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Underfloor Air Conditioning

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IBM invented the computer in the early 60s. Perhaps, this is the most important invention mankind has ever made. The computer has since then reached all parts of the world very fast and has become the lifeline of modern day business.

At that time IBM were looking for someone who could make their computer comfortable in its working environment. Amongst the various air conditioning stalwarts in the US, they chose to entrust this assignment to Ralph Liebert who was a specialist in air conditioning, involving himself in special purpose air conditioning through waste heat recovery in hospitals and commercial buildings.

IBM wanted to cool their computers in a peculiar way, unheard of by air conditioning engineers then, based on the configuration of their computers. They wanted the cold air from an air conditioner to enter their computer from the bottom and leave from top. The reason they came out with this idea was because the heat sink of the computer was made of heavy copper material and was located at the bottom of the computer for obvious reasons.

There were no takers. This was seen as an impossible task then. Liebert found this problem interesting and came out with the first air conditioner, which would deliver air from the bottom of the AC equipment and take the return air from the top of the air conditioner. IBM was thrilled. Their computer, which was tripping because of

unprecedented heating, was more comfortable now and could work on 24-hour shifts. IBM made it compulsory for all their mainframes to be sold to customers with the computer environment being maintained under stringent temperature, humidity and dust conditions all managed through underfloor air conditioning.

Benefits of Underfloor Air Conditioning

Why is under floor air conditioning advantageous compared to conventional ducted air conditioning for computer rooms and other areas housing critical electronic equipment?

1. Natural air flow pattern

Computer rooms and telecommunication switch rooms have high levels of heat densities since there can be more number of servers / switch racks in a given area than people. These areas require faster heat removal. The air will follow the natural tendency of "warm air will rise up" and hence by providing denser cold air at the lower part of the room, it will pick up the heat from the equipment, rise up and return back to the circulating fans of the air conditioner from the top of the AC.

In the conventional method, air coming out of the diffuser located at around 8 feet height at the false ceiling level will diffuse into the room and in turn cool the equipment through convection. This will be a slow process. The warm air from the equipment will create a counter flow since the fans of the computer / switch equipment is normally located at the top. This will leave a gradient in the room i.e. the upper portion of the room being cooler and lower portion remaining warmer, thereby affecting the critical electronic equipment. The heat sinks located at the bottom of the racks will starve of cooling and hence the performance of the mission critical equipment is affected.

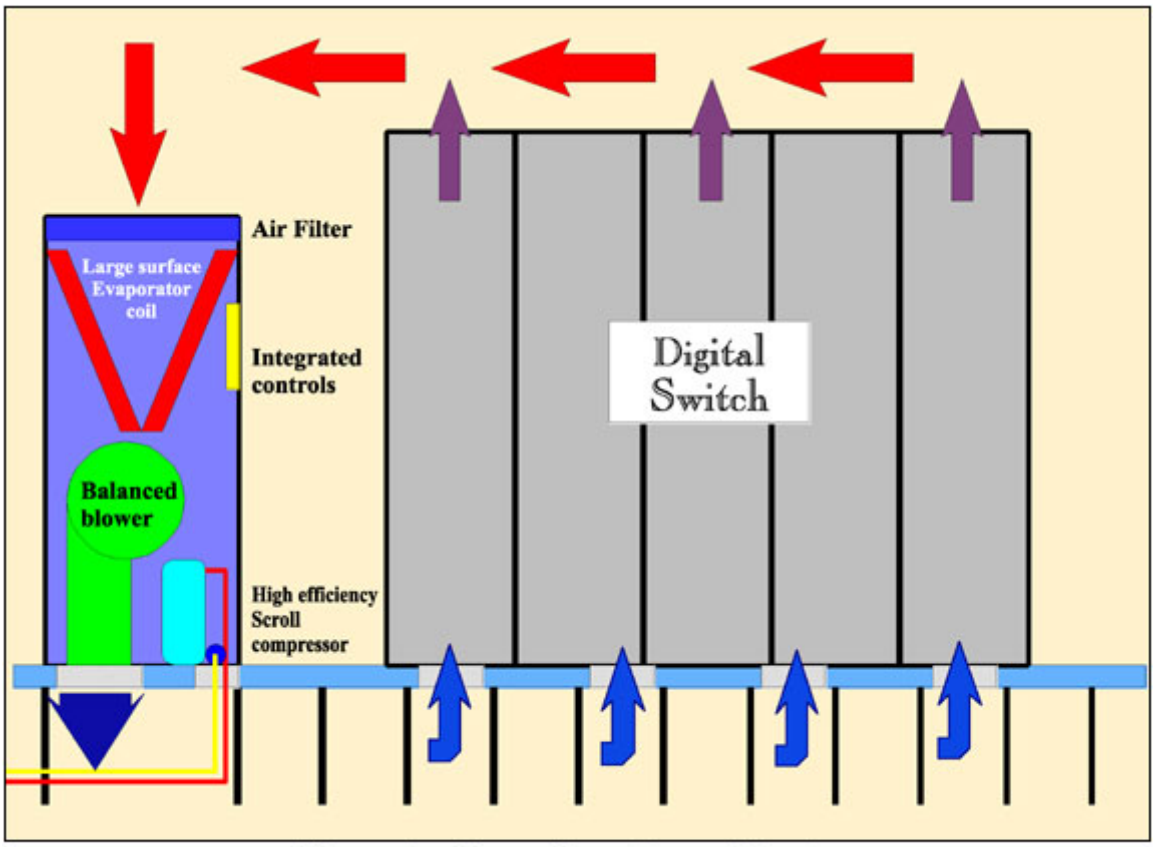

Figure 1 - Down flow air conditioning

2. Saving in tonnage and power

Equipment room cooling means high sensible heat factor (SHF) air conditioning equipment. For computer rooms and switch rooms SHF is of the order of 0.95 and effective room sensible heat is far higher compared to conventional requirements. This means large quantities of dehumidified air. By conventional ducting methods, there are bound to be losses due to the static created by the ducting, dampers, diffusers etc. One needs to select higher capacity motors and at times higher capacity air conditioners to match the large air quantity requirements.

Under floor air conditioning is analogous to blowing air into a balloon. The equal pressure underfloor plenum is made up of the gap between the false floor and the main flooring. Normally, computers and switches, by convention are installed over a false floor so that the cable routing is organized and maintenance of cables becomes easy for the computer engineer. This gap between the computer floor and the main floor can be used for the air passage also. Since air is passing through this equal pressure plenum, air will gush out at whatever point the false floor is punctured like in the case of a balloon. Depending on the number of openings, air comes out equally at all locations of the room.

There is no ducting required under the false floor to direct the air since air exists at equal pressure throughout the plenum.

There is hence no loss in air quantity and it results in considerable savings of tonnage and power.

3. No ducting and no plant room

Since the precision air conditioner with the feature of air conditioning from the false floor can be kept within the critical space, where the electronic equipment is located and air being distributed through the floor, there is no requirement of ducting and also there is no plant room requirement.

4. Flexibility in system design

Typically in a switch room of a Telephone Exchange, the switch installation is planned in stages based on the market demand. For e.g. a cellular operator setting up a Mobile Switching Center (MSC), would typically plan for a load of 75k or 100k capacity. Space will be provided to add switches to increase the capacity upto 200 or 300k. In a conventional central air conditioning system, the system design viz. equipment selection, ducting etc. has to be planned on day 1 and hence the capital cost has to be incurred at the initial stage itself. However, in the case of underfloor air conditioning, the equipment is installed based on the current load only. Provision is made to install more air conditioning equipment as and when the switching capacity needs to be augmented. The allied works like laying the interconnecting copper piping, drain pipe etc. can be done at nominal costs, so that there is no civil work required at a later date when the air conditioner for future expansion needs to be installed. This results in deferring the capital expenditure for capitalintensive telecom projects. This is one of the major reasons, why globally, most of the Switching centers use underfloor air conditioning.

The same logic is true for Internet Data centers, Software development centers, Bank Data centers, which can plan their expansion of servers without interrupting the operations.

5. Resource optimization

It is normal for a Computer / Server room to have false flooring to conceal the data and power cabling, trunking, providing power points for the Server equipment, communication cabling etc. The customer normally incurs the cost of the false floor. If sufficient space can be made available beneath the false floor, air conditioning can be done using the false floor as the plenum and hence optimize the cost. The precision air conditioner can be located

within the Server room for effective control on temperature and humidity conditions. As a result, there is savings on account of the following:

- expensive marble / granite flooring can be avoided.
- false ceiling can be avoided since the fire extinguishing pipes can also be housed beneath the false floor and lighting can be done without the false ceiling.
- cost of floor space in commercial complexes is expensive and hence floor space savings by using underfloor air conditioning is appreciated by customers.

Applications where Underfloor AC can be Applied

Typical areas in various applications where underfloor air conditioning can be applied are:

a. Telecommunication

1. Mobile Switching Center (MSC) of a Cellular service provider or Main Switching Unit (MSU) of a Fixed line service provider which requires round the clock air conditioning for the switch racks.
2. Billing Computer room, which has a server connected to the switch for tracking the billing for various subscribers. The above two areas are normally unmanned.
3. OMC or NMS i.e. Operations and Maintenance Cell or Network Monitoring Station, operates 24 hours a day, 7 days a week for monitoring the network health including the various remotely located utilities like air conditioners, DG sets etc. at the Base Transreceiving Stations (BTS) / Cell sites. This area is normally manned round the clock.

b. Server Rooms

1. Rack mounted compact servers of Internet Data Centers (IDC) or stand-alone mainframes (AS400 etc.) / Servers which typically have fans on top or in the top-front portion of the rack / server.
2. Communication room / VSAT hub room for data communication involving racks housing modems, routers etc. The above two areas are normally unmanned.
3. Network monitoring center, if it is a large IDC or Bank Data Center/ Stock exchange Data Center, where their clients require assistance.

c. Industrial application

1. Rack rooms with Input / Output (I/O) control cabinets involving equipment only (area normally unmanned).
2. Control rooms, which consists of consoles displaying the status of the controls. This area is normally manned 24 hours.

Recommendations for Underfloor AC

The following precautions must be taken while designing and installing underfloor air conditioning systems for telecommunication switch rooms and allied areas:

- Minimum false floor clear height of 400mm to 450mm.
- Grilles with volume control dampers to be sized for face velocity of 550 to 650 FPM per grille. This will ensure proper air distribution to the Servers / Switch racks.
- Floor to be coated with epoxy paint for reducing friction for airflow.
- Floor to be insulated in the case of higher floors since the floor is likely to be very cold and can cause sweating on the ceiling of lower floor causing damage to their false ceiling etc.
- Equipment layout should not block the return air. The air conditioning units should be located in such a way that the airflow should be parallel to the orientation of the server / switch racks.
- The computer and network cables under the false floor should be run through cable tray of minimum height, which are preferably running parallel to air flow.
- All piping holes to be properly sealed particularly to avoid an outside air ingress and to keep away rodents entering into the critical area.