life science labs, faculty offices and lobby. Ducted displacement system coupled with night flush system and TES chilled water supply. Central tower element provides for convective exhaust. Stratified cooling particularly efficient in tall day lit lobby. Concrete floors and steel structure enhance thermal mass.

Napa Valley College, Library: 64,000 gsf, currently under construction.

BASIC PRINCIPLES

Building is flushed at night. Thermal mass is cooled and reduces cooling load. Louver Systems at low points, fan assists and convective exhaust drives systems.

BEST APPLICATIONS

Locations with large diurnal temperature swings (i.e. near coastal California). Cool night air on thermal mass can offset hot days.

ENERGY PROFILE

Substantial reduction in cooling load can be realized. Dependent on large amounts of thermal mass. Renovations of concrete and masonry buildings are ideal candidates.

OCCUPANT COMFORT/INTERFACE

Cooling comfort without mechanical systems during occupied periods.

COST & INSTALLATION PROFILE

Additional louvers, exhaust systems (may be regular HVAC system) and controls.

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