Industrial & Commercial Ventilation Handbook
Foreword
This handbook IS NOT intended to be a textbook that covers the entire field of heating, ventilation and air conditioning. It is not designed to treat the many specialized uses for which ventilating equipment is needed in industrial and commercial buildings. It does not discuss fans or blowers specifically designed for use in the processing of materials and other production operations within a plant. It does not offer information on the design of high pressure, ducted air circulation systems common to modern office buildings and similar structures.

This handbook IS to serve a much more elementary field of ventilation. Its principle value will be to those responsible for the health and comfort of individuals located in a building without air conditioning, especially buildings with no satisfactory alternative system for the ventilation and cooling of its occupants.

Equipment and service
Illustrations of the basic equipment needed in an American Coolair Breeze Conditioning System are found in this handbook. Use of this American Coolair equipment is recommended for reliable performance and low maintenance service. American Coolair has a nationwide system of sales offices with factory-trained engineers ready to assist you in system design, equipment selection and installation. The location and telephone number of these American Coolair sales offices are found in the yellow pages of your local telephone directory. In addition, the American Coolair factory in Jacksonville, Florida is always ready to provide information or service you may need.

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The human environment

Humans are warm blooded animals whose normal body temperature is 98.6°F Fahrenheit. However, we are most comfortable when the air temperature around us is in the 72°F-to-78°F range. If there is air motion around us, the effect of “wind chill”, or evaporative cooling, enables us to feel comfortable in a much higher air temperature.

As the natural air temperature in most non-air conditioned buildings is much warmer than outside air temperatures, the problem of keeping humans comfortable is primarily a cooling problem. Of course, this is not the case in periods of very cold weather.

Our purpose is to discuss the environmental problems that frequently exist in periods of hot weather. An effective, economical solution of these problems is vital to the success of any business.

The problem of personnel discomfort

Almost any individual who finds himself in a situation or location that produces a feeling of discomfort quickly seeks relief from the problem. If there is no convenient solution to his discomfort, he may react in a number of ways. Invariably, the discomfort and his reaction to it has an adverse effect on his attitude, behavior and general efficiency in his job or responsibility.

In almost any building or room used for commercial and industrial operations, it is quite likely that there are recurrent conditions that cause personnel discomfort. This is particularly true unless an expensive system for the circulation of refrigerated air (air conditioning) has been provided. In mild to hot weather, the discomfort of individuals is generally due to the build-up of intense heat within the structure. This becomes a severe problem in summer because the sun load on the building is added to the normal sources of heat build-up within the building. Most buildings have sufficient ventilation to remove smoke and fumes detrimental to health. However, it is unlikely that that system contributes very much toward the comfort of the individuals who occupy the room or building.

If an individual is to produce maximum results, he must be allowed to function in an environment as nearly ideal as can be provided. In fact, the benefits in terms of efficiency and productivity can be substantial. Failure to provide a comfortable environment can be very expensive in terms of errors, work slow-down, complaints, absenteeism, etc. If the major factor is a hot, humid atmosphere, which may include smoke, dust, fumes or other irritants, a practical and effective approach to the problem is available.

A practical approach

To obtain a reasonable degree of personnel comfort in hot weather, there are three basic factors that should be provided for in the ventilation and cooling system of a commercial or industrial building.

Removal of excessively hot air

When the air temperature in the occupied area of a room or building exceeds 78°F to 82°F, most individuals begin to feel uncomfortably warm. The first step toward controlling the problem is to provide for the removal of excessively hot air from the building. This superheated air frequently mixes with the air in cooler areas of the building to produce an overall temperature increase. As superheated air is frequently localized around heat-producing machinery, it should be exhausted from the building near its source. This will prevent some undesirable air temperature increase in other areas.
Supply cooler air

As a rule, outside air temperatures are considerably cooler than those inside a building. As superheated air is exhausted, provision should be made to replace it with fresh, cooler, outside air. Exhaust air in many areas of a building may have a temperature of 125° to 150°. This is usually the case where heat-producing machinery is in use. Similar air temperatures frequently occur near the roof or ceiling where rising warm air is trapped and further heated by the sun load on the roof.

When this high temperature air is replaced by outside air, a substantial improvement in the average air temperature of the building results. Even where outside air temperature may be in the 80s or 90s, invariably it is 15° to 20° cooler than the air it replaces. This is a very important improvement to the individuals affected.

Benefits

A work stoppage or strike may occur if the problem of personnel discomfort is unresolved. The benefits from a solution to such a situation are enormous. In plants where there is a high density of employees and many manual operations involved, an improvement in the environment can produce substantial benefits in terms of increased production, reduced errors, and a decline in complaints and absenteeism among employees. In other circumstances, the attentiveness of an audience or student group may be a factor that spells success or failure for the project.

There is an American Coolair case history where a high ambient temperature had actually reduced the capacity of a big power turbine. To obtain rated performance by the machine, an improvement in the room ventilation and cooling system was necessary. When this was accomplished, the plant management was amazed to find an equivalent improvement in the efficiency of the employees who were required to work in this same environment with the machine.

Available cooling methods

The three basic considerations outlined in A practical approach should be used as yardsticks to evaluate the methods of cooling being considered to solve the personnel discomfort problem. Commonly available methods that should be considered are:

Exhaust fans or Power Roof Ventilators (PRVs)

Almost every building has some type of ventilators to vent hot or contaminated air from the structure. As a rule, this equipment is inadequate for anything more than safeguarding the health of the occupants. In some cases, it does an inadequate job of this.

To do a satisfactory job of eliminating excessively hot air, it is usually essential to have powered wall and/or roof exhausters. These fans should also help to control air pressure within the building whether it be negative or positive pressure.

The most effective way to incorporate wall or roof exhausters into a system will be discussed in the sections that follow.

Supply cooler, fresh air

Breeze conditioning

A very effective way to overcome the discomfort of a hot, stuffy room is to create a breeze. Before refrigerated air systems were invented, mechanical fans of every description were used to provide air circulation.

The circulation of air over a person's body immediately causes a cooling effect on the skin. When air is passed over a moist surface, it will evaporate some of the moisture and thus lower the temperature of the surface. This is precisely what occurs when air circulates across the human body.

Create a breeze

By creating a gentle breeze throughout a room or area, a great deal of cooling comfort is provided for individuals who must work there. This pattern of air circulation is called "breeze conditioning" by American Coolair engineers. It is effective even when the air temperature may be 85° to 95°. When this air circulation is achieved in combination with the factors mentioned in the paragraphs above, a very effective and practical solution is provided for the problem of personnel discomfort in hot weather.

Propeller Fan—Type C
Air circulation

If the exhaust and supply air requirements of a building have been carefully engineered and installed, and there continues to be a high instance of worker discomfort, the problem usually relates to the matter of air circulation.

Typical examples of worker discomfort are found in areas where exhaust fans are roof mounted and air supply is through windows and wall openings. Air flow is generally from the window opening to the nearest roof exhauster. The cooling effect on the individuals in the area is negligible. To be effective, air flow must be at or near floor level. In this way, occupants obtain maximum benefit from the fresh, cooler air; they receive the added comfort of air circulation over their bodies and they are not adversely affected by the superheated air being exhausted from the building.

Supply fans or PRVs

A large number of buildings use exhaust fans and/or power roof ventilators to exhaust fumes, smoke, dust or other contaminants unavoidable in the operation of the business. As a result, these buildings are frequently under a severe negative pressure. This condition can create problems in many areas of operation. Examples are: (1) reduced efficiency of exhaust systems that are working against each other; (2) down drafts in flues, that may extinguish pilot lights and cause explosions and fire; (3) severe drafts around windows, doors and other locations where air seeks to enter the structure.

The solution to problems of this kind is usually found in the use of supply fans or "make-up" air ventilators. During the hot weather period, these fans become a valuable source of fresh, cooler, outside air to replace the superheated air being exhausted. If they are correctly sized and coordinated with the exhaust fans, an effective ventilation system may be achieved.

The American Coolair Breeze Conditioning System

A carefully engineered ventilation and cooling system frequently combines several methods of air movement to accomplish the desired results. Exhaust fans, power roof ventilators, supply fans, make-up air units and air circulators may all be utilized. American Coolair sales engineers with experience and training in the selection and use of this equipment can be consulted for advice in the design of the system and installation of its components. System components, practical limitations and common consideration involved in the design of an American Coolair Breeze Conditioning System are discussed in the following sections.
Basic components for a system

Exhaust fans

One of the ‘’work horses’’ of many ventilation and cooling systems is the wall-mounted exhaust fan. A mounting panel attaches the fan to the inside face of a wall opening. An automatic or motor-operated wall shutter is mounted on the outside face of the wall to provide weather protection when the fan is not in operation. These wall exhausters are available in a wide range of sizes and capacities. American Coolair has models with blade diameters from 7” to 84”. Capacity ranges from 250 cubic feet per minute (CFM) to approximately 100,000 CFM from a single fan.

Fans of this type are quite efficient, dependable and require relatively little maintenance. Minor disadvantages may relate to their wall location. This location may result in interference with operations of the building, may cause damage to the fan itself or it may be a possible disturbance to personnel working in the proximity of the fan.

Power Roof Ventilators (PRVs)

Power roof ventilators of the type manufactured by American Coolair are very similar in basic design to the wall fans. Size and capacity closely parallel the wall fans.

One of the most popular PRVs is the upblast exhauster. This unit utilizes air velocity to expel rain or snow that may try to penetrate into the structure. When the unit is not in service, butterfly dampers effectively seal the opening against the weather. Because of the straight-through air flow design, this is the most effective and efficient PRV available.

PRVs are specified by many design engineers because they are roof located and away from operations within the structure. Maintenance and service can be performed from a roof location. Cost per CFM may exceed by a small margin that of wall fans with equal capacity. However, the advantages may more than offset the slight disadvantage of unit cost.
Supply fans or “make-up air” units

Supply fans may be either wall mounted or roof mounted. Most American Coolair fans and PRVs of the type described above are available for supply usage.

Additional modifications and special products are available from American Coolair to tailor their usage to individual installations. For example, filters may be added to supply PRVs when desirable. Also, American Coolair’s uniquely designed Model PT Power Tube Fan can be used to supply make-up air, in summer and winter, without the need for the supplemental heating required by most other make-up air systems.

For more information on the application of this special product, refer to American Coolair Form No. 520-15.

Intake louver

Many breeze conditioning systems are designed without the use of supply fans or make-up air units of any kind. The exhaust system creates a slight negative pressure in the building and outside air is induced through openings designed for this purpose. Intake louveres are usually mounted at the opposite end of the building from the exhaust fans in suitable wall locations. When the breeze conditioning system is in use, the louveres are opened manually or by damper motors; when not in use, the louveres are closed to provide weather protection. An alternative method for providing air intake openings is through the use of roof mounted hooded supply vents. American Coolair’s Type PE PRV can be furnished without a fan for this purpose.

Air circulators and spot coolers

Mobile Air Circulator

Many buildings are much too large to rely on the circulation of air at the proper velocity and direction without the use of supplemental fans. In other cases, a system of exhaust and supply fans may be lacking in the building. Air circulators or booster fans can usually solve the problem. American Coolair customers have used our Type UD propeller fans (7” to 24”) and CABL/CABH propeller fans (24” to 54”) to good advantage for this purpose. Pedestal fans have been used as air circulators in some cases. Spot coolers or “man coolers” are air circulators used for a specific purpose or problem area. Air circulators have the big advantage of being readily available, inexpensive and easy to install. They are not a satisfactory substitute for a complete ventilation and cooling system, however.

Baffles, deflectors and diffusers

In some sophisticated systems, elaborate duct work and diffusers are incorporated for distribution of air throughout a building. This type of system is expensive and most American Coolair Breeze Conditioning Systems avoid this degree of sophistication. Instead, simple, inexpensive baffles, deflectors and diffusers are used to good advantage. These items are usually fabricated and installed at the job. They are made from a variety of inexpensive materials including polyethylene, masonite, plywood and sheet metal. Specific applications of these items will be discussed in subsequent sections.
**Calculation of air volume**

The volume of air required to operate a ventilating and cooling system is a very fundamental requirement. Before air volume is estimated or calculated, careful consideration should be given to the following factors.

**The objectives of the ventilation system**

Be sure that the decision you make will accomplish the most important objectives or will overcome the most important problems. This should be the overriding consideration in the selection of a system of ventilation.

**The budget**

Availability of money to finance the system is a factor that must be considered early in the planning stage. The funds available will affect the objectives you set and will influence the system of ventilation selected to meet the objectives.

**Alternate methods of calculating the required air volume**

The method selected for calculating air volume will relate closely to the objectives to be accomplished by the system. Based on the objectives and funds available, you can now consider the alternatives and select the best method to use in calculating air volume requirements. A description of these methods follows.

**Rate of air change method**

This is a time-honored approach to a determination of air volume requirements. It is based on the theory that a complete change of air in a room or building should be made at a certain time frequency. The rate selected is frequently an arbitrary decision. It may be based on experience with similar installations or may be established by a health or safety code. Many fan manufacturers have published charts that show recommended rates of air change for typical installations.

The formula for calculating the air volume in CFM by the rate of air change method is as follows:

\[
\text{CFM} = \frac{\text{Area to be cooled (cubic feet)*}}{\text{Recommended rate of air change (minutes)}}
\]

* Area to be cooled (cu. ft.) =

Length (ft.) \times Width (ft.) \times Average Ceiling Height (ft.)

**Example:** A laundry 100’ long by 30’ wide with a 15’ ceiling height requires a complete air change each \( \frac{1}{2} \) minute. The necessary air volume (fan capacity) is determined from the above formula as follows:

\[
\text{CFM} = \frac{100 \times 30 \times 15}{\frac{1}{2}} = 90,000 \text{ cu.ft./min.}
\]

**CFM per square foot of floor area method**

This method of calculation is a modern adaptation of the rate of air change formula. Total air volume (cubic feet per minute) is determined by multiplying the total square feet of floor area by an arbitrary CFM per square foot figure. The figure selected may be as low as 2 CFM or as high as 12 CFM per square foot. Four CFM per square foot has been recommended as a minimum for summer ventilation of large assembly type operations.

This method of calculation, like the rate of air change method, is likely to produce unsatisfactory results in many cases. Failure to control air distribution and air velocity can be a major weakness in the whole concept. Selection of a CFM per square foot figure should be based on experience and a proven method of air distribution.

**Rate of air velocity method**

This method of calculating air volume needed for a system is highly recommended by American Coolair. A breeze conditioning system can be highly effective in providing personnel comfort in hot weather if the recommendations outlined below are observed. It has been determined from field experience that an average air velocity of 150 feet per minute (FPM) to 200 FPM is usually sufficient for personnel cooling under summer-time conditions. The CFM required to do the job is calculated by multiplying the cross section of an area through which the air is to move by the desired velocity. This is expressed in the following formula.

**Typical layout of fans for rate of air change method**

Although the rate of air change method of calculating air volume has been used for many years, American Coolair engineers have found it unsatisfactory except in relatively small buildings or rooms. For jobs that involve personnel comfort, this method is not recommended if the building is over 50,000 cubic feet in content or more than 100’ in length.
**CFM = Cross Sectional Area** \( \times \) **Desired Velocity**

\[
\text{CFM} = \text{Cross Sectional Area} \times \text{Desired Velocity}
\]

\[
\left( \frac{\text{cu.ft.}}{\text{min}} \right) \times \left( \frac{\text{sq.ft.}}{\text{ft.}} \right) = \left( \frac{\text{ft.}}{\text{min.}} \right)
\]

* Cross Sectional Area = Width (ft.) \( \times \) Height (ft.)

**Example:** A laundry 100' \( \times \) 30' \( \times \) 15'. Based on pulling air through 100ft. length, the fan CFM required is determined as follows:

Cross Sectional Area = 15' \( \times \) 30' = 450 sq. ft.

Desired Velocity = 150 ft./min.

\[
\text{CFM} = 450 \times 150 = 67,500 \text{ cu.ft./min.}
\]

**Influence of building size on velocity selected**

As building size increases, there are factors that will affect the average air velocity through the cross section of the building. The longer the building, the greater the amount of air leakage from windows, doors, elevator shafts, etc. To offset this air leakage, air velocity should be increased. This is done by relating the calculated velocity to the length of the building. The results will provide an effective velocity of approximately 150 ft./min. The table below gives the velocity recommendations in terms of the length of the building.

<table>
<thead>
<tr>
<th>VELOCITY TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Building</td>
</tr>
<tr>
<td>Up to 100'</td>
</tr>
<tr>
<td>100' to 200'</td>
</tr>
<tr>
<td>200' to 300'</td>
</tr>
<tr>
<td>300' and longer</td>
</tr>
</tbody>
</table>

**Zone Cooling**

In some buildings, it is not possible or practical to install a complete ventilation system. In such situations, zone cooling may be effectively used. The problem is similar to a spot cooling application, but usually involves a relatively larger area. Effective zone cooling may be accomplished by use of air circulators. See **Air circulation** below.

A very satisfactory zone cooling method is the use of supply-type PRVs to flood the problem area with fresh, cooler air. The adjacent drawing and zone cooling table illustrate the capacity of several American Coolair PRV models to effectively cool an area. The figures are based on discharge of air approximately 15 feet above floor level. It is recommended that an American Coolair sales engineer survey your problem area and recommend equipment to fit your specific needs.

**ZONE COOLING TABLE**

<table>
<thead>
<tr>
<th>Coolair Fan Model</th>
<th>Blade Diameter</th>
<th>Approximate Effective Area</th>
<th>Diameter of Cooled Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSBH24H</td>
<td>24'</td>
<td>175 sq. ft.</td>
<td>15'</td>
</tr>
<tr>
<td>PSBH30H</td>
<td>30'</td>
<td>300 sq. ft.</td>
<td>20'</td>
</tr>
<tr>
<td>PSBH36J</td>
<td>36'</td>
<td>500 sq. ft.</td>
<td>25'</td>
</tr>
<tr>
<td>PSBH42K</td>
<td>42'</td>
<td>700 sq. ft.</td>
<td>30'</td>
</tr>
<tr>
<td>PSBH48L</td>
<td>48'</td>
<td>1000 sq. ft.</td>
<td>35'</td>
</tr>
</tbody>
</table>

**Air circulation**

Air circulators may be effectively used to boost air velocity through large buildings that have a flow pattern difficult to control. Air circulators are also used to redirect air into occupied areas near floor level. The drawing below illustrates each of these uses in a breeze conditioning system based on air velocity.

Air circulators are also effectively used in locations where adequate exhaust and supply air fans may be lacking. Air circulation alone may provide heat relief and cooling comfort to individuals in the area. American Coolair’s Type CABL fan is ideally suited to this application. For many installations, fans like this may be positioned 8' to 10' above the floor and at approximately 50' intervals to obtain a continuously circulating column of air across a room or building. To broaden the column of air, fans should be located abreast of each other 15' to 20' apart. Fan locations and positions are easily adjusted to the requirements of the area.

**Combination of methods**

If a relatively straightforward breeze conditioning system is possible, the rate of air velocity method outlined above should be the basic method used. However, there may be rooms or areas within the building that will require special treatment. If so, one of the other methods, such as spot cooling or zone cooling, may be combined with the basic method to achieve the over-all objectives.
Practical limitations

Although an accurate, intelligent calculation of the required air volume for a breeze conditioning system has been made, there are practical limitations in most buildings that may seriously affect the final results. By giving these limitations proper consideration in the planning stage, the system can usually be modified to compensate for them. Some of the more common limitations are listed here.

Partitions within the building

It is obvious that interior partitions restrict and interrupt the flow of air through a structure. The effect of these partitions on the system must be analyzed and solutions found.

Large cross-sectional area

In buildings with very high ceilings, the cross-sectional area factor may become unrealistic in calculating the required air volume. In most instances, inexpensive baffles can be installed across the building width to reduce the effective cross-section to an area 10' or 12' above floor level.

Another limitation of the very high ceiling or roof is the difficulty of maintaining the air velocity near floor level. The baffle method just described is usually the best way to reconcentrate the air flow along the floor level where it will be effective in providing personnel comfort. In large buildings, baffles may be required at 100-foot intervals to keep air flow near the floor level.

Machinery, raw materials and finished goods that obstruct air circulation

These obstacles, like interior partitions, must be considered and methods worked out to overcome the problems they create to the proper circulation of air through the structure.

Unfavorable location of heat-producing machinery

Frequently, the location of heat-producing machinery will seriously interfere with the preferred pattern of air circulation. This situation can destroy the effectiveness of the system. An alternative plan to overcome the problem is essential.

“Short circuits”

Operations within the area frequently require wall openings or loading doors that will drastically interfere with the desired airflow pattern. In some cases, individuals may open windows that should remain closed to maintain effective air circulation. A remedy for each of these problems is required.

Restricted intake openings

For maximum efficiency and economy, a good layout will avoid the restricted intake opening. The type of exhaust equipment normally utilized is most economical and efficient if static pressure in the system is 1/8" or less. To obtain this condition, air velocity through intake openings should not exceed 1,000 feet per minute. A lower figure is usually desirable.

Common sense considerations

Location of exhaust fans

It is usually wise to locate the exhaust fans near the area where heat-producing machinery is found. This has the very practical advantage of exhausting this superheated air near its source and preventing a heat build-up in other areas.

Prevailing wind direction

If side wall locations are to be utilized for air intake or exhaust, it is desirable to consider the prevailing wind direction during the summer season. If the ventilation system can be oriented to take advantage of prevailing winds, the efficiency of the system may be increased considerably. Systems that incorporate roof exhausters are usually not affected by a prevailing wind.

Economy of the “long dimension”

Where air velocity is the critical factor in a breeze conditioning system, use of the “long dimension” of the building or room is highly desirable. By moving air through the long dimension, the cross-sectional area is reduced and less air volume is required to obtain the needed air velocity.
Use the cleanest, coolest air source
A vital element in the successful breeze conditioning system is a supply of clean, cooler, fresh air. While such an ideal air supply may not be available, common sense dictates that air being supplied into the building should be from the best available source. Avoid recirculating air that has just been exhausted from the building or another nearby structure.

The noise factor in the ventilation system
The noise level in most commercial and industrial buildings has become a highly critical matter. Although the ventilating equipment is only one item in the over-all total, its effect should be carefully considered. If the normal noise level in the building is low, the noise level of the ventilating equipment should be low; if the background noise level is high, the amount of noise added by the ventilation system may be insignificant. For more detailed sound information, refer to American Coolair Form No. 120-15.

Economies from good planning
The greatest economy that can result from good planning is a breeze conditioning system that achieves its basic purpose. If it does not do the job for which it was designed, then no economy has been achieved. Here are a number of other ways in which good planning can result in substantial savings.

A unified ventilation system
Frequently, exhaust fans are obtained and installed to serve a specific need. In many cases, no consideration is given to a method of coordinating this equipment. Process fans may be competing with general exhaust fans; loading doors or windows may be left open needlessly and “short circuit” an otherwise integrated system.

Use of “make-up air” fans
A common problem in the average plant is “air starvation”. Exhaust systems throughout the structure may have been well designed for their intended purpose. However, no consideration may have been given to the replacement of exhaust air. As a result, the building may be under severe negative pressure. This situation reduces the efficiency of the exhaust fans and produces unhealthy and uncomfortable working conditions. Substantial economy and efficiency can be obtained by correcting this situation through the use of supply fans or “make-up air” units.

Controlled air circulation
Many buildings have adequate exhaust and supply fans to provide a comfortable environment for the occupants. Unfortunately, there may be little control over the distribution of the air to produce the desired results. Good planning will recognize the necessity for proper air distribution and circulation through the occupied areas of the building. Suitable deflectors and baffles can be incorporated where needed. “Booster fans” or air circulators can be positioned to take care of trouble spots and augment the direction and velocity of the air flow. Diffusers may be required to assist in air distribution. Drafts and dead spots can thus be eliminated. All of these are inexpensive aids that can ensure that a well planned system will achieve its important objectives.

Typical applications
The following layout of breeze conditioning systems will illustrate the basic principles outlined in this handbook. One or a combination of these plans may be adapted to the specific job under consideration. The advantages and limitations for each of these layouts are explained in the accompanying notes.

Rate of air change method

<table>
<thead>
<tr>
<th>TYPICAL RECOMMENDED RATES OF AIR CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Facility</td>
</tr>
<tr>
<td>Bakeries, Restaurants, Laundries &amp; other hot spots</td>
</tr>
<tr>
<td>Factories, Shops, Warehouses &amp; Garages</td>
</tr>
<tr>
<td>Residences, Schools, Offices &amp; Churches</td>
</tr>
</tbody>
</table>

- An adequate method for small buildings or a single room (50,000 cu.ft. or less).
- The rate selected is somewhat arbitrary, usually based on experience with similar facility or space.
- Velocity and direction are frequently uncontrolled; some degree of control is available by regulation of window or other intake openings.
- Not recommended where complicated air distribution problems exist.

Rate of air velocity method
- Illustrations show 3 variations of same basic system of air distribution. Rate and direction of air flow is identical in each case. Intake and exhaust arrangements are adjusted to meet conditions peculiar to each location.
- This basic system is recommended for its economy and efficiency for both large and small buildings.
- Use of wall fans and PRVs for exhaust requirements is illustrated.
Supply air is obtained through intake louvers, windows or roof vents. Supply fans and PRVs may be substituted where job requirements make it necessary or advisable.

Successful systems based on this method rely on correct velocity and controlled distribution of air flow. Refer to velocity table on page 9 for recommendations.

**Actual Example of American Coolair Breeze Conditioning System**

Illustration shows schematic floor plan of actual breeze conditioning system for corrugated paper board production plant.

- Areas A and C are critical problem areas. Personnel discomfort from hot, humid conditions was acute in these areas. Area B is largely for storage and very few employees are located there.
- Due to the size of the plant, both supply and exhaust fans were used to obtain these air velocities: 280 FPM in area A, 225 FPM in area C.
- With prevailing winds from the southwest, all exhaust fans were relocated on the east side of the building. One exhaust fan on the west wall was required by heat-producing machine at that location.
- East wall of area C was not available for exhaust fan location. This necessitated use of north and south walls as alternate locations.
- Total fan capacity for this plant was near 1,000,000 CFM.

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**Use of deflectors, baffles and air circulators (with air velocity method)**

**Figure 1:** Deflector near air intake directs air into occupied area on floor level. Baffle near mid-point of building re-concentrates air flow into occupied area.

**Figure 2:** Deflectors under supply PRV and in front of supply fan diffuse intake air and prevent high velocity air currents from flowing directly over occupants located near intake area.

**Figure 3:** Air circulators are used to boost air velocity through big buildings that have a flow pattern difficult to control. Air circulators also re-direct air into occupied area near floor level.

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**AMERICAN Coolair**

P.O. Box 2300 • Jacksonville, Florida 32203
Phone: (904) 389-3646
Fax: (904) 387-3449 or (904) 381-7560
E-mail: fans@coolair.com

Represented By:

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