RELIABLE REDUNDANCY

INTERSTITIAL SYSTEMS

REDUNDANCY REALITY

EFFECTIVE REDUNDANCY WITH A SINGLE LEVEL FLOOR OR AN ON-SLAB FLOODED ROOM APPROACH IS COMPLICATED AND COSTLY

FORTUNATELY

IT'S EASY TO ACHIEVE EFFECTIVE N+1 REDUNDANCY WITH INTERSTITIAL

Introduction

19% of data center outages are attributed to mechanical equipment failures which makes effective redundancy paramount for good design and best practices.

Precision cooling units are certainly able to provide accurate temperature and airflow, but that may not mean much unless their associated distribution means is efficient and effective. Single level raised floors are simply not engineered, constructed, or used in a way that optimizes conditioned air delivery. The fact is that leaks, under-floor obstructions, and the lack of true, consistent pressurization are inherent features of single-level designs, making them particularly unsuited for reliable air distribution from the very beginning and especially as a room evolves over time. As appears below, true redundancy under such conditions is virtually impossible to achieve.

The nature of an on-Slab flooded room design makes effective redundancy as challenging as rooms with raised floors, but for different reasons. The primary cooling for on-slab rooms depends on cooling units being positioned directly in front of the cold aisle they need to cool. However, positioning a redundant unit in effectively the same location is basically impossible. Attempting to achieve some form of redundancy generally means installing 20-25% more units than are required for load. That air basically bulkheads into sides of cabinets and doors making any form of effective redundancy unpredictable, ineffective and costly.

In large part, the Interstitial Electro-Mechanical Distribution System was developed to overcome the significant air distribution problems inherent in designs using conventional raised floor and on-slab data centers. While it may not have been as critical in decades past, because of today's higher heat densities and the crucial need to dissipate them, dependable air distribution, including the ability to maintain adequate static pressure and delivery with effective redundancy is key for the ongoing success of mission critical rooms.

CONVENTIONAL APPROACH

In designs using single level raised floors, the placement of down-flow package cooling units is necessarily based on a “zone” approach. This is because without adequate pressurization of the under-floor volume, air distribution is dependent on the cooling units’ fan capacity. Under the best conditions, the supply and return area covered by a unit is about 1,200-1,500 square feet in a pattern that extends about 30 feet from the discharging unit in a pie-slice shape.

The illustration below illustrates in a simple way why as a practical matter it is impossible to provide effective redundancy when using down-flow units with a single level floor: True redundancy in such a design provides redundancy only to a zone when two AHUs are located next to one another.

Fig-1 Although created some time ago, this drawing accurately depicts the air distribution situation when package units are used with a single level floor. The upper left corner sketch represents the unit using a centrifugal fan without a turning vain, rather than newer EC plug fans. The 30’ throw distance shown in Fig. 1 is substantially accurate, especially when floor heights are increased beyond the 18” as is shown in the upper left of the drawing. The illustration at the top center portion of Fig. 1 is reproduced as Figure 2, below. Figure 3 is based on Fig. 2, and shows what happens when one of the space’s four units is shut down or fails. The consequence is readily apparent: Unless a redundant unit is located in close proximity to the failed unit that particular zone will not be adequately provided with cooling. The problem becomes even worse when air leaks through the walking surface and obstructions under the floor significantly impede air flow.

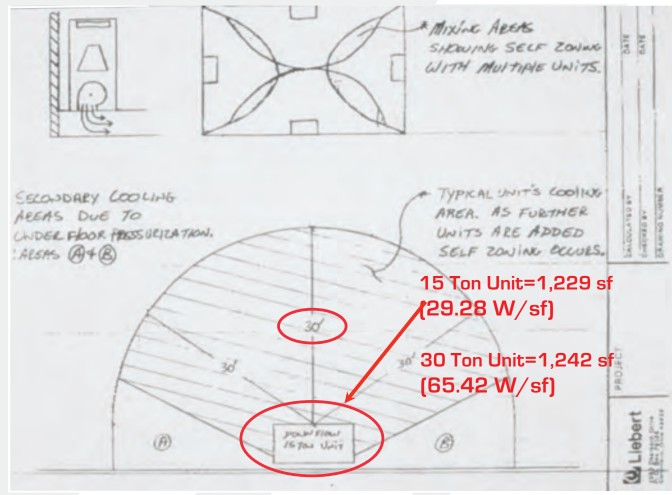

Fig. 1–Liebert sketch showing the air distribution pattern under a single level raised floor of a down-flow unit (red text added)

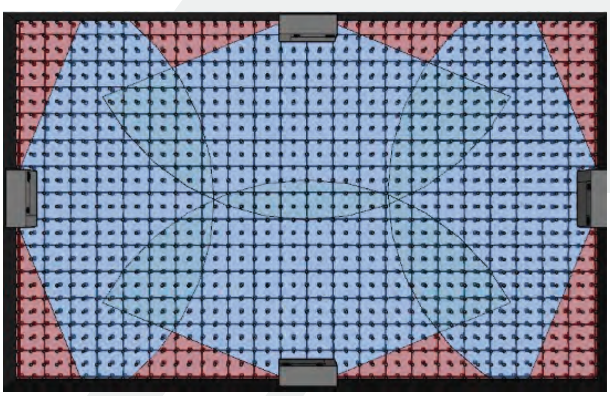

Fig. 2—Theoretical air coverage in a “zoned” design configuration per the Liebert drawing

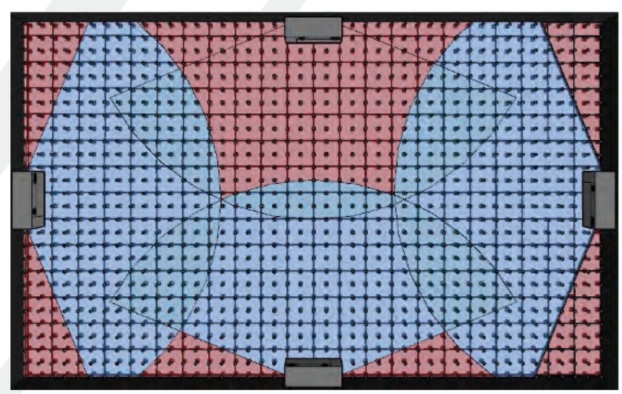

Fig. 3- Shows the air distribution pattern under a single level raised floor with one unit off per the Liebert drawing

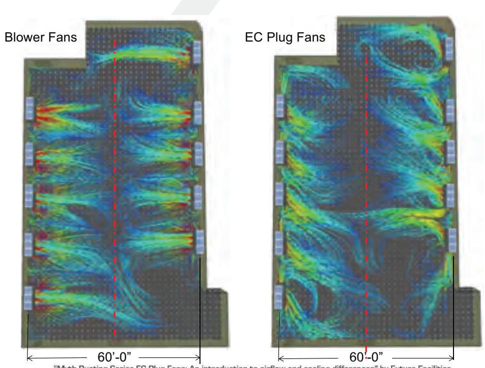

Fig. 4–CFDs are used to demonstrate the difference between a Blower Fan and an EC plug fan. Essentially the results are about the same as far as throw distance for both fan types. The CFD on the Left shows a blower fan essentially moving the air in the in the pie-slice shape as demonstrated in the Liebert drawing above. The EC Plug fans do not provide as thorough a distribution pattern as the Plug Fans. Neither of the fan choices are very effective when distributing air under a “leaky” single level raised floor. (These CFDs do not account for cable accumulation)

ON-SLAB FLOODED ROOM APPROACH

In a flooded room design cooling units are generally (but not always) installed in a separate mechanical equipment room and the air is blown through dedicated louvers into the white space In most instances these units are lined up the length of the room in order to achieve the necessary capacity of the room, and include 20-25% more units are than required attempting to achieve some form of redundancy. In all instances a cold and/or hot aisle containment system is used to confine the supply air from the return air. As you can see in Fig. 5 the the problem of channeling air directly into the cold aisle it's meant to supply is not very practical, CFD simulation models prove that when air is forced into a cold aisle the velocity of that air is significantly increased at the cabinet elevation. An industry rule-of-thumb is that the entering velocity not exceed 500 feet/min, however, often the velocity is doubled if not more so. The high velocity air creates a negative pressure Venturi Effect and by-passes the servers in the first few cabinets. An attempt to overcome this high velocity is to increase the distance between the cooling unit and the cabinets and to widen the cold aisle. Both are a useless waste of cooling equipment, energy and valuable floor space, that overall produces less than ideal results.

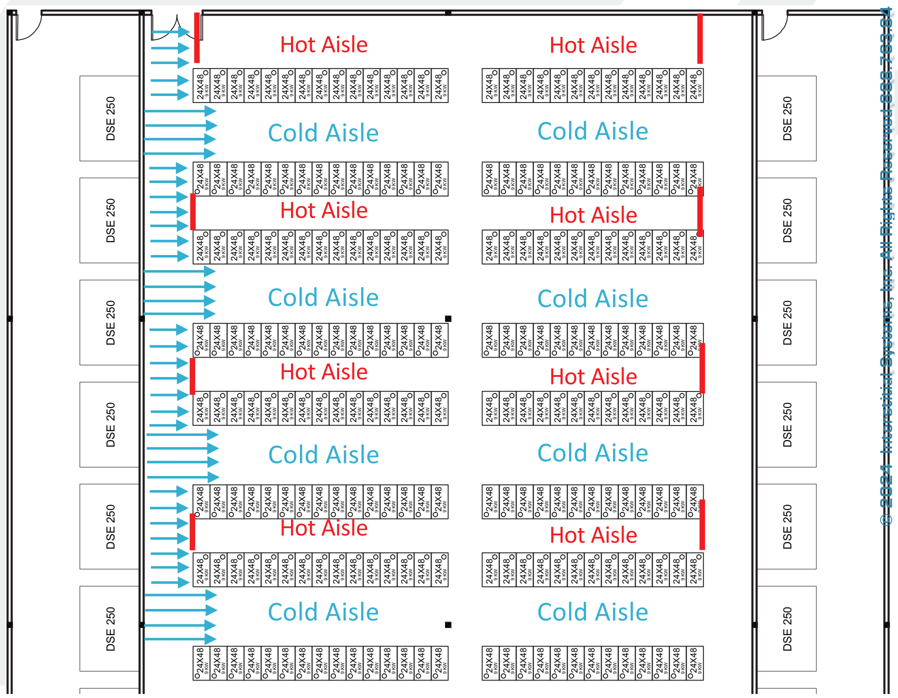

Fig. 5–It's clear from the Blue arrows in the illustration that it's unrealistic to expect any kind of effective redundancy when air isn't and can't be directed into the applicable cold aisle. All the short Blue arrows represent air that bulkheads into the sides of cabinets or the containment doors. Moreover, more cooling equipment is being used than required for load.

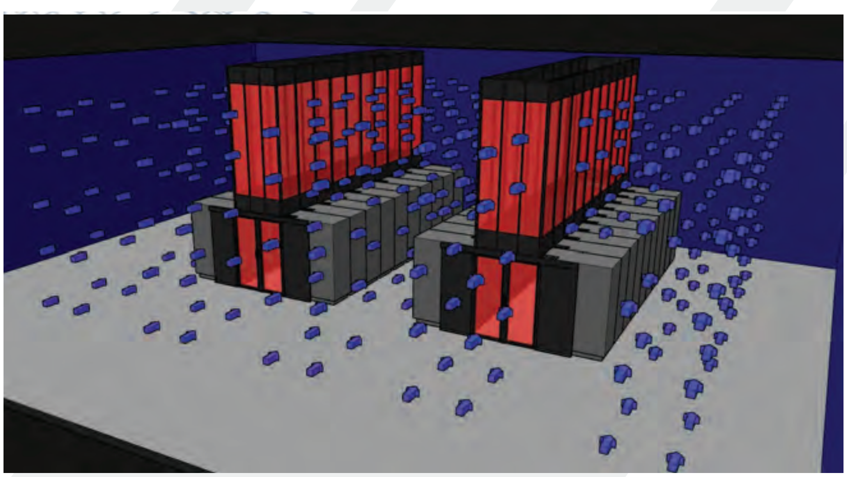

Fig. 6–Is an example of a hot aisle containment system used in a flooded room. It's apparent from this illustration that the air is not being effectively channeled into the cold aisle it was designed to serve. In fact 2/3rds of the cabinet level air bulkheads off sides of cabinets and doors, rather than directly feeding the cold aisle it's supposed to serve.

When using either a single level raised floor or an on-slab flooded room approach any expectations of having an effective redundant means of cooling when servicing equipment or a failure occurs is a hit or miss proposition——clearly not a best practice proposition.

INTERSTITIAL APPROACH

The remarkable performance of Interstitial shows the effectiveness of discharging all of the air from the units into a common pressure manifold. The Figures below makes absolutely clear that locating the AHUs in a separate mechanical room instead of scattering units throughout the data center is far superior to the single level design in providing air conditioning efficiency, dependability, cost effectiveness, and genuine N+1 redundancy that conventional designs simply cannot provide.

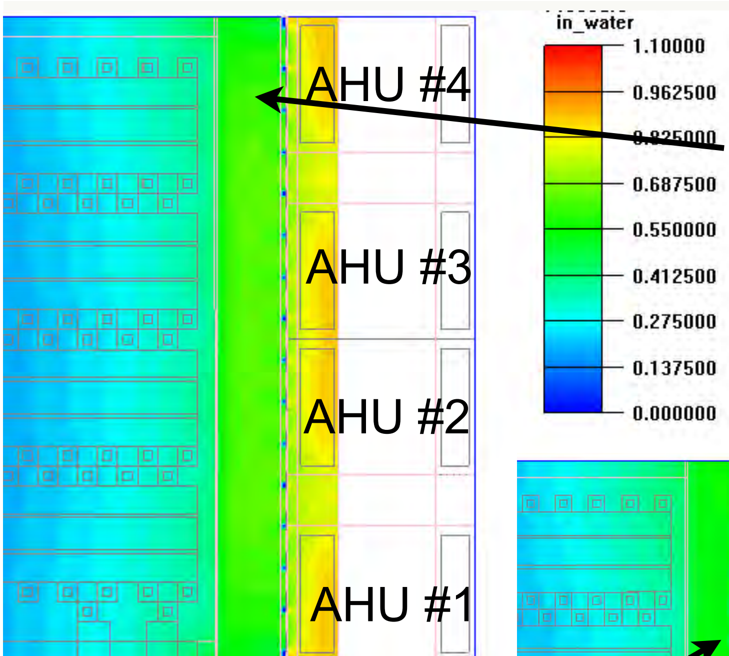

Fig. 7—CFD of a design using a Mechanical Equipment Room with all four AHU's (one redundant) operating at 75% of capacity. The Green from top to bottom (a distance of 64 feet) shows that air is flowing at uniform pressure through the wall outlets and into the Interstitial electro-mechanical distribution system's pressurized air plenum

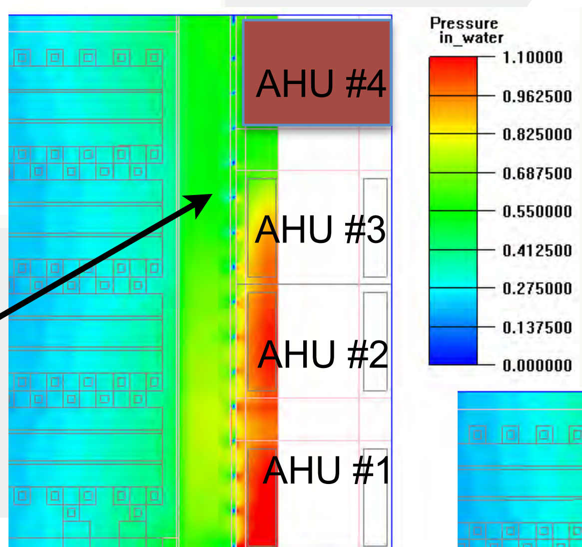

Fig. 8—CFD of the same design as Fig. 7 above, but with one of the peripheral AHUs (#4) shut down, and the remaining 3 operating at 100% of capacity. As you can see the Green from top to bottom shows that the air pressure remains consistent.

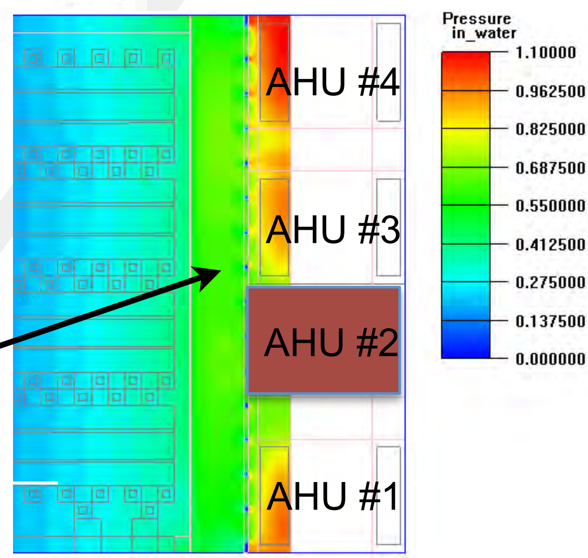

Fig. 9––CFD shows one of the center AHUs (# 2) shut off, and again the Green from top to bottom remains uniform, which represents the air moving under pressure from the Mechanical Equipment Room into Interstitial's pressurized air plenum.

When all the units feed into a common mixing box, and then into Interstitial's pressurized air plenum any of the units can fail or be shut down for servicing without denying any portion of the data center adequate cooling. The load can easily be maintained when the redundant unit is turned on, and the remaining operating units are ramped up to 100% of capacity.

INTERSTITIAL SYSTEMS

The Foundation of Your Data Center

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