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HVAC Design for LEED Projects
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The HVAC&R industry has finally transcended the critical crossroads where several demands, regulations and goals have all influenced the next generation of systems, equipment, components and features for comfort cooling America's buildings.

The influences that have contributed toward the chosen path come from the broadest of areas of regulatory changes, technological innovations and perhaps most significantly consumer demands.

Regulations now require systems meet new energy efficiency standards, use non ozone depleting HFC refrigerants, and maintain indoor air quality standards.

Technology has evolved to provide systems that minimize the waste in resources required for systems to maintain a constant comfort over a diversity of conditions along with the ability to monitor systems.

Consumers have demanded better control over their indoor environment and have become very savvy as to how the HVAC&R system contributes to productivity, health, comfort and overall quality of life. Consumers are also more environmentally conscious than ever and recognize that the ability to meet their comfort expectations can be accomplished without neglecting the responsibility we have to protecting our natural resources and the environment.

Individually these influences might seem uncompromising and together may appear to conflict with one another. However one place that joins all of these influences into a comprehensive order of priority is within the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) Rating System.

The purpose of this paper is to provide the Building Owner, Architect, Consulting Engineer, Contractor and other interested principles an overview of how these evolutions have matured to provide the new direction in HVAC applications, and how the Daikin VRV system enables a comprehensive approach to meeting these needs.

A LEED's Overview for Heating & Cooling.

The LEED Rating System identifies six significant areas of evaluation and grading which are intended to promote high performance sustainable building practices that are environmentally friendly, energy efficient, and provide for ease of maintenance over a long building life. The areas rated are Site Selection, Water Efficiency, Energy & Atmosphere, Materials and Resources, Indoor Environmental Quality, and Innovation and Design Process.

For the HVAC&R Designer the LEED Rating System is a sound culmination of priorities that have in many ways always been goals in applying systems. It identifies in one document several individual issues that have been looming over the industry.

LEED Rating System puts the plan in place for the consultant to begin to implement what are inevitable requirements in a comprehensive and structured manner.

Equipment manufacturers and suppliers have also been well aware of the pending regulatory requirements that they must meet while at the same time seeking more opportunities to meet the consumers increasing demands for comfort control.

For all practical purposes HVAC Equipment has been a very mature industry from a core technology standpoint. The basic refrigeration cycle that is the heart of HVAC&R systems dates back nearly a century. The past two decades brought about component upgrades such as new types of compressors, economizers and controls. The basic cycle, its capabilities and its limitations have however remained sound at the core. Transcending the crossroads has produced a revolution in new and comprehensive HVAC&R systems development.

The result is a completely evolved system that has been developed taking advantage of the technology advancements of past two decades that meet and exceed the demands of new regulations and environmental goals, while providing the consumer with more control over a healthier, more comfortable indoor environment.

HFC410A The New Standard.

Refrigerant HFC410A is a non-ozone depleting refrigerant developed to replace the most common and broadly used HCFC R22 (now being phased-out) for comfort conditioning systems.

Upon development in 1992, HFC410A showed superior performance characteristics over its predecessor R22. The increase in thermal performance has resulted in significant advantages. Heat Exchangers for HFC410A are 40 to 60% smaller in surface area required than that of traditional R22 Systems. The smaller heat exchangers result in smaller condenser and evaporator fans. Compressor displacement is also significantly lower resulting in much smaller compressors.

As an example:
When HFC410A was applied to operate in a system with traditional sized components of a R22 3 Ton split system, the modified HFC410A system produced a 65% increase in system capacity and maintaining a similar efficiency to that of the 3 Ton system.

The above example required some significant modifications however to accommodate the higher operating pressures and lower density of HFC410A. The condenser, evaporator and compressor had to be rated for the higher working pressures and the expansion device had to be reduced in size for the lower density of HFC410A.

HFC410A systems provide significantly smaller equipment to fit into the architecture of buildings and much higher efficiencies. An HFC410A standard split system heat pump typically offers efficiency levels of 15 to 16 SEER (50% over the common 10 SEER systems and 20% over the 2006 mandate level of 13 SEER)

The Expansion of Direct Expansion

A most significant advancement for the commercial HVAC designer will be with the ability to apply direct expansion systems in larger facilities and broader applications than was reasonable with the old systems that used R22. The residential application will now have more space control over each room or zone of a home.

Until now, any building whose square footage requires that primary HVAC equipment be located more than 60 to 80 feet away from the conditioned space, or whose height required vertical distances of more than 4 stories, were commonly forced into indirect expansion cooling systems such as, water cooled equipment systems, large ducted air distribution systems or pumped chilled water systems.

To mitigate the penalties and efficiency losses of indirect cooling/heating and large ducted systems controls, economizers, load shifting devices and variable speed drives have been used and are marketed with claims of adding efficiency.

The typical best case scenario requires multiple equipment, specialty and control vendors to be applied to come up with a system that will attempt to operate in a fashion where energy consumption profiles the building cooling and heating loads.

These systems require a great deal of space, and often require structural enhancements in the building to accommodate the weight and mitigate the sound and vibration effects that equipment has on the buildings operations and occupants.

In order to provide some degree of comfort control, zoning systems such as VAV Boxes, control valves, and other independent devices must be employed.

While these devices do limit the amount of cooling or heating that is supplied to one area, space or zone, the centralized system must operate at a capacity that enables the conditioning of the space that is furthest from it's set point.

While the overall capacity that the central system operation is reduced, it is not at a linear efficiency cost savings. While heat transfer savings are realized, the costs to deliver heat transfer are increased.

In large water cooled systems, the HVAC system is often the largest single consumer of potable water in the facility with significant water losses coming from drift and evaporation losses of cooling towers.

HFC410A provides the designer the ability to eliminate the multitude of these losses and concerns from a building application.

HFC410A direct expansion systems can be distributed over a significantly larger area with respect to distance and height. The distance from the Compressor/Condenser unit to the evaporator coil & indoor air fan can be as much as 330 feet in horizontal distance and up to 150 feet in vertical height difference.

Modular in Lieu of Centralized

Because of the higher working pressures of HFC410A, individual systems components are currently limited to smaller tonnage range capacities (under 20 tons)

This however is overcome as a limitation when one considers the modular capabilities of applying HFC410A systems to a facility.

With equipment being much smaller for a given capacity than any of its predecessors, it is much easier to apply multiple systems to a facility and locate the equipment in a various parts of the building.

With the weight, vibration and noise levels all significantly reduced over conventional systems, equipment using HFC410A can be blended into buildings architecture and configurations in ways that was not previously acceptable for buildings operations, aesthetics' and occupant comfort.

Where conventional systems required significant space allocations, the new HFC410A systems return these spaces back to the occupants. The cost benefits of eliminating costly structural requirements and by providing a higher percentage of usable space in a given building envelop is likely one of the more tangible, more valuable, yet difficult to calculate aspects of this new means of conditioning facilities.

Daikin's VRV
Innovative, Comprehensive, Proven,

Daikin Industries, a Global Leader in the Development of HFC410A, is one of the world's largest manufacturers of HVAC&R systems, and the only manufacturer of both Refrigerants and HVAC Equipment. Daikin began development of a new Variable Refrigerant Volume system in the early 1980's. The employment of new Digitally Commutated motors for compressors and fans resulted in the development of the first truly variable volume systems. Compressor and condenser fan speeds are controlled to maintain precise superheat while the evaporator fans are controlled to maintain precise space temperature set points. The result is a system that can maintain space temperature to within +/-0.5 deg F., while also providing significant space dehumidification as the fan slows.

Further innovation on these systems lead to Daikin's development of a electronic expansion valve, also controlled to maintain superheat, that could now precisely control the amount of refrigerant used at the evaporator coil to match the load.

Combining these new advancements now provides multi-circuiting of several evaporator coils to a single compressor/condenser refrigeration cycle. Space or zone control is now accomplished directly within the integral refrigeration cycle. This eliminates the indirect efficiency losses associated with the conventional indirect means of zoning such as the use of chilled water fan coils or variable air volume control of branch ducts off a large central air handler.

Commercial Building EER's Exceed all expections.

Daikin began selling the VRV© systems in Asia and Europe in the mid 1980's and then in Australia in the mid 1990's. Today these systems have captured leading market shares, not only for the residential and small commercial applications, but are being widely applied to larger facilities with cooling loads of several hundred tons.

An individual VRV© heat pump system consists of a condensing unit of between 3 and 8 Tons and up to 10 individual evaporator coil/fan units that can total up to 130% of the capacity of the condensing unit. The increased operating pressures and lower density of HFC410A enables the Daikin VRV© System to employ up to five times the pipe distances and vertical heights of conventional R22 systems.

Full load EER's for the 8 Ton unit are listed at 11.2 and part load EER's of up to 21 have been realized in proven applications over the test of time.
Designers across all markets have taken the VRV© as a modular approach to larger facility applications. Daikin now has over 500,000 VRV© systems installed.

Daikin US Corporation is now offering this technology to the USA market. The timing is perfect as US Consultants look to provide systems that meet the new efficiency standards, utilize the new HFC refrigerants, offer the end-user the features that he demands, and is looking for proven technology.

The Daikin VRV© system offers more features that assist the engineer in meeting the prerequisites for LEED Certification projects and enables the best potential to maximize points achieved all from our standard system product offering.
Daikin recognizes the LEED Rating System as a significant tool not only in promoting sound construction practices, but will play a broader role for the HVAC&R consultant as a culmination of priorities that exist in every project.

The Daikin VRV© system provides the consultant with more direct measurable features to meet those requirements, goals and priorities. Below is a brief outline on

some of the areas that the Daikin VRV© approach can assist in accomplishing LEEDS Accreditations.

√ Energy & Atmosphere: PREREQUISITE 2.0 – Minimum Energy Performance
Daikin VRV© Systems are ENERGY STAR© rated and exceed the efficiency and performance requirements of ASHRAE/IESNA 90.1-1999 and known local energy codes.

√ Energy & Atmosphere: PREREQUISITE 3,0 – CFC Reduction in HVAC&R Equipment.
Daikin VRV© Systems use HFC410A the internationally recognized and accepted replacement for equipment to HCFC R22 applications.

√ Energy & Atmosphere: CREDIT 1 Optimize Energy Performance, Potential 2-10 Points
Daikin VRV© Systems have consistently exceeded energy efficiency projections and computer simulated models, for both existing and new construction applications. Systems bear the ENERGY STAR logo meeting the highest of the three tier efficiency rating schedule.
Lower Ton Heat Pumps have 15 and 16 SEER ratings and Commercial systems have full load EER's of 11.2 and part load EER's of up to 21.

√ Energy & Atmosphere: CREDIT 4 - Ozone Depletion Potential 1 Point
Daikin VRV© Systems are offered exclusively with HFC410A and do not contain any ozone depleting CFC's, HCFC's, or halons.

√ Energy & Atmosphere: CREDIT 5 Measurement and Verification, Potential 1 Point.
All VRV© Evaporator, Condenser and Compressor Motors are Variable Speed. All indoor units have daisy chained control wiring back to a logic controller at the outdoor unit. Gateways for BACnet and LONworks are available as standard options and can provide precise information for each zone to include energy consumption and cooling and heating loads.

√ Indoor Environmental Quality: PREREQUISITE 2 Environmental Tobacco Control.
Because the air circulation of each space/Daikin VRV© indoor unit is already isolated with respect to all other spaces/zones within a facility, a smoking room with direct fresh air supply and exhaust does not require any additional or autonomous cooling/heating equipment than would any other identified zone within a structure.

√ Indoor Environmental Quality: CREDIT 2 Increase Ventilation Effectiveness, Potential 1 Point.
The energy required to condition fresh air supply to the building is optimized by the Daikin VRV© system as the outside air conditions vary from season to season without having to have the capacity online for the worst case or design condition. Complicated balancing schemes and procedures relative to cooling/heating space with changing fresh air conditions is eliminated.

√ Indoor Environmental Quality: CREDIT 5 Indoor Chemical & Pollutant Source Control, Potential 1 Point.
Typically Daikin VRV© indoor units which consist of the evaporator coil, air circulation fan, space filter, and all controls are applied on a space by space application. Air Circulation is limited to the defined conditioned space with no cross-contamination of air from one space to another through the cooling/heating process. Fresh air supply and exhaust air ventilation cooling/heating loads are applied to each indoor unit without complicated air mix dampers and bypasses.

√ Indoor Environmental Quality: CREDIT 6.2 Controllability of Systems Potential 1-2 Points
Individual Temperature Controls for the VRV© are provided for every indoor unit or zone as they are applied. Indoor units are available from 9000 to 48000 Btu/Hr Cooling. An additional product line of single circuit heat pumps is available with individual indoor units being rated as low as 6000 Btu/Hr and can be applied to areas with loads down to 3500 Btu/Hr.

√ Indoor Environmental Quality: CREDIT 7.1 Thermal Comfort Potential 1-2 Points.
Daikin VRV© Systems have a proven record of providing superior comfort by maintaining space to within +/- .05 deg F., of set points and have inherent dehumidification capabilities.

Daikin US Corporation now employs both sales and service veterans of the HVAC industry in several major markets across the United States. In 2004 a national training center was constructed in Dallas, Texas where engineers, contractors, architects and developers from across the country are provided educational and product presentation opportunities. The facility includes a scaled luxury setting application with complete working systems, training rooms, and conference center.

Local offices with sales engineers and service technicians are now in place in New York, Dallas, Orlando, Tampa, and Miami with additional offices being opened in 2005 and 2006.

Sales activities are supported from several of the 11 Daikin Factories located in Asia and Europe, and Latin America.

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Dave Lucas is a 25 year veteran of the HVAC industry with a career that has traversed from service to design, manufacturing, sales and sales management with experience at national and international scopes. With Daikin Dave is responsible to for all education, marketing, applications and sales of the Daikin Systems and capabilities to the Central and Northeast Florida customers.

Basic Environmental Policy of the Daikin Group

Be a Company that Leads in Applying Environmentally Friendly Practices

As we continue developing our business operations in various fields, it is our mission to proactively develop initiatives to respond to environmental issues. Incorporating environmental initiatives throughout our management must be a priority for us. In all aspects of our business operations, including product development, manufacturing and sales, we need to formulate initiatives that sustain and improve the environment. Meanwhile, we need to promote the development of new products and the innovation of technologies that will lead to a more environmentally healthy world.
Under the precept "environmental response is an important management resource," we must integrate environmental initiatives into our corporate management since they can lead to business expansion, improved business performance, and further enhancement of our credibility with outside parties. We intend to continue being a leading company in the practice of "environmental management," thus contributing to a healthier global environment as a good citizen of the earth.