



Signature CENTRE CASE STUDY



Developer Plans for Platinum Productivity with Office Building's Green Design

The Signature Centre is an 186,000 SF office building developed by Aardex LLC and designed by the world renowned architect Binh Vinh. The building will be leased to tenants and includes the relocated headquarters of Aardex. Located at Denver West in Jefferson County, the Signature Centre is now officially the Denver metro area's greenest building, having become the first commercial LEED® Platinum structure in the state.

Aardex is known for its book, *User Effective® Buildings*, which outlines the methodology to create an overall harmonious work environment. Aardex invests in its own designs to create sustainable, energy efficient, more productive work environments that, within a few years of use, pay for themselves. Dr. Volker Hartkopf, director of the Center for Building

Performance and Diagnostics at Carnegie Mellon University said, "...I'm impressed by what Aardex is doing. This is breaking the mold in development."

LEED® Core and Shell

The Signature Centre recently received a Platinum LEED for Core and Shell certification. It was part of the Version 1.0 Core and Shell Pilot Program and received 46 LEED credits toward the certification. To acquire this many credits the Signature Centre had to fully encompass the green design in both its architecture and mechanical systems, and therefore include many green innovations.

One of the office building's green innovations is its use of natural lighting. The long and narrow profile of the Signature Centre, along with the

nearly floor to ceiling windows on each side, allow 90% of the occupied space to have an outside view. This lighting design reduces the energy used to light the building during daylight hours and gives the building a more "open" feel which improves occupant comfort and thus productivity. However, this design also adds a large perimeter skin-load. To condition this load passive chilled beams near the ceiling and hydronic radiant baseboard heaters are used.

Chilled beams provide radiant cooling and create a natural convection process with rising hot air and falling cooled air. An AAON LL Series roof-mounted evaporative-cooled condenser chiller with a factory-installed distribution pumping package provides the 61°F chilled water for the chilled beams.

Another green innovation of the Signature Centre is its HVAC system. While the skin-load is conditioned with passive chilled beams and hydronic radiant baseboard heaters the interior loads of the building are conditioned with an underfloor air distribution (UFAD) system.

Randy Rinker, an AAON sales representative with Engineered Mechanical Systems, LLC, describes the overall system as “ideal for maximizing energy efficiency, indoor air quality, and allowing individual occupant comfort control.” In the building’s UFAD system, 65°F conditioned air is supplied from the air handler at a low velocity to an underfloor plenum. From there the conditioned air leaves passive floor diffusers and slowly mixes before reaching return air vents near the ceiling. With user adjustable floor diffusers, occupants have moderate control over thermal comfort conditions in their environment. Four AAON RL Series evaporative-cooled condenser packaged rooftop units provide supply air to the UFAD system. “This system allows at least 130% more use of the economizer mode of free cooling because of its higher discharge air temperature,” stated Ben Weeks, Aardex Executive Principal.

Contributing to Credits

The AAON units used in the HVAC system contribute to the buildings LEED® credits. First, by using the AAON patented evaporative-cooled condenser with air-cooled de-superheater coil the chiller and packaged units use at least 22% less water than conventional evaporative-cooled condenser units and are more energy efficient than air-cooled chillers and packaged units. Usable building space is also maximized by eliminating the need to house the chiller or pumps in an internal mechanical equipment room, because the pumps, chiller and condenser are packaged together and installed on the roof—

saving valuable square footage that can be used by the owner or rented by tenants. Second, the chiller and packaged units all use non-ozone depleting R-410A HFC refrigerant. Third, the packaged units include modulating hot gas reheat which provides the exact amount of de-humidification needed while still providing the consistent supply air temperature needed by the UFAD system. Finally, the packaged units use pre and final MERV 13 filters to improve the indoor air quality of the building. “With these unit features the HVAC system was able to provide many positive contributions toward the LEED® certification of the Signature Centre” said Rinker.

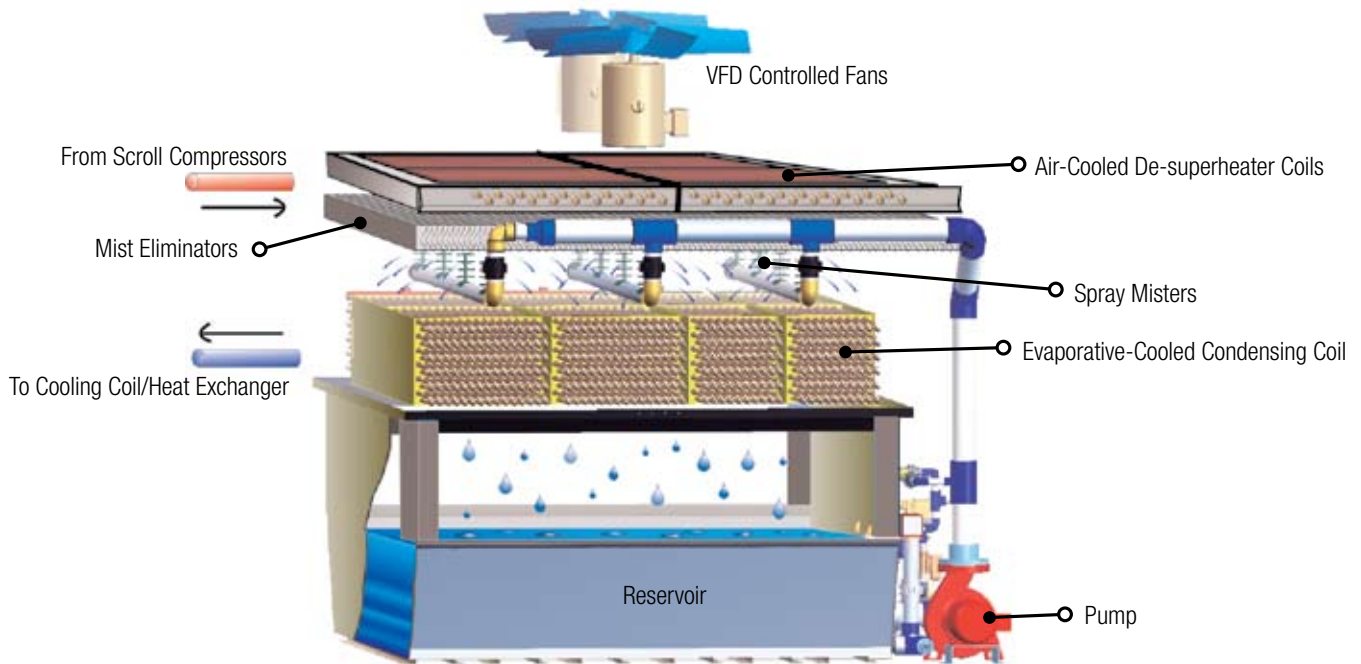
The Signature Centre’s many green innovations, including the lighting and HVAC systems, helped contribute to the building’s LEED® certification and to create a User Effective® work environment. This environmental development approach meant more up front costs, however, with the enormous “built-in” efficiencies Aardex estimates the average tenant will recoup any additional leasing costs in about three years. As Weeks commented “The green designs included in the Signature Centre lead not only to LEED® Platinum certification, but also a more comfortable and productive work environment.”

Contributing to Credits

The AAON evaporative-cooled condenser gives direct benefit over other designs in the industry.

- 22-100% less water usage
- 22-100% less chemical usage
- Reduced tendency to form scale with all water chemistries – refrigerant tube temperature is lowered by the de-superheater before the refrigerant tube comes in contact with the water
- Lower energy consumption due to reduced fouling and more efficient heat transfer
- Longer condenser fan motor life because the de-superheater allows the motor to operate in a maximum 70% RH ambient versus 100% RH for models without a de-superheater
- 100% of the total heat rejection achievable at 33°F DB with no water flow because the de-superheater functions as an air-cooled condenser at low ambient temperature conditions





Patented Evaporative-Cooled Condenser

Chilled Beams

Chilled beams operate by pumping chilled water through cooling elements located near the ceiling. Solar loads, building occupants and office equipment heat the air in the space. This warm air then rises to the ceiling level, is cooled by the beams, and descends to displace the warmer air in the occupied zone, creating a natural convection process. Additional radiant cooling is also supplied by the chilled beams.

A challenge that chilled beams pose is condensation on the beams. To combat this, the water temperature supplied to the beams must be elevated at least 2°F above the space dew point.

The AAON LL Series chiller with an energy efficient evaporative-cooled condenser and a factory installed distribution pumping package is a perfect fit for chilled beam applications. Because the condenser, chiller, and pumps are all packaged together the installation cost of chilled beams is greatly minimized and the need

for an internal mechanical equipment room is eliminated. Finally, boilers can be included in the LL Series chiller and energy efficient hydronic radiant baseboard heating can also be provided.

Underfloor Air Distribution

UFAD systems supply conditioned air at a low velocity from a low pressure plenum between the floor slab and a raised floor, with return air vents located in the ceiling. The conditioned air is supplied from the floor plenum at a temperature between 62°F and 68°F, as opposed to 55°F with traditional mixed air systems, through passive or active floor diffusers. The theory behind UFAD is to create a stratified condition from floor to ceiling, thus relying on the natural buoyancy of the air to remove heat and contaminants away from the space occupants. However, in reality, turbulent floor diffusers and activity in the space slowly mixes the conditioned supply air and space air a few feet above the floor as it ascends toward the ceiling.

This gives the space a comfortable temperature of around 70°F to 75°F.

A challenge posed by UFAD systems is dehumidification and condensation. Because air is supplied at a higher sensible temperature than traditional mixed air systems, the latent load of outside ventilation air may not be satisfied and a humid space condition may result. In addition, condensation may occur on the cool floor slab surface of the under-floor plenum and, in the Signature Centre's case, on the chilled beams near the ceiling. To combat this dehumidification may be necessary.

Modulating Hot Gas Reheat

The AAON modulating hot gas reheat system is a perfect dehumidification solution for UFAD and chilled beam applications. During dehumidification, the modulating hot gas reheat system condenses water out of the air stream at the unit's evaporator coil, and then, to avoid overcooling the supply air, reheats the air, with modulating valves and heat that would have been rejected

Annual Water Usage Comparison (Evaporative-Cooled Condensers)

Location	Chiller (Tons)	Hours of Operation	Barometric Pressure (psia)	Water Usage Conventional Condenser (Gallons)	Water Usage AAON Condenser (Gallons)	Water Saving %
Albuquerque, NM	100	8760	12.1	1,604,683	804,617	49.9
Dallas, TX	100	8760	14.7	1,478,941	914,909	38.1
Tampa, FL	100	8760	14.7	1,481,039	1,052,485	28.9

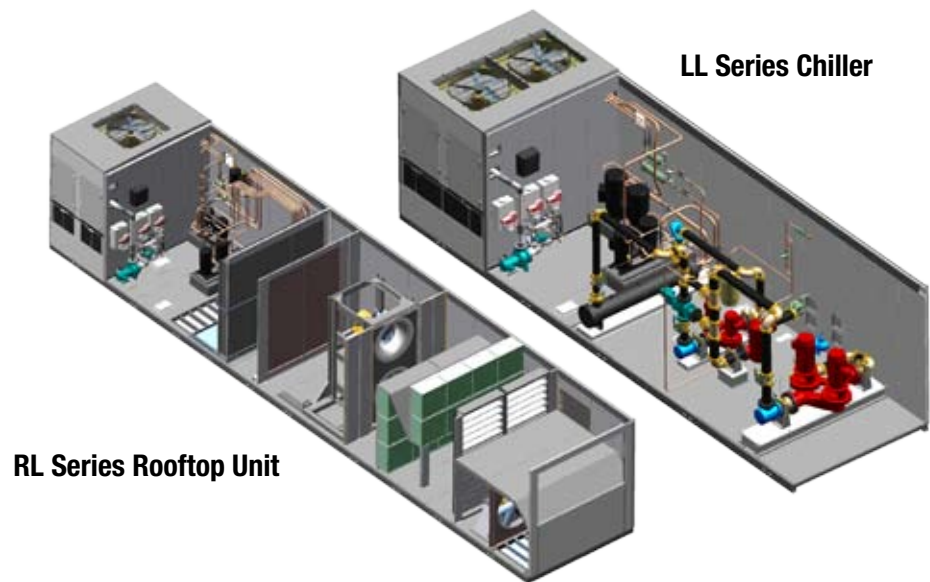
with the unit's condenser, to a desired discharge air temperature. Therefore, this system can be used in UFAD (and VAV) applications where dehumidification and tight supply air temperature control are needed. It can also be used in chilled beam applications to prevent condensation on the chilled beams, by preventing the space dew point from rising.

tion because the refrigerants contain chlorine, which breaks down ozone molecules in the upper atmosphere and disrupts the absorption of potentially harmful UV-B radiation. Because HFC refrigerant R-410A is a non-chlorinated refrigerant it has a no potential for ozone depletion. Also, R-410A is used in high efficiency AAON products and all

AAON products are pressurized and carefully leak tested at multiple stages throughout the manufacturing process to prevent refrigerant leakage into the atmosphere. Thus, R-410A has a low total global warming impact. Therefore, R-410A is the preferred HVAC refrigerant for LEED and green building projects.

R-410A

The Signature Centre's cooling systems operate using environmentally friendly R-410A. Systems with HCFC refrigerants, such as R-22, have a potential for ozone deple-



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