



VERTIV WHITE PAPER

Chilled Water Data Center Cooling for Non-Raised-Floor Applications

Non-Raised-Floor Data Center Cooling Solutions That Drive
Performance While Reducing Costs

The data center industry is experiencing fast-paced innovation. Hyperscalers, colocation facility providers, and other large data center owners and operators have led the way in implementing the latest compute, power, and cooling technology in their designs to meet growing market demand. They're driven by a desire to optimize operations, reduce resource consumption, and decrease costs, among other goals.

Their work to continually enhance performance is yielding rich dividends. The global data center market is slated to reach \$519 billion by 2025. Demand is driven by organizations' faster digitization of their products and services, hybrid work models, 5G rollouts, and connected processes powered by the Industrial Internet of Things (IIoT). In a recent survey, 95 percent of data center professionals said demand in 2022 would outpace 2021's torrid growth.

However, data center design and development challenges are increasing. The industry is experiencing a widespread shortage of materials due to supply chain issues, say 87 percent of respondents to a recent survey. In addition, 89 percent of data center professionals can't find enough skilled labor. These shortages and costs are driving up construction costs and timeframes. That's making it difficult to meet customer demand for new data center capacities in a 12-month accelerated timeframe, instead of the previous standard 18-month schedule.

Further, data centers are densifying – placing more compute in tightly packed places to support big-data analytics and other digital workloads. That's creating new burdens for cooling systems, which must protect these hot-running, often mission-critical, workloads.

The good news is that data center owners and their teams have new options for data center construction, thanks to innovations in cooling systems. For decades, the common wisdom has been that data center owners needed to use raised floor environments to enable more efficient cooling of technology. With raised-floor systems, air flows up through perforated floor tiles to cool the technology placed directly above it. This provides operators with exceptional flexibility during data center white space design and equipment deployment and operation.

For the past decade, however, colocation and hyperscale providers have been able to experience the reality of deploying data centers with simple slab, or non-raised floors, thanks to their use of different indoor chilled-water cooling solutions.

Simplifying data center design with simple slab floors enables data center owners to construct new white space more quickly and cost-effectively. They can save on skilled labor and the materials required to design and implement raised floors, as well as avoid the complex engineering required to brace them. As a result, data center investors and owners can reduce their cost structure and increase speed to market. In addition, data center teams can leverage simple slab, or non-raised floors, to design and use new cooling unit concepts. Some of these solutions will enable data center teams to increase the unit cooling density in the same footprint.

However, building facilities with non-raised floors introduces new cooling challenges that teams need to consider before embarking on new projects. As a result, the debate between whether to build a raised floor data center or one with slab floors is not an either-or decision, but one that requires careful consideration of business goals and technical objectives.

Vertiv predicts that data center owners will increasingly adopt slab floors for large 2MW to 5MW data hall. Smaller, sub-2MW facilities will only partially transition to non-raised floors.

Solving the Data Center Cooling Challenges Caused by Non-Raised Floors

Our Vertiv white paper, [Overcoming the Challenges in Cooling Non-Raised Floor Data Centers](#), discusses the challenges of designing cool air systems for slab-floor facilities, which include the airflow control strategy for these applications. As all data center cooling experts and their partners know, it's harder to control air distribution when air travels through racks, rather than emerging from under the floors used to house technology.

There are two primary risks with air distribution in facilities with non-raised floors. High-velocity air that hits the first server rows creates negative pressure, while airflow decreases the farther it travels, meaning that it does not reach servers that are placed the furthest away. Both scenarios negatively impact the ability of systems to consistently cool servers, increasing their risk of overheating or failing.

The paper proposes that data center teams adopt the Delta T method (measuring temperature variations between hot and cold aisles) to control fan speeds, keeping airflow distribution more consistent and cooling technology evenly that's placed in its path. In this paper, we take those insights a step further by discussing new data center cooling system options for non-raised floors. Data center operators that select the right cooling solution can use it to apply uniform air pressure across racks, safeguarding equipment and preventing temperature-related outages. This paper concentrates on exploring the benefits of chilled-water cooling solutions, which teams can use in data centers with non-raised floors, as well as to retrofit existing space.

Why is a new design approach needed to accommodate indoor chilled water units? If standard perimeter chilled water units are placed in a non-raised floor data center environment, they increase the risk of high-velocity airflow, which creates turbulent air distribution and can harm servers. Thus, a new approach is needed. However, there is no single solution to cool equipment placed on non-raised floors in data centers. For that reason, Vertiv offers multiple cooling solutions to provide buyers with choice and flexibility in how they address the challenges of slab-floor facilities and meet their unique business requirements.

These new solutions include:

Perimeter units: Vertiv has redesigned its standard Liebert® perimeter cooling solutions to meet the demands of non-raised floor applications. A fan is installed on the top of the unit. The units blow air from the coil section, exploiting this larger surface area and reducing air speed to create better airflow distribution. The product provides almost the same airflow and cool air capacity of a standard computer room air handler (CRAH).

Data center operators gain the ability to deploy a well-known, established technology that requires minimal design modifications. These units are available with either back air discharge or frontal air discharge. As a result, they can be flexibly installed in the service corridor or directly in data center white space.

As with all perimeter units, this product can be easily ducted. Thus, it's possible to physically separate data center air volume from the service corridor. From a design and operational points of view, this is a great benefit because the service corridor doesn't require a specific design since it is not pressurized. Moreover, workers will have a more comfortable operating environment since the service corridor temperature is lower than the hot aisle zone.



Thermal wall units placed in service corridors: Vertiv also offers a standard Liebert thermal wall unit solution, based on the air-handling unit (AHU) concept. Thermal wall units blow air horizontally directly to the server room.

Thermal wall solutions are growing in popularity. They can be used to cool data centers that have high density IT loads, providing high volumes of air that move at low speeds. However, using these products requires that data centers be redesigned to provide more space in the service corridor.

The advantages of using a thermal wall include the ability to achieve high cooling density and operate with extreme efficiency. Improving these two variables enables data center operators to optimize data center power usage effectiveness (PUE) at their facilities.

Custom thermal wall units: Vertiv can also create custom Liebert cooling units to better fit specific customer needs. We have developed several highly innovative air handling units (AHU) as custom solutions to better integrate into customers' buildings.

Data center teams that deploy these custom solutions can increase their use of white space and gain greater business and operational flexibility. In addition, they can use higher capacity to cool high-density servers or plan for computing growth.

Since customers' buildings have myriad layouts and equipment configurations, Vertiv provides consulting and design expertise to create the right solution for their specific data center white space requirements.

Choosing the Right Chilled Water Solution for Your Application

For non-raised floor applications, there are multiple cooling technologies available. As a result, it can be challenging to know which indoor chilled-water cooling solution is the best for specific data center applications. Data center and facility teams should work through the following steps to choose the right product. The upfront design work required for non-raised floor applications should not be underestimated. Teams can select the right product when they have considered key variables and have the right data in hand. They should:

Determine server heat density and airflow requirements:

Teams should calculate the total cooling capacity required for IT equipment, as well as airflow needed.

Define the number of units based on the system redundancy:

Teams should consider the level of desired cooling redundancy and then determine the number of units to place inside the IT room.

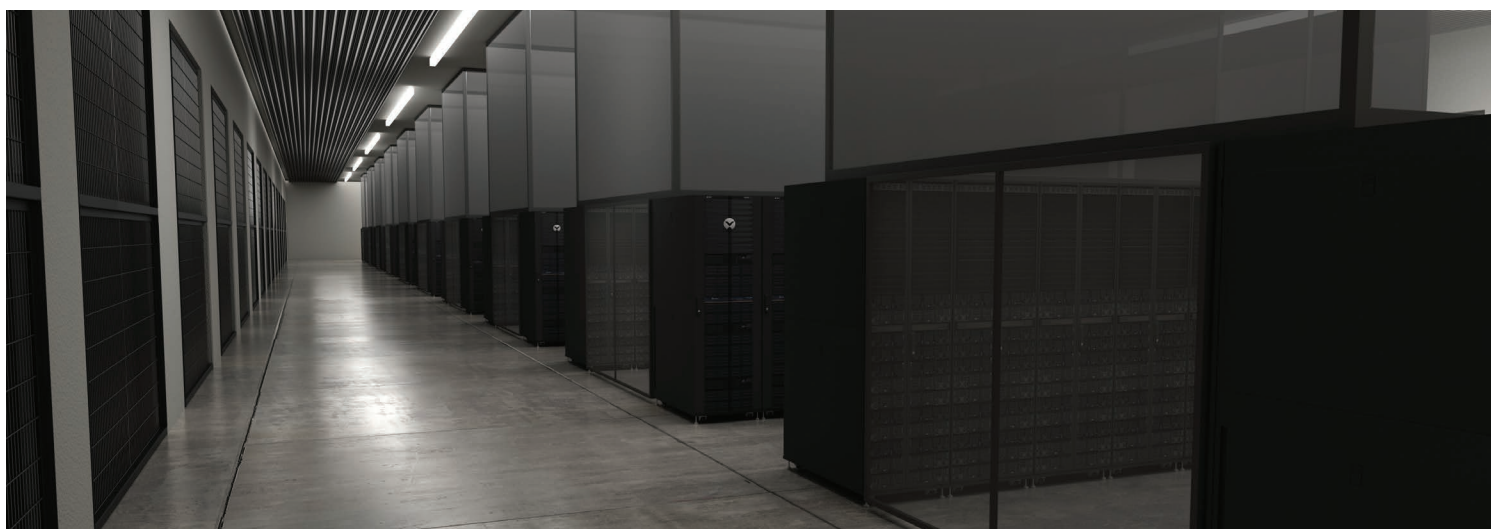


Evaluate computer room layout specifications: Teams should define the cooling unit positioning in the room, evaluating server aisle positioning and considering IT room dimensions and height, service corridor space, and return air duct placement.

Verify the airflow distribution considering different scenarios: Using computational fluid dynamics (CFD) analysis, teams can verify the airflow and temperature distribution for different load scenarios. At the same time, they should determine the impacts of cooling unit failures on their networking and other equipment.

Define the right product: After doing this analysis, teams should have the right data in hand to select the right indoor chilled-water cooling unit for their application. However, they should still carefully consider the pros and cons of each unit design before making their final decision.

“Don’t start to design your datacenter from the product needs, but select the right product based on your data center needs”



Conclusion

As data market growth accelerates, data center investors, owners, and teams are looking for ways to speed deployment and reduce cost. To simplify data center design, they’re considering deploying facilities with non-raised floors that don’t require special engineering or materials to construct floors. However, using non-raised floors does require that teams use a new approach to cool equipment, which requires data center cooling design expertise and effort.

Vertiv has designed Liebert indoor chilled water data center cooling systems that help these buyers architect cooling continuity for mission-critical workloads. We provide design expertise, global manufacturing capacity, and a range of solutions to meet data center teams’ cooling technology requirements. We provide standardized data center cooling solutions that teams can quickly evaluate and deploy across facilities and regions to gain exceptional performance and operating cost efficiencies. We also offer custom cooling solutions for customers who want greater flexibility and capacity.

Ready to capitalize on the cost and speed-to-market advantages of non-raised-floor data centers? We can help you evaluate and deploy Liebert indoor chilled water data center cooling solutions that will protect vital equipment and help ensure exceptional performance as your business grows.



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