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MODERN VENTILATION SYSTEM

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Abstract: Everything in the world evolves according to the human need and comfort. Likely, the ventilation system also emerged simultaneously for the requirement. Basically, providing ventilation in any building or construction is to maintain the condition of air inside the closed structures. Because of ventilation the temperature, air quality and relative humidity as such parameters are maintained and provides thermal or human comfort.

In passive or natural ventilation system the supply and removal of air from the internal space is performed without using any mechanical system. Process is performed naturally and mainly through wind and temperature difference. The passage of air through the provided ventilation controls the CO2 level, air humidity and temperature inside the room. This Traditional system of ventilation does not perform efficiently in every condition and situation. If we consider summers the temperature needs to be lowered inside the room and whereas in winters the temperature needs to be increased in the internal space.And, in the huge gatherings in the places like auditorium and halls the natural ventilation system may not fulfill the human comfort. To overcome this issue most of the constructions are now provided by Mechanical ventilation system.

Key Words– Central air-conditioning, auditorium, temperature, load estimate, comfort.

Introduction:

In mechanical ventilation system the air is intentionally driven by the fans to provide ventilation and this system also uses exhaust and supply fans according to the requirement. When a huge crowd is gathered in a closed and confined space the CO2 content in the room increases there will be a drastic change in the environment of that particular room.

As the closed hall Requires the usage of high energy driven electrical appliances which increases the temperature inside room. These effect the human comfort and also dampen the health of people. Natural ventilation alone is not sufficient to maintain proper quality of air and maintaining thermal comfort. [1] Without replenishing the fresh air from outside can lead to rise in Carbon-di-oxide level and without controlling the factors like humidity, temperature it can have a significant effect on health of individuals. The energy driven ventilation system replenishes the air and maintain proper air quality which consequently provides thermal comfort.

Heat interaction between human body and its environment takes place through three modes i.e., radiation, convection and conduction. The common heat sources are electrical equipment such as lights, gadgets and radiation through sun and human presence in the room effect the atmosphere. The integration of six factors air temperature, mean radiant temperature, air velocity, humidity, clothing level and physical activity level shows major impact on the internal thermal comfort. These factors are effectively maintained by the new or modern ventilation system.

CHRONOLOGY-

The process of ventilation ways longs back to the time when there was neither electricity nor steam engines. But at that time too they figured out there was a connection between air quality and health risks. [2] To make the indoor quality better and replenishing the hot air inside with fresh air, a stacking effect was used at that time. Through the chimneys and gaps on the upper flooring, the hot air being light would often escape which could make the way for outside air to travel in. To increase the stack effect and this increasing the draught generated, the height of chimneys was also increased.

Along with this natural method in which just infrastructure comes into play, the hand driven fans were also invented which would replace the air indoors with fresh outside air.

This innovation was further advanced to use of giant bellows which were installed through holes in the wall, the outside air was pumped inside the building.

But in the auditoriums where there were large gatherings this system was found to be in-adequate.

To solve the problem, ice cooling was introduced in the auditoriums. In this system outdoor air could pass through ice, so that

the temperature inside the auditorium could also be maintained. [3]

This also had some of the downside too, tons of ice were used every time there was an event in the auditoriums so that also proved to be a costly and ineffective method.

There was also a time when fire places where used inside the building , to disperse the hot air through chimneys and replace that with the cool air from outside , but this at the same time had one downside that sometimes , when proper dispersion is not carried out smoke could also get trapped inside the building making this method in-efficient.

As the concept of power generation and electricity came into effect, large power-driven fans or blowers which can supply variable speed air flow, were used and this method is being used till now also.

After this development, emphasis was also made on the concentration of carbon-di-oxide inside the auditoriums which got collected, monitoring the level of the toxic gas. Various methods were also incorporated to take care of this.

The electricity really paved a way for development for more efficient systems for ventilation for auditoriums. The ducts systems ensured that the auditoriums are supplied with the fresh air from outside, and it also played a role for extraction of from inside and deliver it outside. This system was also modified to cool the air which is being delivered inside, so that the temperature could also be maintained inside the auditorium.

HVAC (Heat, Ventilation and Air-conditioning) is the most modern-day approach now a days, because along with maintaining the quality of air, temperature of air is also to be maintained. [4] The more and more efficient system hascome into play and more are coming.

Modern Ventilation System

The recuperation system in your home ensures the necessary level of fresh air and saves energy. automation technology has a great impact on system performance start control reduces power costs of air handling units, adjust ventilation to your everyday needs provides a wide range of control options. it has been estimated that smart control allows to reduce the average cost of electricity for ventilation by half how is this achieved!

Ventilation modes and scheduling

Excessive ventilation of premises is just a waste of power you can select different ventilation modes optimised for your daily needs, each ventilation mode allows you to set the volume and temperature of the air supply. weekly scheduling adjusts the ventilation intensity to your lifestyle, rooms are ventilated every day of the week for a limited number of hours in accordance with the scheduling program. when nobody is at home the automation reduces the ventilation intensity and before you return the unit starts to operate in normal mode, this scheduling programs can reduce your energy costs for ventilation by half. [5] The power

consumption of the ventilation system directly depends on the air temperature settings when choosing the air supply temperature, it is important to remember that the air handling unit recovers 80 to 90% of heat. During the cold season the desired temperature indoors is maintained by the heating system, the air supply can be additionally heated with an electric heater however a one degree increase in the air supply temperature raises energy consumption on average by a quarter. smart control allows you to manage the operation of the electric air heater, with additional energy saving functions in the air handling unit minimises your cost but under certain conditions it may not support your comfort requirements.

Special ventilation modes

Special ventilation modes allow you to save energy and ensure comfort in various daily situations, when kitchen hood is turned on it removes a large amount of air therefore the pressure difference created between the indoors and outdoors reduces the hoods performance and results in worse removal of voters in combustion products, smart control allows you to select a special mode reduces the air volume exhausted by the air handling unit upon adjustment of air flow the hood can operate effectively. Special modes work as well, adjusting the ventilation settings of poorly ventilated fireplaces to contaminate the building. To avoid this, you can open the windows to let in more air. [6] However, in cold weather, using expensive heat in a special ventilation mode can increase the air flow, which not only simplifies the lighting of the fireplace, but also improves the air flow, one from the chimney carbon monoxide is removed. Special ventilation modes can be adapted to your other daily needs, for example when you switch on the light in the bathroom a signal is sent to the handling unit to quickly when the premises automation increases the intensity of ventilation, when you turn off the switch the intensity of ventilation returns to the previous level. In holiday mode you can pre-set the time when you're not at home the special program will activate the handling unit at minimum intensity to ventilate the premises at regular intervals with this program ventilation energy costs are minimised and when you return after the holiday you will enjoy clean and fresh air at home.

Automatic air quality control

With air quality sensors the air handling unit operates if necessary, in order to maintain the required air quality no need to worry about weekly schedules or adjustment of ventilation intensity smart control will do it for you. An air quality sensor response to the number of people in the rooms or do you need fumes and odours maintaining a comfortable and healthy environment with a high level of accuracy the sensor sends signals and the ventilation automation effectively controls the air flow with fresh air ventilation intensity is reduced or turned off thus saving energy, an indoor humidity sensor measures relative humidity and if the threshold limit value exceeded increases the

intensity of ventilation thus excess moisture is removed from the rooms. It has been estimated that a ventilation system functioning on demand reduces annual energy consumption of the unit up to 3-fold.

Control of the ventilation unit

Smart control informs the user about the performance of the ventilation system one can easily find out the heating energy savings and energy consumption of the air handling unit, an informative screensaver always shows the key indoor climate values and ventilation parameters, special software allows to connect and control your air handling unit remotely at any time, with smart control you can operate your ventilation system comfortably and properly by selecting the most efficient settings, it has been confirmed that smart control reduces energy costs for ventilation more than 2-fold.

For the best and efficient working of the HVAC system, the tonnage capacity and load calculation are to be carried out. And by the word Load,[7] it is referring to the heat which is to be removed from the auditorium for to obtain the human comfort and suitable temperature levels. It will also help us in finding out the equipment's to use and the sizes to take for designing.

There are basically 2 types of loads –

1. Cooling Load – these types of calculations are done to figure out the heat gained, and then according to it solutions are figured out for the cooling capacities required.
2. Heating Load - these types of calculations are done to figure out the heat loss, and then according to it solutions are figured out for the heating required.

For cooling load calculations, the system must be divided into several parts such as.

1. Heating by people.
2. Heating through doors and roof.
3. Heating through roof and walls.
4. Heating through lights.
5. Heating through appliances.

HEATING BY PEOPLE –

In an auditorium the people present there are the main source of latent as well as sensible heat. The internal heat gained by people through Metabolic heat is highest comparative to other sources. Since we are calculating it for 600 people plus extra 50 people as a part of the performers group. [8]

PEOPLE WHO ARE SITTING –

- Sensible heat per person – 70 watt
- Latent heat per person - 50 watt
- Number of people - 600
- Total sensible heat - 42000 watt
- Total latent heat - 30000 watt

PEOPLE WHO ARE PERFORMING/DANCING –

- Sensible heat per person – 90 watt
- Latent heat per person - 160 watt
- Number of people - 50

- Total sensible heat - 4500 watt
- Total latent heat - 8000 watt

Total heat gained due to people = Total sensible heat(sitting+dancing) + Total latent heat(sitting+dancing)

=42000+4500+30000+8000
=84500 watt.

Ventilation behaves like the lungs of the structure. It is the most common way of moving outside air into the structure or a room and conveying it nearby. The outside air will weaken within dirtied air, and furthermore it will be supplanted by a portion of the debased air. The basic role of ventilation is to get ready solid air for the breathing of individuals there.

Five Types of Ventilation

Ventilation can commonly be classified into five sorts: Natural, Mechanical, Hybrid, Spot, and Task-Ambient Conditioning (TAC).

Regardless of the use of your structure or where it is found, you ought to think about one of these five sorts of ventilation frameworks in your structure.

Regular Ventilation

Regular or conventional ventilation frameworks rely upon normal powers, for example, wind and warm lightness to drive outside air all through the structure's openings. Three elements assume parts for normal ventilation to work. These variables are environment, human way of behaving, and fabricating plan.

Exhaust-Only Ventilation

In these sorts of ventilation, exhaust ventilation is a subset of mechanical ventilation. These frameworks work by diminishing the tension inside the structure. It regularly has no exceptional part to pull outside air into the room. [9] The outside air enters the structure through spills in a structure's design and balances the tension.

Supply-Only Ventilation

In these sorts of ventilation, exhaust ventilation is a subset of mechanical ventilation. The inventory ventilation framework utilizes a fan to compress the room air and power the open-air wind stream inside. Within air escapes outside through divider holes and exhaust fan pipes. A normal stock ventilation framework contains a fan and conduit framework that helps natural air comes into the structure. At times they have a Central Fan Integrated (CFI)

framework. In this condition, establishment and working expenses might increment.

Balanced Ventilation

If exhaust-just and supply-just frameworks consolidate, the reasonable framework appears. In this framework, the wind stream pace of indoor exhaust and outside supply is generally equivalent. At times adjusted framework utilizes Energy Recovery Ventilator (ERV) as well as a Heat Recovery Ventilator (HRV). Adjusted ventilation is one more subset of kinds of ventilation

Energy-Recovery

At the point when we talk about kinds of ventilation, we ought to think about energy recuperation, too. Energy recuperation ventilation readies a controlled method of ventilation to limit squander energy. It moves heat from the warm exhaust air to the virus supply air. Along these lines, the expense of warming ventilated air reduces definitely. In the mid-year, within air, which is colder, gets the hotness from hotter outside air and chills it off, diminishing the cooling cost.

Hybrid Ventilation

Among different kinds of ventilation, Hybrid ventilation (blended mode) relies upon normal main impetuses to set up the ideal stream rate (plan stream rate). At the point when normal ventilation has an extremely low flowrate, the job of mechanical ventilation is conspicuous.

Whenever normal ventilation isn't adequate alone, exhaust fans can be introduced to expand the ventilation rate. These have enough pre-testing and arranging to work appropriately.

Spot Ventilation

One more sort of kind of ventilation is spot ventilation. To work on the viability of both regular and mechanical ventilation frameworks, spot ventilation appeared. All in all, it is smarter to say that it is a helper framework. This includes conveying neighborhood exhaust fans, equivalent to those utilized in the washrooms or kitchens. It eliminates the dampness and inside air contamination at its source, and subsequently, it works on the value of the ventilation framework

Task Ambient Conditioning (TAC)

Task Ambient Conditioning (TAC) is one of different sorts of ventilation. The ideal temperature and solace level rely upon people. While certain individuals whine of overheating, the others might feel that the temperature is some way or another virus. The conventional ventilation frameworks can't meet one's inclinations. That is the place where the errand encompassing molding assumes its part. This somewhat new innovation controls the wind current in a space.

HEATING THROUGH LIGHTING -

As we have discussed in length about the importance of lighting and its evolution in auditoriums, As much they are of importance

in an auditorium , they can also be the main source for heating an auditorium. That is why it is said that Lightning and HVAC system goes hand in hand. As lighting results in the increase in heat gain of an auditorium and which in turn is responsible for increasing the discomfort; [10] that is why lighting equipment are situated carefully while considering all the factors in an auditorium.

The heat gain by lighting can be given by the equation,

$Q_{lighting} = W * F_u * F_s$

W = Total wattage of light

F_U = Usage factor (used wattage /installed wattage)

F_S = Special allowance (ballast factor)

- **USAGE FACTOR**

  This can be calculated by noting down wattage of all the lighting LEDS OR LAMPS which are present in an auditorium .
  Basically it tells how many watts are being used .

- **BALLAST FACTOR**

  Basically ballast is a heart of a bulb or led . It make sure that the bulb is lit by managing the energy distribution through fixtures. It is basically used for stability .

  And ballast factor is referred to as the ratio of the actual lumen output which will be delivered by a bulb to the rated or mentioned output of the bulb.

  Ballast factor is mostly in the range 0.70 – 1.20

Conclusion

The environment inside any auditorium is not stable, until and unless any external device or system is introduced inside it. Some of the conditions are uncertainty in temperature, humidity, percentage of oxygen and rise in carbon dioxide etc. So, to overcome this issue many systems and devices have been introduced, but there has not been a perfect solution for this, as we have seen many times the person sitting just beside the Ac feels cold more than others, so it is a kind of problem. The system which we are introducing here is acolumn-based ventilation system so that the cold air from air conditioner should be equally distributed among the crowd present inside the auditorium.

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