



Comparison between installations in buildings of an "All Air System" and a "Radiant Ceiling System" combined with "Ventilation Air System"

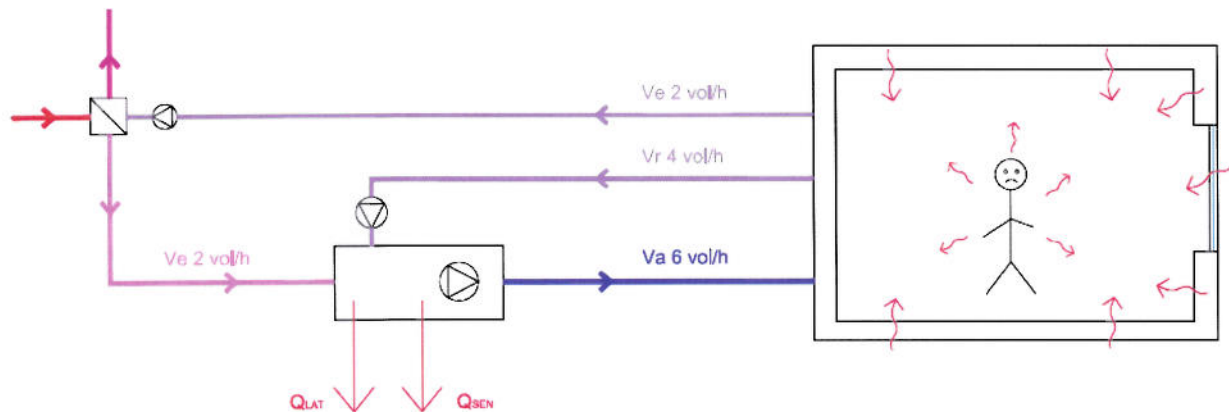
The scope of this document is to explicate few simple but important concepts, with the objective to compare two diffused systems of energy treatment into a building.

The concepts below are of general application, they do not refer to specific installation or specific countries. These considerations can be adjusted, but the final results have the same order of magnitude.

This comparison is made for cooling conditions, because they are normally more difficult to meet.

- All Air System

This solution provides to introduce in the building volume, a quantity of air necessary to satisfy the total load, sensible and latent. To obtain this result it is necessary installing air ducts of admission, recirculation and for the exhausted air.



- Calculation for an area of 10000 square meters, with a volume of 30000 cubic meters

Supply air volume: 6 volume/h that corresponds to 180000 cubic meter/h

Primary channels: with speed of 10 m/s we need an area of 5 square meters which corresponds to a channel with circular cross-section of $D = 2,53$ m, or to a rectangular channel with dimensions 1,7 x 3 m

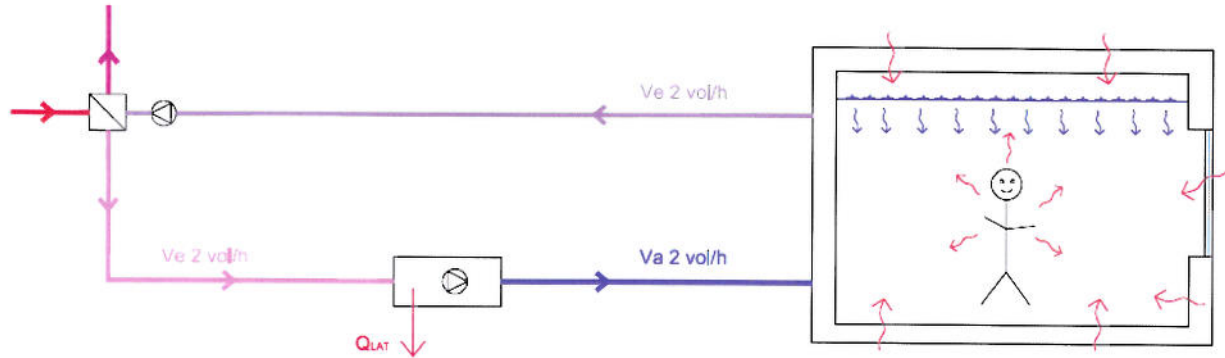
Secondary channels: assuming a speed of 5 m/s and 5 channels, it is necessary for each channel an area of 2 square meters which corresponds to a circular channel of $D = 1,6$ m or to a rectangular channel with dimensions 1 x 2 m

Power blowers: considering a pressure drop of 1000 Pa in the channels, we need a supply fan with electrical power of 62,5 kW, and other two fans for recirculation and for the expulsion of the exhausted air, with approximately the same capacity, for a total electrical power installed of 125 KW



- Radiant Ceiling System with Ventilation Air System

With this solution, the total or the larger sensible load in a limited space, is in charge of the radiant ceiling system. The air system functions are limited to guarantee the ventilation of the building, and the control of the internal humidity due to latent load. With this solution the air ducts are limited in terms of quantity, surface and weight.



- Calculation for an area of 10000 square meters, with a volume of 30000 cubic meters

Supply air volume: 2 volume/h corresponding to 60000 cubic meter/h

Primary channels: with speed of 10 m/s we need an area of 1,67 square meters, which corresponds to a channel with circular cross-section of $D = 1,46$ m, or to a rectangular channel with dimensions 1,2 x 1,4 m

Secondary channels: assuming speed of 5 m/s and 5 channels, it is necessary for each channel an area of 0,67 square meters, corresponding to a circular channel of $D = 0,92$ m, or to a rectangular channel with dimensions 0,4 x 1,7 m

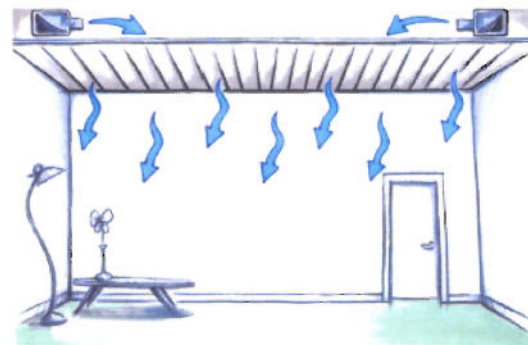
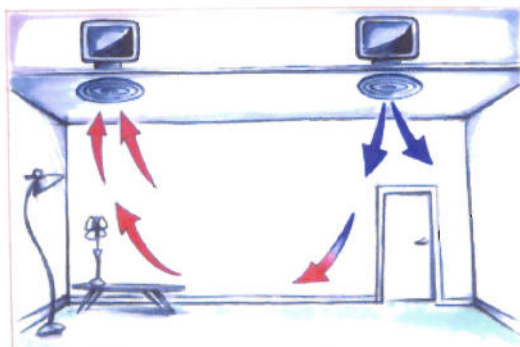
Power blowers: considering pressure drop of 1000 Pa in the channels, we need a supply fan with electrical power of 20,8 kW, and another one fan for the expulsion of the exhausted air with approximately the same capacity, for a total electrical power installed of 41,6 KW

Pump ceiling: for 10000 square meters of ceiling with specific power of 100 W/sqm, 3 K of delivery/return temperature difference, delivery water pressure of 100000 Pa, it is necessary to use a circulator with electrical power close to 10 KW



- Main advantages of the Radiant Ceiling System in comparison with the All Air System about the air distribution in the building

- 1) Smaller primary vertical channels, with space saving in the floors
- 2) Smaller secondary horizontal channels, with height saving in the floor
- 3) Reduced sizes of the channels involve less quantities of metal, less installation work with consequent cost saving, and lower weights imposed to the building
- 4) Reduced sizes of the filters in the air machines and therefore lower costs of purchase and maintenance. The reducing of the filters surface involves also the decrease of the risk to have bacteria colonies, that could produce infections to the building occupants.
- 5) Smaller Air Treatment Units with consequent cost-saving, weight reduction (especially important for installation on the roof), and less noise from fans
- 6) Lower volumes of distributed air reduce the air movements in the rooms, with consequent lower risk to have unsatisfied people in the building because of low comfort due to drafts
- 7) Saving of 66% of electrical energy supplied to the Air Units. The difference between the two systems considered in the example, is estimated in 73,4 kW which correspond to 643000 kWh saved in one year
- 8) With the micro-perforated ceiling panels, it is possible to avoid the unsightly anemostats for the air admission. The air flow required by the room can be supplied directly from the plenum using the perforation of the panels. With this solution the inlet air speed is very low with consequent high comfort in the rooms.





- Other two huge advantages of the Radiant Ceiling System

A) Concerning the great comfort produced by this system compared with other system, it is not necessary spend others words in addition to the considerable literature published in the last 80 years. It is important in any case to make a consideration concerning the comfort temperature: we can obtain the same comfort with room temperature higher during summer, and lower during winter. With the radiant system, in summer, if the room temperature is 1 °C over the standard temperature of air system, the power load reduces approximately of 16%. This means that with the radiant ceiling system, the total power installed is lower, with large energy saving.



B) Normally where the radiant ceiling system is installed, there are two different chiller units, one dedicated to the supply of cooled water to the air units with temperature range 7 °C/12 °C, and another machine dedicated to the ceiling system that supplies cooled water at temperature 15 °C/19 °C. The big advantage is that the chiller for the ceiling has higher efficiency, because its cooling cycle is tight, with consequent electrical energy saving around 25-30% compared with a similar machine with 7/12 cycle.

- Conclusion

There are many advantages in the application of the radiant ceiling system, concerning comfort, cost, return of the investments and energy saving.

Giacomini develops and installs in the world its radiant system since 15 years.

Giacomini's customers that tried the system are very satisfied of the results obtained and pleased for the professionalism of Giacomini's service.

S. Maurizio D'Opaglio, 22 February 2011

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