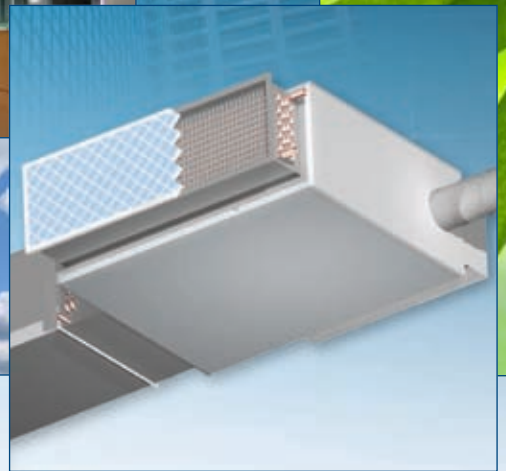


The DOAS Solution Guide

FOR DEDICATED OUTDOOR AIR SYSTEMS



Intelligent Design



Outdoor Ventilation



Energy Efficient



 **KRUEGER**
Excellence in Air Distribution

YOUR COMPLETE AIR DISTRIBUTION PROVIDER OF GRILLES, REGISTERS, DIFFUSERS, TERMINAL UNITS, CHILLED BEAMS, DISPLACEMENT VENTILATION, RAISED FLOOR PRODUCTS AND ACCESSORIES.

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Additional Product Information:



Product Catalog

For detailed product information that includes engineering and application information, as well as product dimensional data, performance information, engineering specifications and more, contact your local Krueger representative to request a copy of Krueger's latest Product Catalog.



www.Krueger-HVAC.com

The Krueger website has a wealth of information that extends beyond the pages of this brochure. Whether you are looking for the latest product releases, additional literature pieces, general product information, white papers, or electronic tools, you can find it all very quickly and easily at www.krueger-hvac.com.



Selection Software

Krueger is proud to provide the most robust selection software in the industry for terminal units as well as air distribution products (grilles, registers, and diffusers). Having incorporated several powerful engineering tools, Krueger's software will save significant time in the design of a building's HVAC system. Simply download it from the Krueger website.



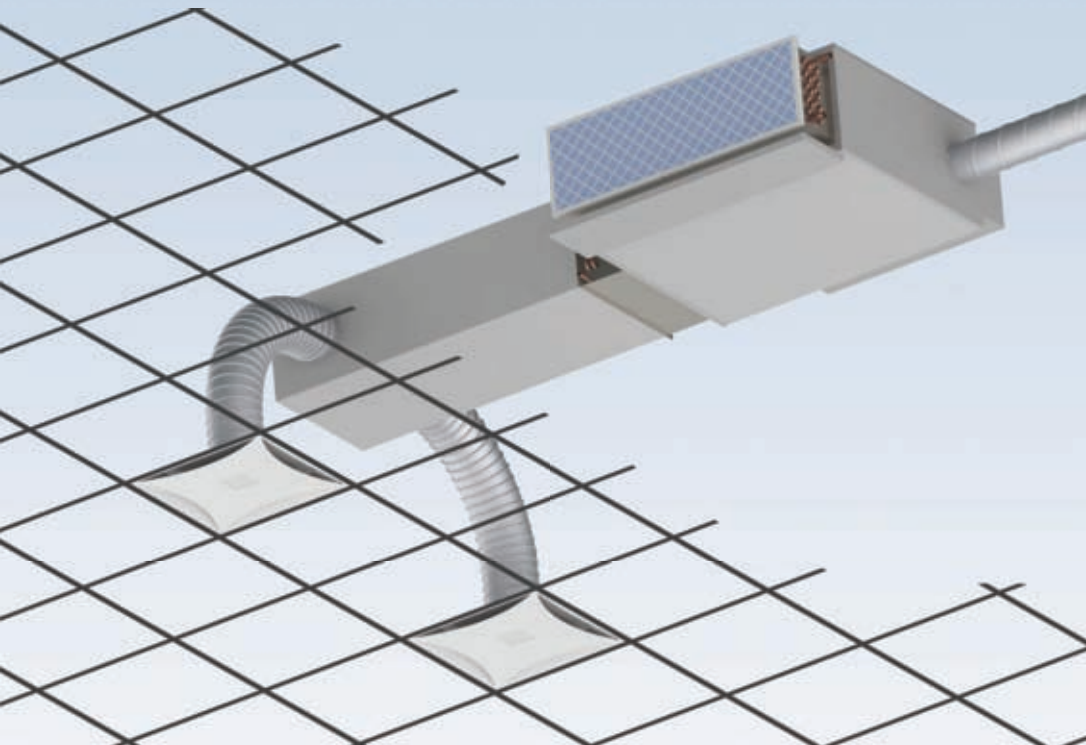
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Innovative Design Meets Practical Application

Krueger's DOAS Fan Powered Terminal Unit

The complete air distribution solution for a dedicated outdoor air supply system. Learn more about how Krueger can help you meet tomorrow's energy and ventilation needs today.



DOAS Fan Powered Terminal Unit

Krueger's Dedicated Outdoor Air System (DOAS) fan powered terminal unit is a highly versatile air distribution solution with a variety of applications, a few of which are outlined in this DOAS Solution Guide.

The DOAS terminal unit functions much like a conventional series or parallel fan powered terminal unit, with two important exceptions. The primary inlet of the DOAS terminal unit is supplied from a DOAS air handler serving two functions: providing ventilation air and handling latent loads in the space. Then, a cooling coil, located on the unit's induced air inlet, provides additional cooling to handle the sensible loads in the space. For additional flexibility, options include standard hot water and electric reheat as well as a MERV 8 filter.¹

When compared to traditional air handler/chiller systems that handle the full cooling load, Krueger's DOAS terminal unit has the potential to create significant energy savings. Transferring energy using water rather than air is considerably more efficient. The DOAS terminal unit takes advantage of this efficiency by utilizing a cooling coil to handle the sensible load in the space. Since the cooling coil on the DOAS terminal unit requires approximately 57° water, this allows designers to specify a smaller chiller on their projects. Also, since the DOAS air handler is supplying only the fresh air and latent load requirements, a smaller unit can be specified, and the

primary inlet on the DOAS terminal unit can be sized smaller than conventional VAV systems. These characteristics make the DOAS terminal unit a sustainable building solution. Other sustainable features include an ECM motor, which comes standard and has the potential to reduce fan energy. The DOAS terminal unit has a low minimum inlet pressure requirement (about 0.1"), which means the air handler does not have to work as hard to provide the inlet static pressure. In the parallel version, a DOAS terminal unit can be used in lieu of the air handler during off-peak times to provide conditioned air to the space. All of these items significantly lower the DOAS total system pressure and can lead to more savings when compared to other technologies.

To maximize sustainable design, Krueger's DOAS terminal unit can be used in conjunction with Krueger's chilled beams. Krueger by Halton offers one of the industry's most robust chilled beam product lines. DOAS terminal units and chilled beams use the same mechanical systems, making them natural partners. Combining them is also an ideal solution where using chilled beams alone is not optimal, such as spaces with localized, high or difficult to control humidity levels, including lobbies, atria, or exterior walls with high loads.

¹ IEQ 3.1 Construction IAQ Management Plan - During Construction - When used during the construction cycle, the MERV 8 filter qualifies for a LEED Point.

Features & Benefits

Earn "Green" / LEED Points

Using Krueger's DOAS terminal unit can earn you LEED points by its flexible design. Whether the occupant space expands or changes, the system can easily adapt.

Optional MERV 8 Filter

Earn a LEED point for providing the optional MERV 8 filter on the sensible cooling coil during construction.

Assures Minimum Ventilation Rates

By providing up to 4 settings of ventilation air, utilizing a self contained pressure independent air volume controller, the DOAS terminal unit assures the proper amount of ventilation air is supplied at all times.

Natural Partner for Chilled Beams

Krueger's DOAS terminal unit uses the same primary water and air as a chilled beam system, which allows both to be used on a project.

Energy Efficiency

ECM motors are utilized for optimum energy use and control.

Optional Reheat Capabilities

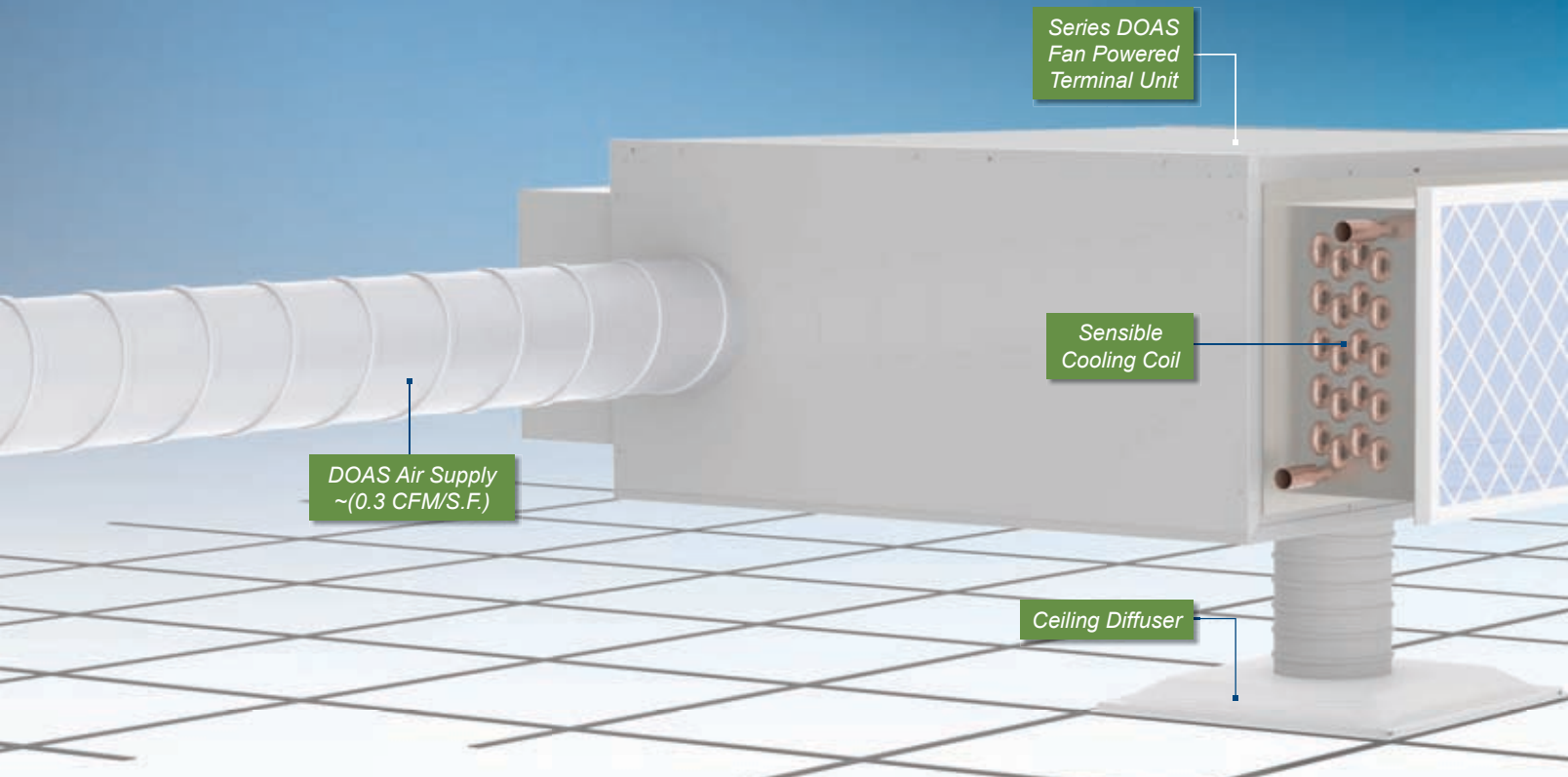
Optional hot water or electric heat allows for effective standard overhead heating, eliminating the need for a secondary system.

Conventional Installation

Using standard diffusers, contractors will be able to install the complete system with traditional industry practices.

Approach 1

Series DOAS, Standard Ceiling Diffuser Design



Why Consider DOAS?

Industry standards, building codes, and LEED are requiring tighter control of ventilation rates. For many buildings with integrated energy-efficient equipment, the lower latent heat load allows ventilation air to handle most of the load. Currently, with this reduced need for supplemental cooling, ventilation air makes up a significant amount of the building's total supply air. In many cases, the percentage could near 100%. For these situations, it is likely the entire latent load can be handled with a DOAS air handler supplying proper ventilation rates at the appropriate temperature.

- Engineers are currently using DOAS in many of their designs and it is becoming the new standard for projects.
- The capacity of the DOAS air handler is based on the required ventilation rate and latent load of the building.
- Energy savings are realized by using a smaller DOAS air handler and chiller.
- When using 100% outside air, warm return air is exhausted from the building, including heat from lights.
- Increased outside air can result in a LEED point.²
- Outside air has been shown to improve both health and productivity.
- Optimum system design will include pressure independent zone ventilation rate control.

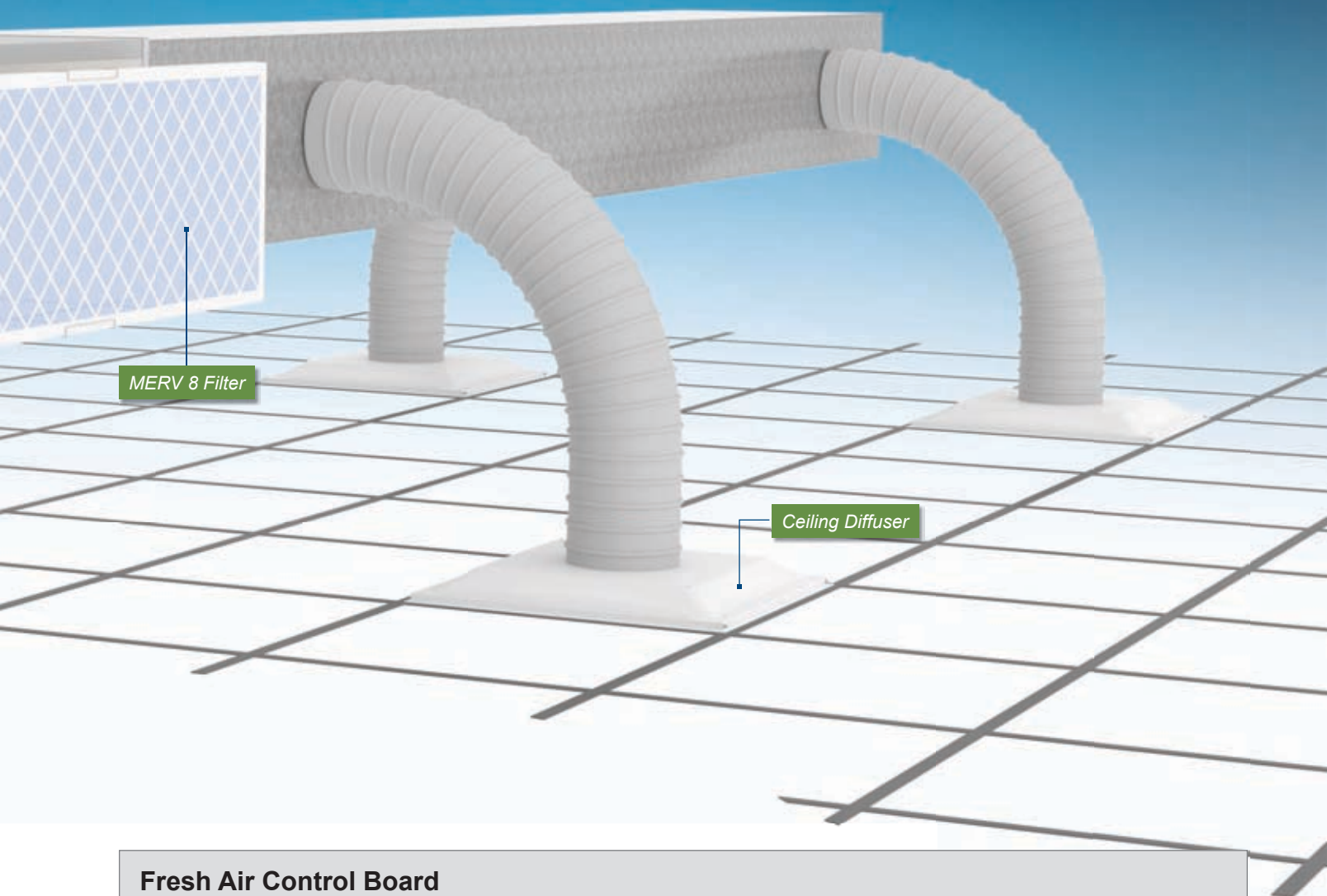
² IEQ Credit 2 Increased Ventilation - One LEED Point can be earned by increasing ventilation rates at least 30% above the minimum rates required by ASHRAE Standard 62.1.

About This Application

The series DOAS terminal unit can be used in conjunction with standard ceiling diffusers as a standalone application. This layout has advantages in certain building designs. First, the series DOAS terminal unit can be installed in a location that facilitates easy service and routine maintenance. The total number of connections is reduced since the chilled water, power, and DOAS duct connections for a zone terminate at a single unit, which then distributes conditioned air to the space through traditional diffusers. This simplifies the installation. The series DOAS terminal unit requires low inlet static pressure from the air handler, which allows for a reduction in size of the air handler and energy used. Since the primary air is providing all the outside air to the space, it is easy to meet, and more importantly to control, the ventilation rates for the space, which potentially qualifies for a LEED point³. Our product also offers the option of hot water or electric reheat (if required), which allows the series DOAS terminal unit to be the all-in-one solution for a building.

When chilled beams are the basis of design, there are still potential locations in the building where relative humidity may be higher than optimum for a chilled beam system, such as lobbies and entranceways. There may also be areas where loads are higher than practical for the chilled beam designs, such as high volume copiers or mini server rooms. One solution is to use the series DOAS terminal unit to feed standard ceiling diffusers in these locations. The additional capacity provided allows for an innovative design solution that can prevent issues in these areas.

³ IEQ Credit 2 Increased Ventilation - One LEED Point can be earned by increasing ventilation rates at least 30% above the minimum rates required by ASHRAE Standard 62.1.

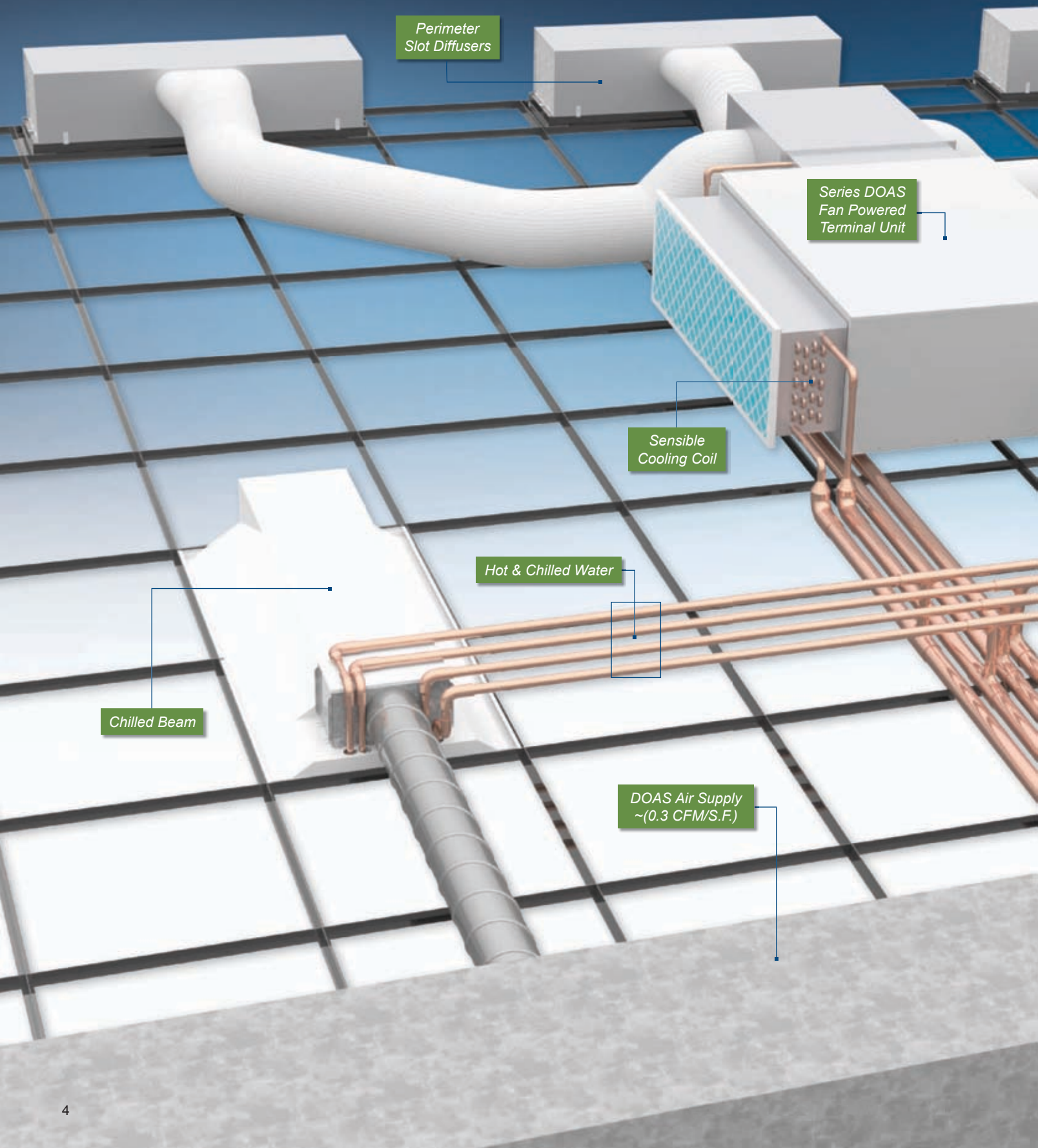


Fresh Air Control Board

LEED is focusing heavily on indoor air quality (IAQ) performance. One of the most effective ways to achieve high IAQ is to control the amount of outside (ventilation) air. Krueger's DOAS terminal unit offers a self-contained, pressure-independent air volume controller that ensures the proper amount of ventilation air is always supplied to the space. The optional Krueger Fresh Air Control Board works with a standard DDC fan coil type controller and provides up to four ventilation settings, all of which can easily be manually selected, auto-detected, or set through the building's Energy Management System (EMS).

Approach 2

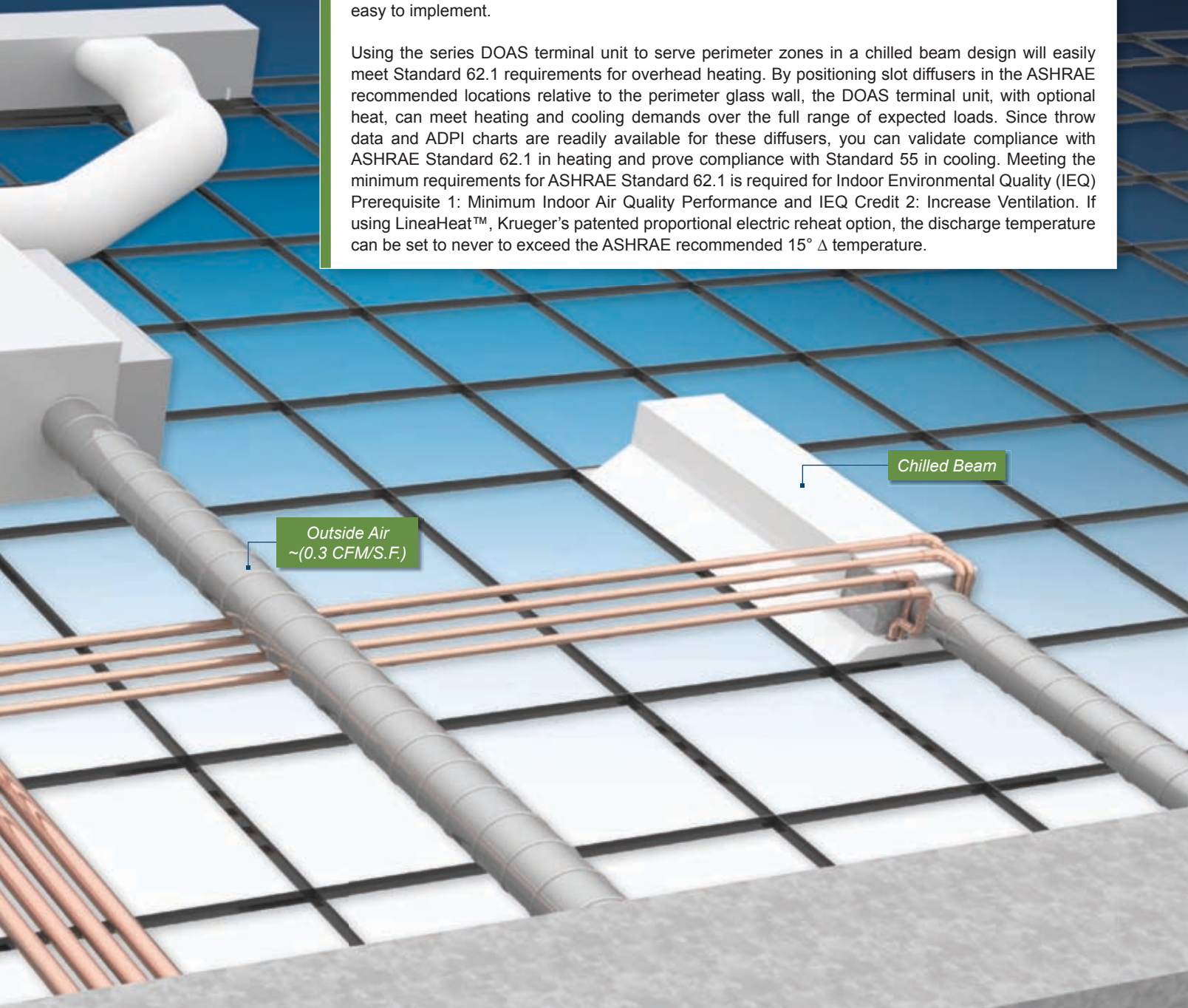
Series DOAS, Perimeter Zones in a Chilled Beam Design



About This Application

A series DOAS terminal unit can be used to supplement chilled beam designs. As illustrated, the interior zones are conditioned using chilled beams, with the building's perimeter zones being conditioned by linear slot diffusers, supplied by the series DOAS terminal unit. Because the series DOAS terminal unit and chilled beams are connected to the same DOAS air supply and water loop, this design is easy to implement.

Using the series DOAS terminal unit to serve perimeter zones in a chilled beam design will easily meet Standard 62.1 requirements for overhead heating. By positioning slot diffusers in the ASHRAE recommended locations relative to the perimeter glass wall, the DOAS terminal unit, with optional heat, can meet heating and cooling demands over the full range of expected loads. Since throw data and ADPI charts are readily available for these diffusers, you can validate compliance with ASHRAE Standard 62.1 in heating and prove compliance with Standard 55 in cooling. Meeting the minimum requirements for ASHRAE Standard 62.1 is required for Indoor Environmental Quality (IEQ) Prerequisite 1: Minimum Indoor Air Quality Performance and IEQ Credit 2: Increase Ventilation. If using LineaHeat™, Krueger's patented proportional electric reheat option, the discharge temperature can be set to never to exceed the ASHRAE recommended $15^{\circ} \Delta$ temperature.



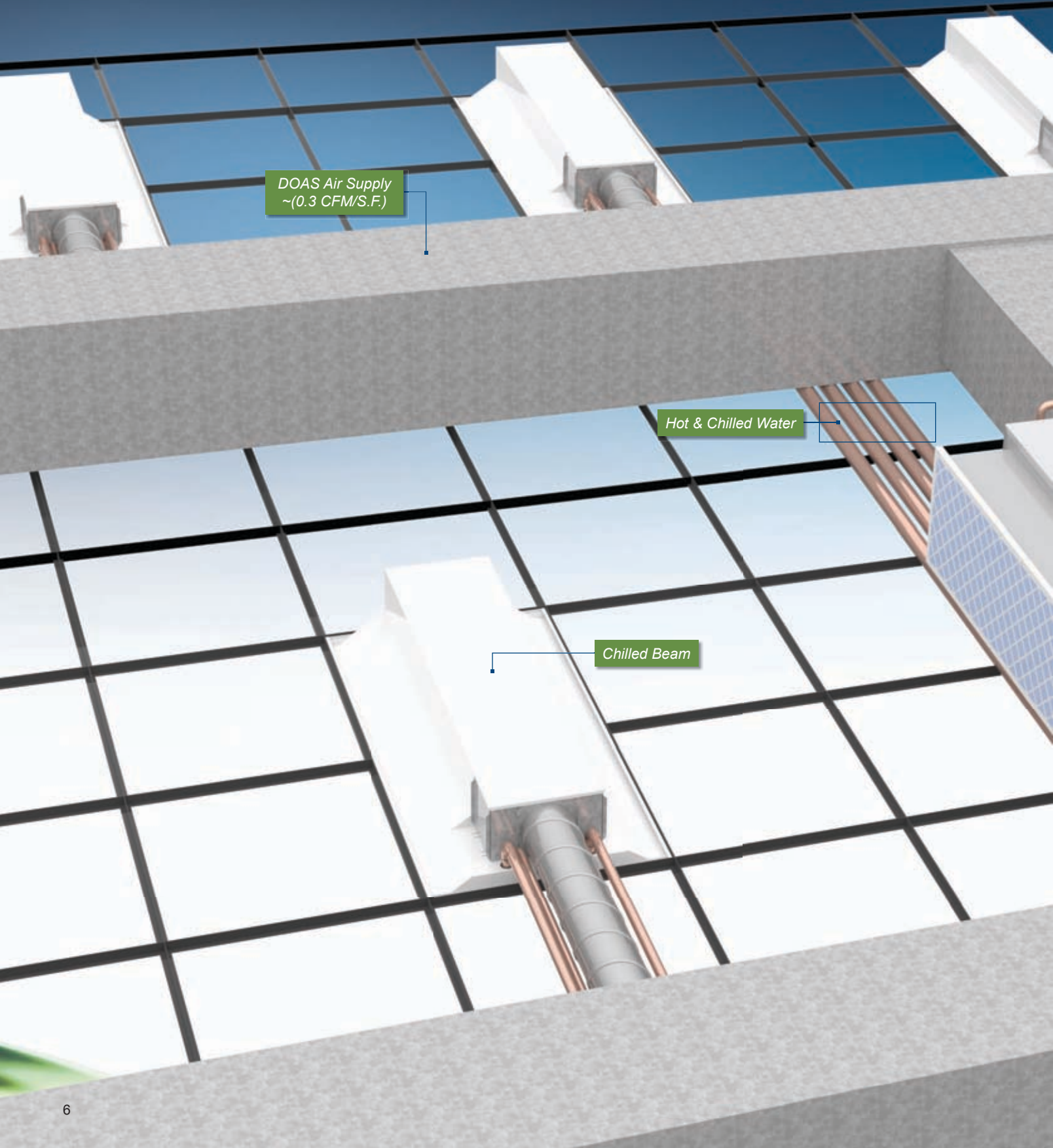
The LEED Challenge

The Krueger DOAS terminal unit is a design solution for any LEED project, where LEED points can be earned through:

- Providing the optional MERV 8 filter during the construction cycle qualifies for Indoor Environmental Quality (IEQ) Credit 3.1.
- The ECM motor that comes standard helps work towards achieving Energy Performance Credits under the EA (Energy and Atmosphere) category.
- Optional LineaHeat™ for electric reheat helps count towards Indoor Air Quality performance and Thermal Comfort related credits under IEQ.
- The Krueger Fresh Air Control Board can help with IAQ related credits under IEQ.

Approach 3

Parallel DOAS, Supply to Chilled Beams



DOAS Air Supply
~(0.3 CFM/S.F.)

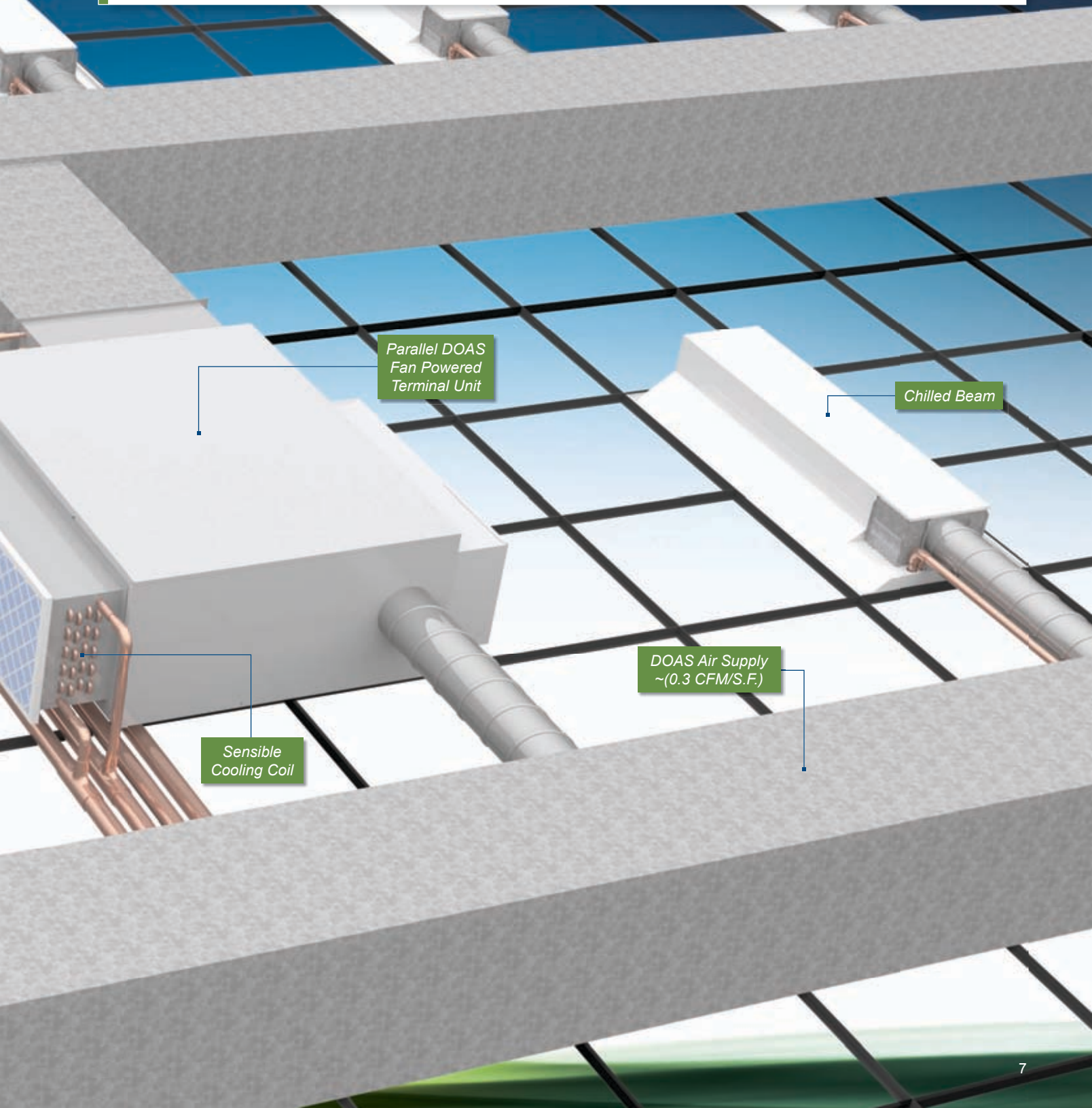
Hot & Chilled Water

Chilled Beam

About This Application

A parallel version of the DOAS terminal unit can be used to supply chilled beams in locations where it may be necessary to provide conditioned air independent of the main air handling units. When the air handler is on, the fan on the parallel DOAS terminal unit is off. Using the parallel DOAS in this application provides an additional level of control (that is currently not available in chilled beam designs) since the primary air inlet on the parallel DOAS terminal unit acts as a VAV control valve for the chilled beams. This allows for airflow going to the chilled beams to better adapt to varying load conditions in the space. A good example would be to provide more air to a conference room when it is fully occupied.

However, the real potential for energy savings occurs during off-peak or partially occupied times. When the air handlers are turned off, the fan on the parallel DOAS terminal unit is turned on to provide cool air to the chilled beams only in the zones that require it.



Parallel DOAS
Fan Powered
Terminal Unit

Chilled Beam

Sensible
Cooling Coil

DOAS Air Supply
~ (0.3 CFM/S.F.)

Approach 4

Parallel DOAS, Laboratory Ceiling & Forced Displacement Diffusers

About This Application

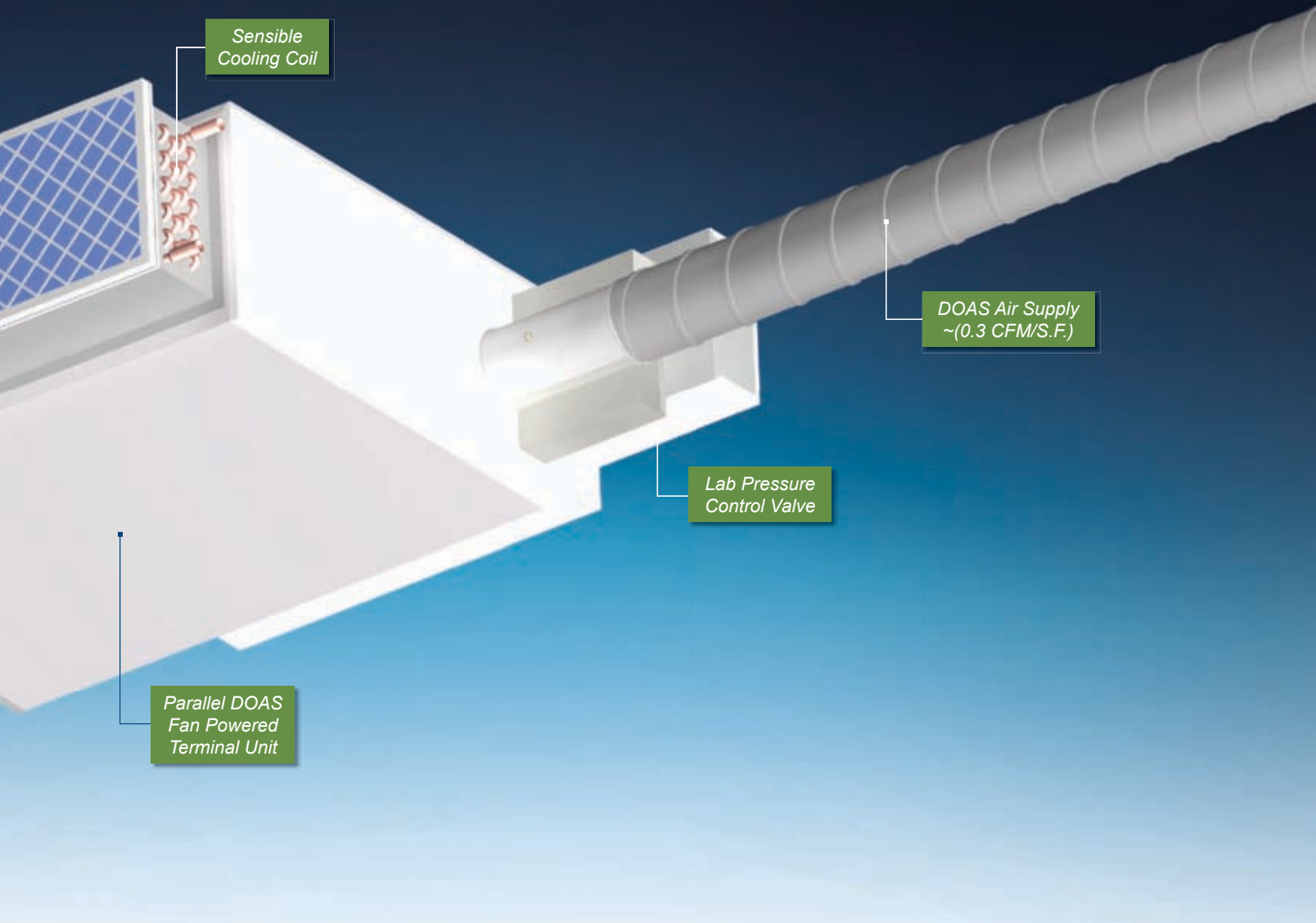
A parallel DOAS terminal unit may also be used to provide extra cooling capacity when precise air control is critical. Unlike traditional parallel terminal unit applications, where the fan is only activated for heating, in the DOAS application, the fan is activated to provide additional cooling to the space.

The parallel DOAS terminal unit has built-in flexibility to provide environmental control in a variety of critical applications. Fume hoods, by design, require low room air velocities at the face to maintain its integrity. A low induction, radial flow, forced displacement ceiling diffuser, such as the Krueger TAD or RadiaFlo™ connected to the parallel DOAS terminal unit will meet this need. Additionally, for applications where room pressurization is critical, we recommend including a laboratory pressure control valve on the primary inlet of the parallel DOAS terminal unit.



*Radiaflo™ Flush Face
Radial Diffuser*

*TAD Drop Face
Radial Diffuser*

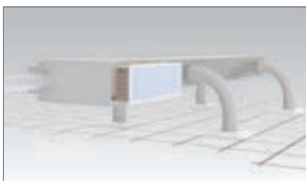


In Summary

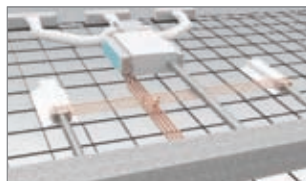
The addition of a sensible cooling coil to a traditional fan powered terminal unit can provide solutions for challenging applications. While only a few have been described here, there are countless other ways to use this unique system.

A series DOAS terminal unit with conventional diffusers can be used in interior and perimeter spaces as a standalone system. This unit can also be used to supplement a chilled beam design by allowing conventional diffusers in zones where chilled beams may not be optimal.

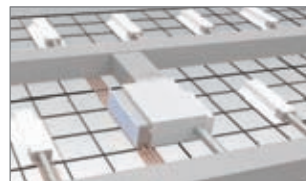
A parallel DOAS terminal unit can be used to power chilled beams without requiring the main DOAS air handler to be operating, providing an alternate source of air when the air handler is off. A parallel DOAS terminal unit can be used in VAV fume hood applications with lab air outlets to offer additional cooling, yet still provide the precise air control required.



*Series DOAS Terminal Unit,
Standard Ceiling Diffuser Design*



*Series DOAS Terminal Unit,
Perimeter Zones in Chilled
Beam Design*



*Parallel DOAS Terminal Unit,
Supply to Chilled Beams Design*



*Parallel DOAS Terminal Unit,
Laboratory Ceiling & Forced
Displacement Diffusers Design*

With Krueger's DOAS terminal unit and chilled beam solutions, all the air distribution can be handled by a single manufacturer, providing a complete solution for tomorrow's designs, today. For complete product information, visit our website at www.krueger-hvac.com.



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Displacement Ventilation

Chilled Beams

Accessories & Dampers

Engineering Information

Krueger continues to lead the industry in the development of innovative products and air distribution solutions. To learn more about what we can do for you, contact your local Krueger representative or visit us on the web at www.krueger-hvac.com.



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DOAS SOLUTIONS GUIDE | 10/2010
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