Virginia Events

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Okay, lets talk about understanding event profiles and how that understanding directly impacts your porta potty choices. Because honestly, nobody wants to be stuck in a long line for a less-than-ideal restroom experience, especially when theyre trying to enjoy an event. Its all about matching the right restroom type to the specific needs of your crowd and the nature of your gathering.

Think of it this way: a black-tie gala requires a vastly different restroom solution than a muddy music festival. For the gala, youre aiming for comfort and sophistication. Think spacious units, maybe even flushing toilets with sinks and mirrors. Aesthetics matter! You want something that blends seamlessly with the upscale atmosphere. Winter rentals in Virginia may require heated units and freeze protection in northern regions like Fairfax County **porta potty rental prices near me** Georgetown, Delaware. Now, picture that music festival. Durability and volume are key. You need units that can withstand heavy use, potential spills, and a generally less-than-delicate crowd. Quantity becomes more important than luxury.

Beyond the obvious differences, consider the demographics of your attendees. Are you expecting a lot of families with young children? If so, units with baby changing stations are a must. Will there be attendees with disabilities? ADA-compliant restrooms are essential for inclusivity and legal compliance. Age and mobility considerations can heavily influence the type and placement of your portable restrooms.

Then theres the duration of the event. A short afternoon picnic might only require a minimal number of basic units. A multi-day camping festival, on the other hand, will necessitate a more robust plan, including regular cleaning and potentially even pumping services. Consider the potential for increased demand at peak times, like after a concert or during meal breaks.

Finally, dont forget about the logistical factors. Whats the terrain like? Is it easily accessible for delivery and servicing? Are there any space constraints? Factoring in these practical considerations will prevent headaches down the road and ensure that your portable restroom solution is both appropriate and feasible.

In short, understanding your event profile – the type of event, the attendees, the duration, and the environment – is paramount to selecting the right portable restroom solution. Its about more than just providing a place to "go;" its about ensuring comfort, convenience, and a positive overall experience for everyone involved. And a happy attendee is always a win!

Standard Porta Potties: Ideal Use Cases and Limitations for Matching Portable Restroom Types to Event Profiles

When it comes to organizing events, ensuring that attendees have access to adequate restroom facilities is crucial. Standard porta potties are a popular choice for many events due to their convenience and affordability. However, understanding the ideal use cases and limitations of these portable restrooms is essential for matching the right type of portable restroom to the specific needs of an event.

Standard porta potties are typically designed for temporary use and are best suited for outdoor events where permanent restroom facilities are not available. These portable restrooms are ideal for festivals, concerts, outdoor weddings, and other similar events where a large number of people need access to basic restroom facilities. They are easy to set up and can be quickly deployed, making them a practical solution for events that require a large number of restrooms in a short amount of time.

One of the main advantages of standard porta potties is their affordability. They are generally less expensive than permanent restroom facilities and can be rented for a fraction of the cost of building a permanent structure. This makes them an attractive option for events with limited budgets. Additionally, standard porta potties are easy to maintain and can be quickly cleaned and restocked, ensuring that they remain in good condition throughout the event.

However, there are also some limitations to using standard porta potties. One of the main drawbacks is their lack of privacy and comfort. They are often made of basic materials and may not provide the same level of comfort as permanent restroom facilities. Additionally, standard porta potties may not be suitable for events that require a higher level of sanitation, such as food festivals or medical events, where more advanced restroom facilities may be necessary.

Another limitation of standard porta potties is their environmental impact. They often require regular cleaning and maintenance, which can lead to the use of large amounts of water and cleaning chemicals. This can have a negative impact on the environment, particularly if the event is held in an area where water is scarce or where there are strict regulations on water usage.

In conclusion, standard porta potties are a practical and affordable solution for many events that require temporary restroom facilities. They are ideal for outdoor events where permanent restroom facilities are not available and can be quickly deployed to meet the needs of a large number of attendees. However, it is important to consider the limitations of standard porta potties, such as their lack of privacy and comfort, as well as their environmental impact, when choosing the right type of portable restroom for an event. Ultimately, matching the right type of portable restroom to the specific needs of an event is crucial for ensuring that attendees have access to adequate and comfortable restroom facilities.

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Essential Features of ADA Compliant Portable Restrooms

For the discerning event planner, and the guest list that demands a certain level of… refinement, the standard plastic porta-potty simply wont cut it. Thats where Enhanced Comfort Options: Luxury Restroom Trailers come into play, stepping in to elevate the restroom experience from functional necessity to a subtle statement of sophistication, particularly for VIP events.

Imagine this: a high-end wedding nestled in a vineyard, a corporate retreat at a sprawling estate, or a celebrity golf tournament. The attendees are accustomed to comfort and expect a seamless, elegant experience. Presenting them with a row of basic portable restrooms would be jarring, an incongruous note in an otherwise carefully orchestrated symphony of luxury.

Luxury restroom trailers bridge that gap. They offer climate control, flushing toilets, running water, vanities with mirrors, tasteful décor, and even music. Think of them as miniature, mobile bathrooms, meticulously designed to provide a comfortable and discreet experience. For VIP events, these trailers often feature additional amenities like premium toiletries, hand towels instead of paper dispensers, and even dedicated attendants to ensure cleanliness and upkeep throughout the event.

The event profile that screams for enhanced comfort options is one where the guest experience is paramount and image matters. Think galas, fundraising events, exclusive parties, and any gathering where the attendees are accustomed to a higher standard of comfort and hygiene. It's about more than just providing a place to "go"; it's about contributing to a positive overall impression and demonstrating a commitment to guest satisfaction. Choosing luxury restroom trailers isnt just about providing a facility; its about enhancing the entire event experience and signaling a dedication to quality and comfort that resonates with a discerning audience.

Placement and Accessibility Considerations for ADA Porta Potties on Site

Accessibility Requirements: ADA-Compliant Porta Potty Solutions for Matching Portable Restroom Types to Event Profiles

In todays diverse and inclusive society, ensuring accessibility is not just a legal requirement but a moral imperative. The Americans with Disabilities Act (ADA) sets forth guidelines to make public spaces, including portable restrooms, accessible to everyone. When planning events, its crucial to match the right type of portable restroom to the specific needs of the event profile, ensuring compliance with ADA standards.

Firstly, understanding the ADAs accessibility requirements is essential. The ADA mandates that portable restrooms should be equipped with features that accommodate individuals with disabilities. This includes wide entry doors, grab bars, non-slip flooring, and appropriate height for sinks and toilets. These features are not just optional; they are necessary to provide equal access and comfort to all attendees.

For large-scale events such as festivals, concerts, and sporting events, ADA-compliant porta potties are a must. These events often attract a diverse crowd, including individuals with mobility impairments, visual or hearing disabilities, and other special needs. Providing accessible portable restrooms ensures that everyone can enjoy the event without facing unnecessary barriers. Opt for porta potties with reinforced structures, ample space for maneuvering wheelchairs, and clear signage indicating accessibility features.

Corporate events and conferences also benefit from ADA-compliant portable restrooms. Attendees may include executives, clients, and employees with varying degrees of mobility. Ensuring that the portable restrooms meet ADA standards demonstrates a commitment to inclusivity and professionalism. Portable restrooms with features like automatic doors, height-adjustable sinks, and ample space for wheelchairs can significantly enhance the attendee experience.

Educational institutions and community events, such as school fairs, church gatherings, and community festivals, should not be overlooked. These events often involve children and elderly individuals who may require additional assistance. ADA-compliant portable restrooms with child-friendly fixtures, such as lower sinks and appropriate-sized toilets, and features like handrails and non-slip surfaces, ensure safety and comfort for all age groups.

In summary, matching portable restroom types to event profiles while adhering to ADA compliance is essential for creating an inclusive and welcoming environment. By providing accessible facilities, event organizers can ensure that everyone, regardless of ability, can participate fully and comfortably. This not only fulfills legal obligations but also reflects a commitment to diversity and respect for all individuals.

ADA Porta Potty Rental: Compliance and Documentation

Okay, lets talk about portable restrooms, event profiles, and how many loos you actually need. Its not exactly glamorous, but trust me, getting this wrong can *really* ruin an event. Think about it: nobody wants to spend half their time in line for a porta-potty, especially at a marathon or a music festival. Thats where capacity planning comes in. Its all about figuring out the "right number of units," as the textbooks say, but in a way that makes sense for *your* specific event.

Its not just pulling a number out of thin air. You have to consider the event profile. Is it a short, sharp burst of activity like a construction site lunch break? Or a long, leisurely, beer-fueled weekend at a county fair? The type of event drastically changes the demand. A wine tasting is going to have different bathroom needs than a monster truck rally, believe it or not.

Then youve got the demographics. Are you expecting mostly families with young kids? Youll need more accessible units and maybe even some with baby-changing stations. A predominantly male sporting event? Urinals can significantly reduce wait times. Its all about understanding your audience.

And lets not forget the duration and the availability of other facilities. If its an all-day event, youll need more units than if its just a few hours. Are there any existing restrooms on site that attendees can use? That will impact the number of portable restrooms you need to provide.

Finally, think about the type of porta-potty itself. A standard unit is fine for some situations, but a deluxe unit with hand sanitizer and better ventilation is a worthwhile investment for others. And dont forget about accessibility! Making sure you have enough ADA-compliant units is not just good ethics, its often the law.

So, capacity planning for portable restrooms isnt just about math; its about understanding people and events. Its about anticipating needs and ensuring a comfortable, convenient experience for everyone involved. Get it right, and your attendees will barely notice the restrooms. Get it wrong, and theyll be talking about it for all the wrong reasons. Its a dirty job, but someones gotta do it. And that someone should be you, armed with a good understanding of event profiles and a clear idea of how many units you really need.

Maintaining ADA Compliance During Porta Potty Rental Period

Okay, lets talk about portable restrooms – those humble necessities that can seriously make or break an event. Were not just slapping down any old blue box and calling it a day. No, placement and logistics, when it comes to these things, are all about ensuring a decent, even *pleasant*, user experience. And a big part of that is figuring out which type of portable restroom actually *fits* the event profile.

Think about it: a black-tie gala isnt going to be enhanced by a standard construction site porta-potty. You need something…fancier. Maybe a luxury restroom trailer with flushing toilets, running water, and maybe even some air conditioning. On the other hand, a muddy motocross event doesnt need porcelain thrones; durable, easy-to-clean, and strategically placed units are the name of the game.

The key is to consider the events vibe, the expected number of attendees, the demographics of those attendees, and the duration of the event. A family-friendly festival needs more accessible units and maybe even some baby-changing stations. A beer festival? Well, lets just say you need to plan for a higher frequency of usage and perhaps some heavy-duty cleaning protocols.

Then theres the logistics part. Its not just about *what* kind of restroom, but *where* theyre placed. Are they easily accessible from the main areas of the event? Are they well-lit at night? Are they positioned to minimize noise and odor impact on attendees? Nobody wants to eat their gourmet burger next to a row of unkempt portable restrooms.

And lets not forget about maintenance! Regular cleaning, restocking of supplies, and prompt attention to any issues are crucial. A poorly maintained restroom can quickly become a biohazard and a source of negative reviews, no matter how fancy it started out.

So, matching portable restroom types to event profiles isnt just about providing a place for people to, well, you know. Its about showing attendees that you care about their comfort and experience. Its about anticipating their needs and providing a clean, convenient, and even (dare I say it) enjoyable restroom experience. Because in the end, the devil's in the details, and surprisingly, those details often include where people go when they gotta go.

Common ADA Porta Potty Rental Mistakes to Avoid

Seasonal Considerations: Adapting Porta Potty Rentals to Different Weather

When it comes to hosting events, whether they are large-scale festivals, outdoor weddings, or community gatherings, the provision of adequate sanitation facilities is crucial. Porta potties are a staple in this regard, offering a convenient and hygienic solution for attendees. However, the effectiveness of these portable restrooms can be significantly influenced by the weather conditions of the season. To ensure that events run smoothly and comfortably, its essential to adapt porta potty rentals to different weather scenarios.

In the summer, high temperatures can turn a porta potty into an uncomfortable, if not unbearable, space. To combat this, its important to choose models with adequate ventilation and cooling systems. Some companies offer porta potties with built-in fans and shaded canopies, which can help maintain a more tolerable environment inside. Additionally, ensuring that porta potties are placed in shaded areas can further reduce the internal temperature, making them more pleasant for use.

Conversely, winter events present their own set of challenges. Cold weather can lead to frozen plumbing and uncomfortable conditions for users. To address this, its advisable to rent heated porta potties, which are equipped with systems to prevent pipes from freezing. These units often include heated floors and hand dryers, providing a more comfortable experience for users in chilly conditions. Furthermore, ensuring that porta potties are well-maintained and that users are aware of the location of these heated facilities can help mitigate discomfort.

Spring and fall can be more unpredictable, with fluctuating temperatures and occasional rain. In these seasons, its wise to rent versatile porta potties that can handle a range of conditions. Models with robust construction and weather-resistant materials can withstand the elements better. Additionally, ensuring that porta potties are regularly serviced and stocked with necessary supplies, such as hand sanitizer and toilet paper, can enhance the user experience regardless of the weather.

Ultimately, matching the type of portable restroom to the event profile and seasonal weather conditions is key to ensuring a successful event. By considering the specific needs of attendees and the environmental challenges posed by different seasons, event organizers can provide a comfortable and hygienic experience that enhances the overall enjoyment of the event.

When organizing an event, one of the key considerations is ensuring that the amenities provided align well with both the events profile and its budget constraints. This is particularly true when it comes to selecting the right types of portable restrooms, as they play a crucial role in attendee comfort and satisfaction. Budgeting and cost-effectiveness are central to maximizing value in this aspect, ensuring that you get the best possible facilities for your investment.

Firstly, understanding your events profile is essential. For instance, a small community gathering might only require basic portable toilets, which are typically more affordable. These units serve their purpose without unnecessary luxury, keeping costs low while still providing necessary sanitation. On the other hand, larger or more upscale events like music festivals or corporate functions might benefit from higher-end options such as luxury restroom trailers. These units come equipped with features like running water, proper flushing toilets, and even air conditioning, significantly enhancing user experience but at a higher cost.

To maintain cost-effectiveness while choosing these facilities, its important to match the restroom type not only to the event size but also to the expected duration and demographic of attendees. For shorter events with younger crowds who might not mind simpler conditions, standard portable toilets suffice. However, for longer events or those attracting an older or more discerning crowd, investing in better facilities can prevent discomfort and complaints, adding value by improving overall attendee satisfaction.

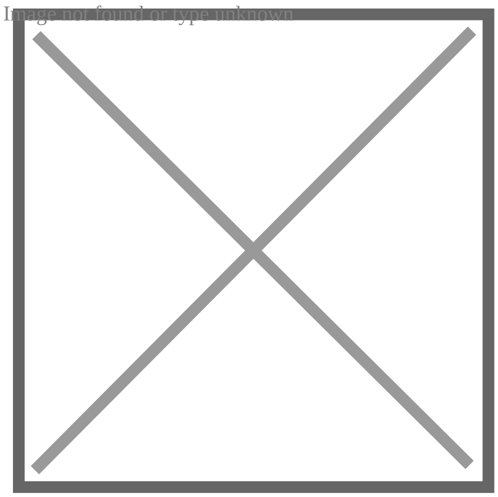
Moreover, strategic placement can also enhance value. By placing restrooms in accessible yet discreet locations, you reduce the visual impact on your event setup while ensuring ease of access for all guests. This thoughtful placement can save on potential additional costs related to landscaping or aesthetic considerations if restrooms were overly prominent.

In terms of budgeting specifics, consider leasing rather than purchasing if this is a one-time event; leasing often provides flexibility without long-term financial commitment. Also, look into package deals offered by rental companies that might include cleaning services or delivery/setup within the price, reducing additional expenses.

Lastly, anticipate usage patterns; for high-traffic periods during your event (like peak hours), having additional units can prevent lines and dissatisfaction without necessarily increasing costs if planned correctly within your budget framework.

In summary, maximizing value through budgeting and cost-effectiveness when matching portable restroom types to event profiles involves a delicate balance of understanding your audiences needs against financial considerations. By making informed choices about what type of facilities to provide based on event specifics and strategically managing costs through smart planning and negotiation with suppliers, you ensure that every dollar spent contributes positively to your events success and attendee experience.

About Soap dispenser



A **soap dispenser** is a device that, when manipulated or triggered appropriately, dispenses soap (usually in small, single-use quantities). Soap dispensers typically dispense liquid soap or foam soap. They can be automatic or manually operated by a handle and are often found in public toilets or private bathrooms.

Manual

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The design of a manual soap dispenser is generally determined by whether the soap comes in liquid, powder or foam form.

Liquid soap

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When soap is dispensed in liquid form, it is generally in a squeeze bottle or pump. The most popular soap dispensers of this type are plastic pump bottles, many of which are disposable.

William Quick patented liquid soap on August 22, 1865. Minnetonka Corporation introduced the first modern liquid soap in 1980 and bought up the entire supply of plastic pumps used in their dispensers to delay competition entering the market.[1]

Parts

[edit]

- Actuator – This is the top of the pump from which is pressed down to get the liquid out
- Closure – Closure is the bottle that is fastened to the bottle's neck. it has a smooth or ribbed surface
- Outer gasket – Made up of plastic or rubber, it is fit inside the closure and prevents leakage
- Housing – The main pump that keeps the other components in the right place and sends liquid to the actuator from the dip tube
- Dip tube – This is the visible tube that carries liquid from the bottom of the bottle up to the housing
- Interior components – A spring, ball, piston or stem that helps move the liquid to the actuator

Operation

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The handwash bottle acts much like an air suction device that draws liquid upwards to the user's hands against the force of gravity. When the user presses down the actuator, the piston compresses the spring and upward air pressure pulls the ball upward, along with the liquid product into the dip tube and then reaches the housing. When the user releases the actuator, the spring returns the piston and actuator to the normal position and the ball returns to its earlier position to stop the backflow of the liquid back to the bottle. This process is called ‘priming' and is only used when the handwash is put in the bottle.

When the user presses the bottle again, the liquid in the housing is drawn from there and is released out of the actuator. The housing is again filled up with the handwash from the bottle, and the process goes on.

Dry soap

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A vertical stainless steel tube, mounted on a wall, with a crank handle on the side at the bottom, ne

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A soap mill in a public washroom.

A moulded bulge proturding from the underside of a mounled plastic surface; at the base of the bu

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A train-washroom built-in soap mill from below. When the black spokes are rotated with one finger, the spiral blades rotate against the soap bar visible behind them and flakes of soap fall out the bottom of the device into the other hand.

Some soap dispensers grate, plane[2] or grind solid soap bars to flakes or powder as they are dispensed. About 40 grams (1.4 oz) fresh weight of soap is equivalent to 1 liter (0.22 imp gal; 0.26 U.S. gal) of liquid soap, providing soap for up to 400 handwashings.

Soap mills are common in public washrooms in Germany.[3] **Soap graters** made specifically for home use[4][2] can be wall-mounted or free-standing (like a pepper grinder) and waterproof for use in a shower.[5][6] Some graters take specially dimensioned soap bars, others will take a range of ordinary soap bar sizes.[3][2]

Dispensers of pre-powdered soaps, such as borax, often take the form of a metal box with a weighted lever; when the lever is pressed, a handful of soap is released. Ground soap is also used to wash laundry.[7]

Foam soap

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Foam soap dispensers have dual foam pumps that when used, move both air and soap, injecting both together through small openings to create a lather. They can be found in both manual and automatic varieties.

Manual dispensers of foam soap often consist of a large button that squeezes the foam out of a tube. Many liquid soap dispensers operate in this way as well. A few dispensers operate with a lever that pulls forward and squeezes the soap out.

The majority of manual foam soap dispensers have the soap in a bladder in the dispenser in liquid form, as the pump is pressed the liquid soap is pushed through a small foaming nozzle which foams the soap.

Automatic

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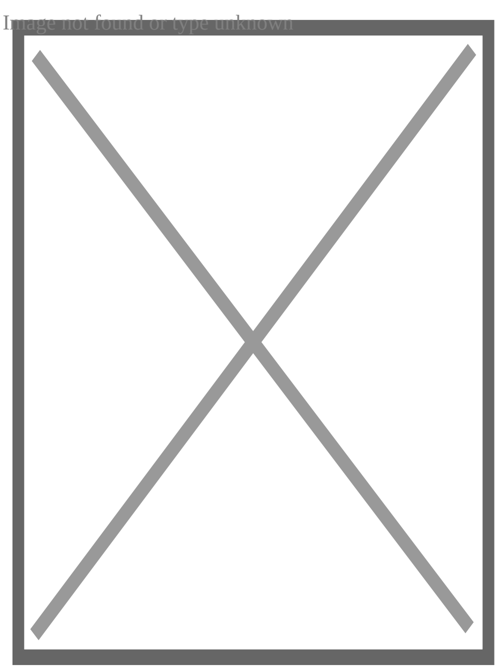

Automatic soap dispenser

Main article: Automatic soap dispenser

An automatic soap dispenser is specifically a hands-free dispenser of liquid or foam soap, and generally can be used for other liquids such as hand sanitizers, shampoos or hand lotions. They are often battery-powered-powered. Hands-free dispensers for water and soap/hand sanitizer have particular virtues for operating theatres and treatment rooms.

Mechanism

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The touch-free design dispenses the liquid when a sensor detects motion under the nozzle. The electronic components of an automatic soap dispenser allow for a timing device or signal (sound, lights, etc.) which can indicate to the user whether they have washed their hands for the correct amount of time or not.

See also

[edit]

- Foam pump
- Hand washing
- Soapdish

References

[edit]

1. **^** *"The History of Soap and Detergent". Archived from the original on July 14, 2012.*
2. ^ ***a b c*** *"Trockenseifenspender SoapPlaner". SoapPlaner (in German).*
3. ^ ***a b*** *Morwood, Peter. "Trockenseifenspender (dry soap dispenser)".*
4. **^** *John Brownlee (12 January 2011). "Bar soap dispenser will double as cheese grater in a pinch". Geek.com.*
5. **^** *"Soap Grater Looks Practical". Cool Things. January 11, 2011.*
6. **^** *"Soap Flakes - Soap Bar Dispensers". The Green Head - Finds Cool New Stuff!.*
7. **^** *"How To Make Classic DIY Laundry Detergent With NO Grating!". Farming My Backyard. 10 April 2018.*

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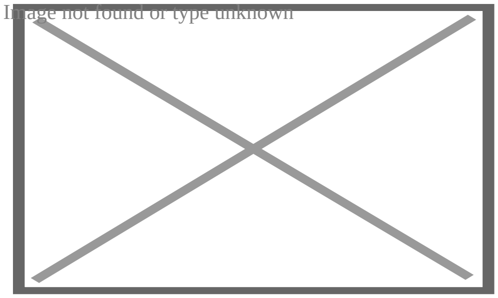
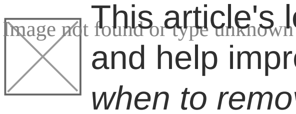
Wikimedia Commons has media related to ***Soap dispensers***.

About Ventilation (architecture)



An Ab anbar (water reservoir) with double domes and windcatchers (openings near the top of the towers) in the central desert city of Naeen, Iran. Windcatchers are a form of natural ventilation.[1]



This article's lead section **may need to be rewritten**. Please review the lead guide and help improve the lead of this article if you can. *(July 2025) (Learn how and when to remove this message)*

Ventilation is the intentional introduction of outdoor air into a space. Ventilation is mainly used to control indoor air quality by diluting and displacing indoor effluents and pollutants. It can also be used to control indoor temperature, humidity, and air motion to benefit thermal comfort, satisfaction with other aspects of the indoor environment, or other objectives.

The intentional introduction of outdoor air is usually categorized as either mechanical ventilation, natural ventilation, or mixed-mode ventilation.[2]

- Mechanical ventilation is the intentional fan-driven flow of outdoor air into and/or out from a building. Mechanical ventilation systems may include supply fans (which push outdoor air into a building), exhaust[3] fans (which draw air out of a building and thereby cause equal ventilation flow into a building), or a combination of both (called balanced ventilation if it neither pressurizes nor depressurizes the inside air,[3] or only slightly depressurizes it). Mechanical ventilation is often provided by equipment that is also used to heat and cool a space.
- Natural ventilation is the intentional passive flow of outdoor air into a building through planned openings (such as louvers, doors, and windows). Natural ventilation does not require mechanical systems to move outdoor air. Instead, it relies entirely on passive physical phenomena, such as wind pressure, or the stack effect. Natural ventilation openings may be fixed, or adjustable. Adjustable openings may be controlled automatically (automated), owned by occupants (operable), or a combination of both. Cross ventilation is a phenomenon of natural ventilation.
- Mixed-mode ventilation systems use both mechanical and natural processes. The mechanical and natural components may be used at the same time, at different times of day, or in different seasons of the year.[4] Since natural ventilation flow depends on environmental conditions, it may not always provide an appropriate amount of ventilation. In this case, mechanical systems may be used to supplement or regulate the naturally driven flow.

Ventilation is typically described as separate from infiltration.

- Infiltration is the circumstantial flow of air from outdoors to indoors through leaks (unplanned openings) in a building envelope. When a building design relies on infiltration to maintain indoor air quality, this flow has been referred to as adventitious ventilation.[5]

The design of buildings that promote occupant health and well-being requires a clear understanding of the ways that ventilation airflow interacts with, dilutes, displaces, or introduces pollutants within the occupied space. Although ventilation is an integral component of maintaining good indoor air quality, it may not be satisfactory alone.[6] A clear understanding of both indoor and outdoor air quality parameters is needed to improve the performance of ventilation in terms of occupant health and energy.[7] In scenarios where outdoor pollution would deteriorate indoor air quality, other treatment devices such as filtration may also be necessary.[8] In kitchen ventilation systems, or for laboratory fume hoods, the design of effective effluent capture can be more important than the bulk amount of ventilation in a space. More generally, the way that an air distribution system causes ventilation to flow into and out of a space impacts the ability of a particular ventilation rate to remove internally generated pollutants. The ability of a system to reduce pollution in space is described as its "ventilation effectiveness". However, the overall impacts of ventilation on indoor air quality can depend on more complex factors such as the sources of pollution, and the ways that activities and airflow interact to affect occupant exposure.

An array of factors related to the design and operation of ventilation systems are regulated by various codes and standards. Standards dealing with the design and operation of ventilation systems to achieve acceptable indoor air quality include the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards 62.1 and 62.2, the International Residential Code, the International Mechanical Code, and the United Kingdom Building Regulations Part F. Other standards that focus on energy conservation also impact the design and operation of ventilation systems, including ASHRAE Standard 90.1, and the International Energy Conservation Code.

When indoor and outdoor conditions are favorable, increasing ventilation beyond the minimum required for indoor air quality can significantly improve both indoor air quality and thermal comfort through ventilative cooling, which also helps reduce the energy demand of buildings.[9][10] During these times, higher ventilation rates, achieved through passive or mechanical means (air-side economizer, ventilative pre-cooling), can be particularly beneficial for enhancing people's physical health.[11] Conversely, when conditions are less favorable, maintaining or improving indoor air quality through ventilation may require increased use of mechanical heating or cooling, leading to higher energy consumption.

Ventilation should be considered for its relationship to "venting" for appliances and combustion equipment such as water heaters, furnaces, boilers, and wood stoves. Most importantly, building ventilation design must be careful to avoid the backdraft of combustion products from "naturally vented" appliances into the occupied space. This issue is of greater importance for buildings with more air-tight envelopes. To avoid the hazard, many modern combustion appliances utilize "direct venting" which draws combustion air directly from outdoors, instead of from the indoor environment.

Design of air flow in rooms

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The air in a room can be supplied and removed in several ways, for example via ceiling ventilation, cross ventilation, floor ventilation or displacement ventilation.[*citation needed*]

Ceiling ventilation

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  Ceiling ventilation
  Cross ventilation

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  Cross ventilation
  Floor ventilation

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  Floor ventilation
  Displacement ventilation

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Displacement
ventilation

Furthermore, the air can be circulated in the room using vortexes which can be initiated in various ways:

Tangential flow vortices, initiated horizontally

○

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Tangential flow
vortices, initiated
horizontally
Tangential flow vortices, initiated vertically

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Tangential flow
vortices, initiated
vertically
Diffused flow vortices from air nozzles

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Diffused flow
vortices from air
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Diffused flow vortices due to roof vortices

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Diffused flow
vortices due to roof
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Ventilation rates for indoor air quality

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Globe icon.

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The examples and perspective in this article **deal primarily with the United States and do not represent a worldwide view of the subject**. You may improve this article, discuss the issue on the talk page, or create a new article, as appropriate. *(April 2024) (Learn how and when to remove this message)*

The ventilation rate, for commercial, industrial, and institutional (CII) buildings, is normally expressed by the volumetric flow rate of outdoor air, introduced to the building. The typical units used are cubic feet per minute (CFM) in the imperial system, or liters per second (L/s) in the metric system (even though cubic meter per second is the preferred unit for volumetric flow rate in the SI system of units). The ventilation rate can also be expressed on a per person or per unit floor area basis, such as CFM/p or CFM/ft², or as air changes per hour (ACH).

Standards for residential buildings

[edit]

For residential buildings, which mostly rely on infiltration for meeting their ventilation needs, a common ventilation rate measure is the air change rate (or air changes per hour): the hourly ventilation rate divided by the volume of the space (*I* or *ACH*; units of 1/h). During the winter, ACH may range from 0.50 to 0.41 in a tightly air-sealed house to 1.11 to 1.47 in a loosely air-sealed house.[12]

ASHRAE now recommends ventilation rates dependent upon floor area, as a revision to the 62-2001 standard, in which the minimum ACH was 0.35, but no less than 15 CFM/person (7.1 L/s/person). As of 2003, the standard has been changed to 3 CFM/100 sq. ft. (15 L/s/100 sq. m.) plus 7.5 CFM/person (3.5 L/s/person).[13]

Standards for commercial buildings

[edit]

Ventilation rate procedure

[edit]

Ventilation Rate Procedure is rate based on standard and prescribes the rate at which ventilation air must be delivered to space and various means to the condition that air.[14] Air quality is assessed (through CO_2 measurement) and ventilation rates are mathematically derived using constants.Indoor Air Quality Procedure uses one or more guidelines for the specification of acceptable concentrations of certain contaminants in indoor air but does not prescribe ventilation rates or air treatment methods.[14] This addresses both quantitative and subjective evaluations and is based on the Ventilation Rate Procedure. It also accounts for potential contaminants that may have no measured limits, or for which no limits are not set (such as formaldehyde off-gassing from carpet and furniture).

Natural ventilation

[edit]
Main article: Natural ventilation

Natural ventilation harnesses naturally available forces to supply and remove air in an enclosed space. Poor ventilation in rooms is identified to significantly increase the localized moldy smell in specific places of the room including room corners.[11] There are three types of natural ventilation occurring in buildings: wind-driven ventilation, pressure-driven flows, and stack ventilation.[15] The pressures generated by 'the stack effect' rely upon the buoyancy of heated or rising air. Wind-driven ventilation relies upon the force of the prevailing wind to pull and push air through the enclosed space as well as through breaches in the building's envelope.

Almost all historic buildings were ventilated naturally.[16] The technique was generally abandoned in larger US buildings during the late 20th century as the use of air conditioning became more widespread. However, with the advent of advanced Building Performance Simulation (BPS) software, improved Building Automation Systems (BAS), Leadership in Energy and Environmental Design (LEED) design requirements, and improved window manufacturing techniques; natural ventilation has made a resurgence in commercial buildings both globally and throughout the US.[17]

The benefits of natural ventilation include:

- Improved indoor air quality (IAQ)
- Energy savings
- Reduction of greenhouse gas emissions

- Occupant control
- Reduction in occupant illness associated with sick building syndrome
- Increased worker productivity

Techniques and architectural features used to ventilate buildings and structures naturally include, but are not limited to:

- Operable windows
- Clerestory windows and vented skylights
- Lev/convection doors
- Night purge ventilation
- Building orientation
- Wind capture façades

Airborne diseases

[edit]

Natural ventilation is a key factor in reducing the spread of airborne illnesses such as tuberculosis, the common cold, influenza, meningitis or COVID-19.[18] Opening doors and windows are good ways to maximize natural ventilation, which would make the risk of airborne contagion much lower than with costly and maintenance-requiring mechanical systems. Old-fashioned clinical areas with high ceilings and large windows provide the greatest protection. Natural ventilation costs little and is maintenance-free, and is particularly suited to limited-resource settings and tropical climates, where the burden of TB and institutional TB transmission is highest. In settings where respiratory isolation is difficult and climate permits, windows and doors should be opened to reduce the risk of airborne contagion. Natural ventilation requires little maintenance and is inexpensive.[19]

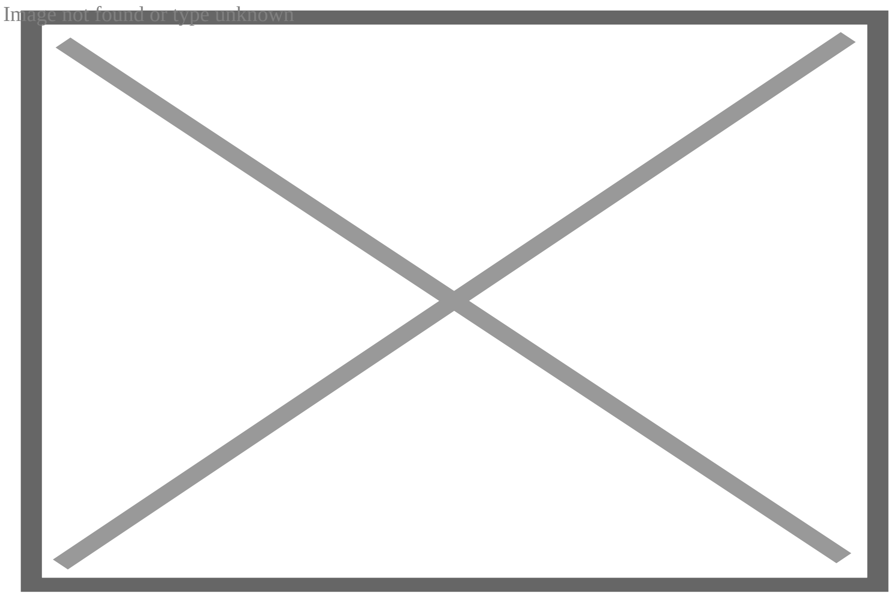
Natural ventilation is not practical in much of the infrastructure because of climate. This means that the facilities need to have effective mechanical ventilation systems and or use Ceiling Level UV or FAR UV ventilation systems.

Ventilation is measured in terms of air changes per hour (ACH). As of 2023, the CDC recommends that all spaces have a minimum of 5 ACH.[20] For hospital rooms with airborne contagions the CDC recommends a minimum of 12 ACH.[21] Challenges in facility ventilation are public unawareness,[22][23] ineffective government oversight, poor building codes that are based on comfort levels, poor system operations, poor maintenance, and lack of transparency.[24]

Pressure, both political and economic, to improve energy conservation has led to decreased ventilation rates. Heating, ventilation, and air conditioning rates have dropped since the energy crisis in the 1970s and the banning of cigarette smoke in the 1980s and 1990s.[25][26][*better source needed*]

Mechanical ventilation

[edit]
Main article: HVAC



An axial belt-drive exhaust fan serving an underground car park. This exhaust fan's operation is interlocked with the concentration of contaminants emitted by internal combustion engines.

Mechanical ventilation of buildings and structures can be achieved by the use of the following techniques:

- Whole-house ventilation
- Mixing ventilation
- Displacement ventilation
- Dedicated subaerial air supply

Demand-controlled ventilation (DCV)

[edit]

Demand-controlled ventilation (**DCV**, also known as Demand Control Ventilation) makes it possible to maintain air quality while conserving energy.[27][28] ASHRAE has determined that "It is consistent with the ventilation rate procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy."[29] In a DCV system, CO_2 sensors control the amount of ventilation.[30][31] During peak occupancy, CO_2 levels rise, and the system adjusts to deliver the same amount of outdoor air as would be used by the ventilation-rate procedure.[32] However, when spaces are less occupied, CO_2 levels reduce, and the system reduces ventilation to conserves energy. DCV is a well-established practice,[33] and is required in high occupancy spaces by building energy standards such as ASHRAE 90.1.[34]

Personalized ventilation

[edit]

This section needs to be **updated**. Please help update this article to reflect recent events or newly available information. *(September 2024)*

Personalized ventilation is an air distribution strategy that allows individuals to control the amount of ventilation received. The approach delivers fresh air more directly to the breathing zone and aims to improve the air quality of inhaled air. Personalized ventilation provides much higher ventilation effectiveness than conventional mixing ventilation systems by displacing pollution from the breathing zone with far less air volume. Beyond improved air quality benefits, the strategy can also improve occupants' thermal comfort, perceived air quality, and overall satisfaction with the indoor environment. Individuals' preferences for temperature and air movement are not equal, and so traditional approaches to homogeneous environmental control have failed to achieve high occupant satisfaction. Techniques such as personalized ventilation facilitate control of a more diverse thermal environment that can improve thermal satisfaction for most occupants.

Local exhaust ventilation

[edit]

See also: Power tool

Local exhaust ventilation addresses the issue of avoiding the contamination of indoor air by specific high-emission sources by capturing airborne contaminants before they are spread into the environment. This can include water vapor control, lavatory effluent control, solvent vapors from industrial processes, and dust from wood- and metal-working machinery. Air can be exhausted through pressurized hoods or the use of fans and pressurizing a specific area.[35]

A local exhaust system is composed of five basic parts:

1. A hood that captures the contaminant at its source
2. Ducts for transporting the air
3. An air-cleaning device that removes/minimizes the contaminant
4. A fan that moves the air through the system
5. An exhaust stack through which the contaminated air is discharged[35]

In the UK, the use of LEV systems has regulations set out by the Health and Safety Executive (HSE) which are referred to as the Control of Substances Hazardous to Health

(CoSHH). Under CoSHH, legislation is set to protect users of LEV systems by ensuring that all equipment is tested at least every fourteen months to ensure the LEV systems are performing adequately. All parts of the system must be visually inspected and thoroughly tested and where any parts are found to be defective, the inspector must issue a red label to identify the defective part and the issue.

The owner of the LEV system must then have the defective parts repaired or replaced before the system can be used.

Smart ventilation

[edit]

Smart ventilation is a process of continually adjusting the ventilation system in time, and optionally by location, to provide the desired IAQ benefits while minimizing energy consumption, utility bills, and other non-IAQ costs (such as thermal discomfort or noise). A smart ventilation system adjusts ventilation rates in time or by location in a building to be responsive to one or more of the following: occupancy, outdoor thermal and air quality conditions, electricity grid needs, direct sensing of contaminants, operation of other air moving and air cleaning systems. In addition, smart ventilation systems can provide information to building owners, occupants, and managers on operational energy consumption and indoor air quality as well as a signal when systems need maintenance or repair. Being responsive to occupancy means that a smart ventilation system can adjust ventilation depending on demand such as reducing ventilation if the building is unoccupied. Smart ventilation can time-shift ventilation to periods when a) indoor-outdoor temperature differences are smaller (and away from peak outdoor temperatures and humidity), b) when indoor-outdoor temperatures are appropriate for ventilative cooling, or c) when outdoor air quality is acceptable. Being responsive to electricity grid needs means providing flexibility to electricity demand (including direct signals from utilities) and integration with electric grid control strategies. Smart ventilation systems can have sensors to detect airflow, systems pressures, or fan energy use in such a way that systems failures can be detected and repaired, as well as when system components need maintenance, such as filter replacement.[36]

Ventilation and combustion

[edit]

Combustion (in a fireplace, gas heater, candle, oil lamp, etc.) consumes oxygen while producing carbon dioxide and other unhealthy gases and smoke, requiring ventilation air. An open chimney promotes infiltration (i.e. natural ventilation) because of the negative pressure change induced by the buoyant, warmer air leaving through the chimney. The warm air is typically replaced by heavier, cold air.

Ventilation in a structure is also needed for removing water vapor produced by respiration, burning, and cooking, and for removing odors. If water vapor is permitted to accumulate, it may damage the structure, insulation, or finishes. [*citation needed*] When operating, an air conditioner usually removes excess moisture from the air. A dehumidifier may also be appropriate for removing airborne moisture.

Calculation for acceptable ventilation rate

[edit]

Ventilation guidelines are based on the minimum ventilation rate required to maintain acceptable levels of effluents. Carbon dioxide is used as a reference point, as it is the gas of highest emission at a relatively constant value of 0.005 L/s. The mass balance equation is:

$Q = G/ (C_i ? C_a)$

- Q = ventilation rate (L/s)
- G = CO_2 generation rate
- C_i = acceptable indoor CO_2 concentration
- C_a = ambient CO_2 concentration[37]

Smoking and ventilation

[edit]

ASHRAE standard 62 states that air removed from an area with environmental tobacco smoke shall not be recirculated into ETS-free air. A space with ETS requires more ventilation to achieve similar perceived air quality to that of a non-smoking environment.

The amount of ventilation in an ETS area is equal to the amount of an ETS-free area plus the amount V, where:

V = DSD × VA × A/60E

- V = recommended extra flow rate in CFM (L/s)
- DSD = design smoking density (estimated number of cigarettes smoked per hour per unit area)
- VA = volume of ventilation air per cigarette for the room being designed (ft^3/cig)
- E = contaminant removal effectiveness[38]

History

[edit]

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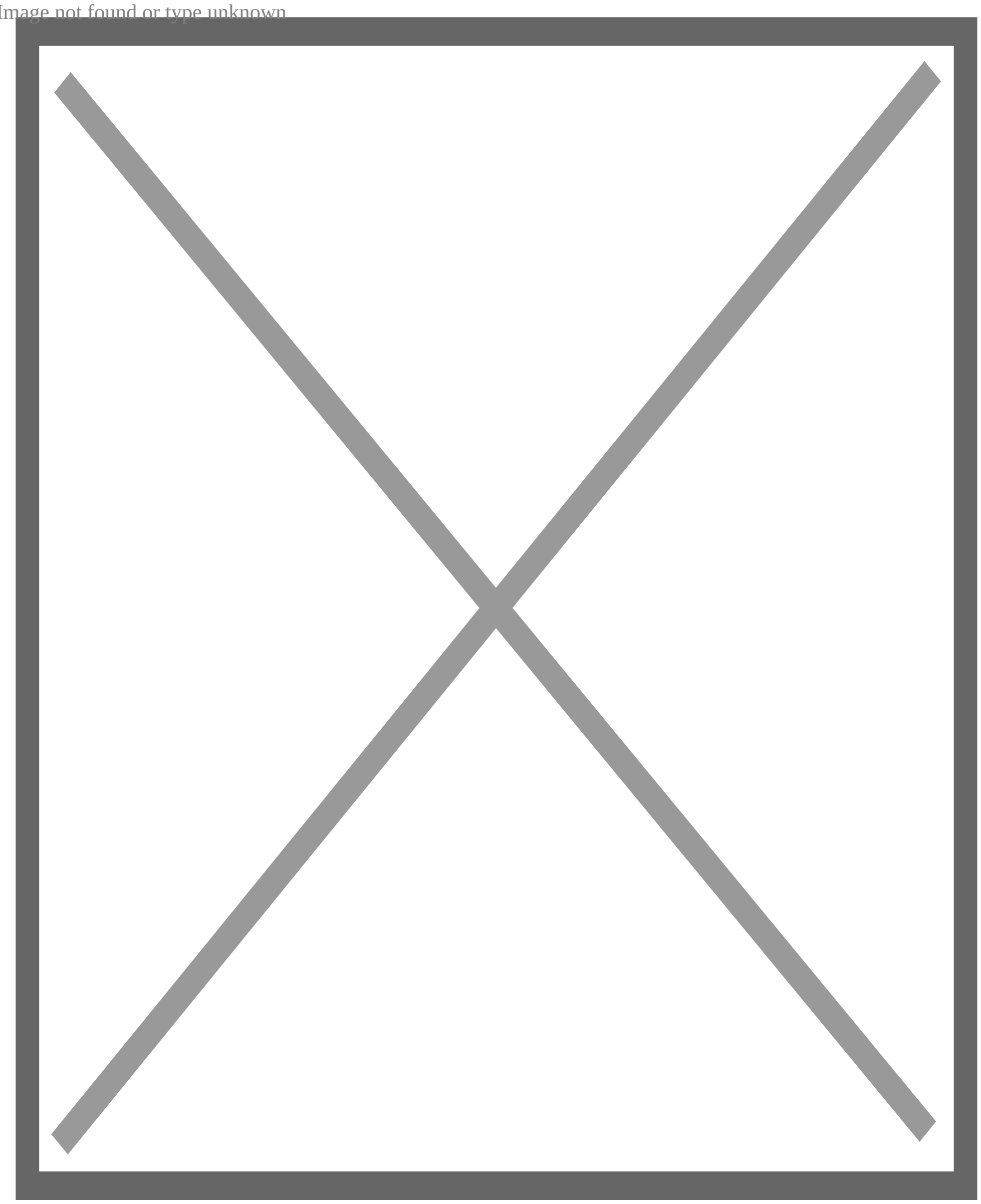

This ancient Roman house uses a variety of passive cooling and passive ventilation techniques. Heavy masonry walls, small exterior windows, and a narrow walled garden oriented N-S shade the house, preventing heat gain. The house opens onto a central atrium with an impluvium (open to the sky); the evaporative cooling of the water causes a cross-draft from atrium to garden.

Primitive ventilation systems were found at the Plo?nik archeological site (belonging to the Vin?a culture) in Serbia and were built into early copper smelting furnaces. The furnace, built on the outside of the workshop, featured earthen pipe-like air vents with hundreds of tiny holes in them and a prototype chimney to ensure air goes into the furnace to feed the fire and smoke comes out safely.[[39]]

Passive ventilation and passive cooling systems were widely written about around the Mediterranean by Classical times. Both sources of heat and sources of cooling (such as fountains and subterranean heat reservoirs) were used to drive air circulation, and buildings were designed to encourage or exclude drafts, according to climate and function. Public bathhouses were often particularly sophisticated in their heating and cooling. Icehouses are some millennia old, and were part of a well-developed ice industry by classical times.

The development of forced ventilation was spurred by the common belief in the late 18th and early 19th century in the miasma theory of disease, where stagnant 'airs' were thought to spread illness. An early method of ventilation was the use of a ventilating fire near an air vent which would forcibly cause the air in the building to circulate. English engineer John Theophilus Desaguliers provided an early example of this when he installed ventilating fires in the air tubes on the roof of the House of Commons. Starting with the Covent Garden Theatre, gas burning chandeliers on the ceiling were often specially designed to perform a ventilating role.

Mechanical systems

[edit]
Further information: Heating, ventilation, and air conditioning § Mechanical or forced ventilation

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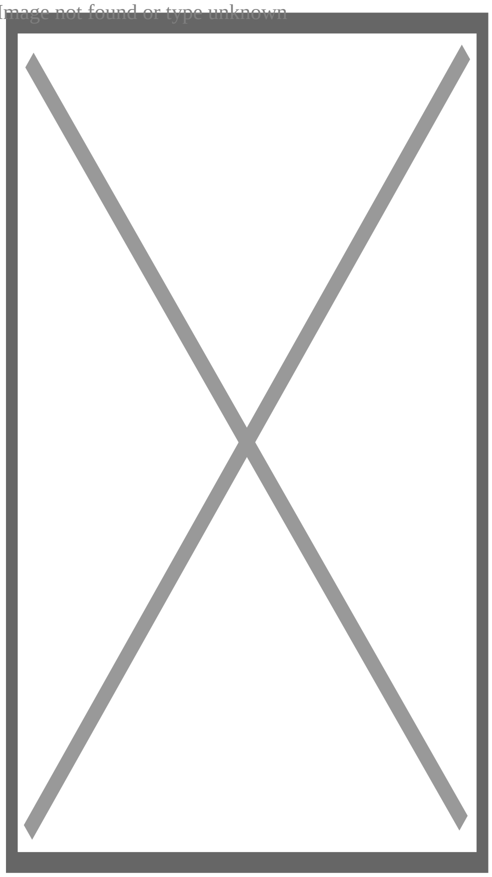

The Central Tower of the Palace of Westminster. This octagonal spire was for ventilation purposes, in the more complex system imposed by Reid on Barry, in which it was to draw air out of the Palace. The design was for the aesthetic disguise of its function.[40][41]

A more sophisticated system involving the use of mechanical equipment to circulate the air was developed in the mid-19th century. A basic system of bellows was put in place to ventilate Newgate Prison and outlying buildings, by the engineer Stephen Hales in the mid-1700s. The problem with these early devices was that they required constant human labor to operate. David Boswell Reid was called to testify before a Parliamentary committee on proposed architectural designs for the new House of Commons, after the old one burned down in a fire in 1834.[40] In January 1840 Reid was appointed by the committee for the House of Lords dealing with the construction of the replacement for the Houses of Parliament. The post was in the capacity of ventilation engineer, in effect; and with its creation there began a long series of quarrels between Reid and Charles Barry, the architect.[42]

Reid advocated the installation of a very advanced ventilation system in the new House. His design had air being drawn into an underground chamber, where it would undergo either heating or cooling. It would then ascend into the chamber through thousands of small holes drilled into the floor, and would be extracted through the ceiling by a special ventilation fire within a great stack.[43]

Reid's reputation was made by his work in Westminster. He was commissioned for an air quality survey in 1837 by the Leeds and Selby Railway in their tunnel.[44] The steam vessels built for the Niger expedition of 1841 were fitted with ventilation systems based on Reid's Westminster model.[45] Air was dried, filtered and passed over charcoal.[46][47] Reid's ventilation method was also applied more fully to St. George's Hall, Liverpool, where the architect, Harvey Lonsdale Elmes, requested that Reid should be involved in ventilation design.[48] Reid considered this the only building in which his system was completely carried out.[49]

Fans

[edit]

With the advent of practical steam power, ceiling fans could finally be used for ventilation. Reid installed four steam-powered fans in the ceiling of St George's Hospital in Liverpool, so that the pressure produced by the fans would force the incoming air upward and through vents in the ceiling. Reid's pioneering work provides the basis for ventilation systems to this day.[43] He was remembered as "Dr. Reid the ventilator" in the twenty-first century in discussions of energy efficiency, by Lord Wade of Chorlton.[50]

History and development of ventilation rate standards

[edit]

Ventilating a space with fresh air aims to avoid "bad air". The study of what constitutes bad air dates back to the 1600s when the scientist Mayow studied asphyxia of animals in confined bottles.[51] The poisonous component of air was later identified as carbon dioxide (CO_2), by Lavoisier in the very late 1700s, starting a debate as to the nature of "bad air" which humans perceive to be stuffy or unpleasant. Early hypotheses included excess concentrations of CO_2 and oxygen depletion. However, by the late 1800s, scientists thought biological contamination, not oxygen or CO_2, was the primary component of unacceptable indoor air. However, it was noted as early as 1872 that CO_2 concentration closely correlates to perceived air quality.

The first estimate of minimum ventilation rates was developed by Tredgold in 1836.[52] This was followed by subsequent studies on the topic by Billings [53] in 1886 and Flugge in 1905. The recommendations of Billings and Flugge were incorporated into numerous building codes from 1900–the 1920s and published as an industry standard by ASHVE (the predecessor to ASHRAE) in 1914.[51]

The study continued into the varied effects of thermal comfort, oxygen, carbon dioxide, and biological contaminants. The research was conducted with human subjects in controlled test chambers. Two studies, published between 1909 and 1911, showed that carbon dioxide was not the offending component. Subjects remained satisfied in chambers with high levels of CO_2, so long as the chamber remained cool.[51] (Subsequently, it has been determined that CO_2 is, in fact, harmful at concentrations over 50,000ppm[54])

ASHVE began a robust research effort in 1919. By 1935, ASHVE-funded research conducted by Lemberg, Brandt, and Morse – again using human subjects in test chambers – suggested the primary component of "bad air" was an odor, perceived by the human olfactory nerves.[55] Human response to odor was found to be logarithmic to contaminant concentrations, and related to temperature. At lower, more comfortable temperatures, lower ventilation rates were satisfactory. A 1936 human test chamber study by Yaglou, Riley, and Coggins culminated much of this effort, considering odor, room volume, occupant age, cooling equipment effects, and recirculated air implications, which guided ventilation rates.[56] The Yagle research has been validated, and adopted into industry standards, beginning with the ASA code in 1946. From this research base, ASHRAE (having replaced ASHVE) developed space-by-space recommendations, and published them as ASHRAE Standard 62-1975: Ventilation for acceptable indoor air quality.

As more architecture incorporated mechanical ventilation, the cost of outdoor air ventilation came under some scrutiny. In 1973, in response to the 1973 oil crisis and conservation concerns, ASHRAE Standards 62-73 and 62–81) reduced required ventilation from 10 CFM (4.76 L/s) per person to 5 CFM (2.37 L/s) per person. In cold, warm, humid, or dusty climates, it is preferable to minimize ventilation with outdoor air to conserve energy, cost, or filtration. This critique (e.g. Tiller[57]) led ASHRAE to reduce outdoor ventilation rates in 1981, particularly in non-smoking areas. However subsequent research by Fanger,[58] W. Cain, and Janssen validated the Yagle model. The reduced ventilation rates were found to be a contributing factor to sick building syndrome.[59]

The 1989 ASHRAE standard (Standard 62–89) states that appropriate ventilation guidelines are 20 CFM (9.2 L/s) per person in an office building, and 15 CFM (7.1 L/s) per person for schools, while 2004 Standard 62.1-2004 has lower recommendations again (see tables below). ANSI/ASHRAE (Standard 62–89) speculated that "comfort (odor) criteria are likely to be satisfied if the ventilation rate is set so that 1,000 ppm CO_2 is not exceeded"[60] while OSHA has set a limit of 5000 ppm over 8 hours.[61]

Historical ventilation rates

Author or source	Year	Ventilation rate (IP)	Ventilation rate (SI)	Basis or rationale
Tredgold	1836	4 CFM per person	2 L/s per person	Basic metabolic needs, breathing rate, and candle burning
Billings	1895	30 CFM per person	15 L/s per person	Indoor air hygiene, preventing spread of disease
Flugge	1905	30 CFM per person	15 L/s per person	Excessive temperature or unpleasant odor
ASHVE	1914	30 CFM per person	15 L/s per person	Based on Billings, Flugge and contemporaries
Early US Codes	1925	30 CFM per person	15 L/s per person	Same as above
Yaglou	1936	15 CFM per person	7.5 L/s per person	Odor control, outdoor air as a fraction of total air
ASA	1946	15 CFM per person	7.5 L/s per person	Based on Yahlou and contemporaries
ASHRAE	1975	15 CFM per person	7.5 L/s per person	Same as above
ASHRAE	1981	10 CFM per person	5 L/s per person	For non-smoking areas, reduced.
ASHRAE	1989	15 CFM per person	7.5 L/s per person	Based on Fanger, W. Cain, and Janssen

ASHRAE continues to publish space-by-space ventilation rate recommendations, which are decided by a consensus committee of industry experts. The modern descendants of ASHRAE standard 62-1975 are ASHRAE Standard 62.1, for non-residential spaces, and ASHRAE 62.2 for residences.

In 2004, the calculation method was revised to include both an occupant-based contamination component and an area–based contamination component.[62] These two components are additive, to arrive at an overall ventilation rate. The change was made to recognize that densely populated areas were sometimes overventilated (leading to higher energy and cost) using a per-person methodology.

Occupant Based Ventilation Rates,[62] ANSI/ASHRAE Standard 62.1-2004

IP Units	SI Units	Category	Examples
0 cfm/person	0 L/s/person	Spaces where ventilation requirements are primarily associated with building elements, not occupants.	Storage Rooms, Warehouses
5 cfm/person	2.5 L/s/person	Spaces occupied by adults, engaged in low levels of activity	Office space
7.5 cfm/person	3.5 L/s/person	Spaces where occupants are engaged in higher levels of activity, but not strenuous, or activities generating more contaminants	Retail spaces, lobbies
10 cfm/person	5 L/s/person	Spaces where occupants are engaged in more strenuous activity, but not exercise, or activities generating more contaminants	Classrooms, school settings
20 cfm/person	10 L/s/person	Spaces where occupants are engaged in exercise, or activities generating many contaminants	dance floors, exercise rooms

Area-based ventilation rates,[62] ANSI/ASHRAE Standard 62.1-2004

IP Units	SI Units	Category	Examples
0.06 cfm/ft^2	0.30 L/s/m^2	Spaces where space contamination is normal, or similar to an office environment	Conference rooms, lobbies
0.12 cfm/ft^2	0.60 L/s/m^2	Spaces where space contamination is significantly higher than an office environment	Classrooms, museums
0.18 cfm/ft^2	0.90 L/s/m^2	Spaces where space contamination is even higher than the previous category	Laboratories, art classrooms
0.30 cfm/ft^2	1.5 L/s/m^2	Specific spaces in sports or entertainment where contaminants are released	Sports, entertainment
0.48 cfm/ft^2	2.4 L/s/m^2	Reserved for indoor swimming areas, where chemical concentrations are high	Indoor swimming areas

The addition of occupant- and area-based ventilation rates found in the tables above often results in significantly reduced rates compared to the former standard. This is compensated in other sections of the standard which require that this minimum amount of air is delivered to the breathing zone of the individual occupant at all times. The total outdoor air intake of the ventilation system (in multiple-zone variable air volume (VAV) systems) might therefore be similar to the airflow required by the 1989 standard.
From 1999 to 2010, there was considerable development of the application protocol for ventilation rates. These advancements address occupant- and process-based ventilation rates, room ventilation effectiveness, and system ventilation effectiveness[63]

Problems

[edit]

- In hot, humid climates, unconditioned ventilation air can daily deliver approximately 260 milliliters of water for each cubic meters per hour (m^3/h) of outdoor air (or one pound of water each day for each cubic feet per minute of outdoor air per day), annual average.[*citation needed*] This is a great deal of moisture and can create serious indoor moisture and mold problems. For example, given a 150 m^2 building with an airflow of 180 m^3/h this could result in about 47 liters of water accumulated per day.
- Ventilation efficiency is determined by design and layout, and is dependent upon the placement and proximity of diffusers and return air outlets. If they are located closely together, supply air may mix with stale air, decreasing the efficiency of the HVAC system, and creating air quality problems.
- System imbalances occur when components of the HVAC system are improperly adjusted or installed and can create pressure differences (too much-circulating air creating a draft or too little circulating air creating stagnancy).
- Cross-contamination occurs when pressure differences arise, forcing potentially contaminated air from one zone to an uncontaminated zone. This often involves undesired odors or VOCs.
- Re-entry of exhaust air occurs when exhaust outlets and fresh air intakes are either too close, prevailing winds change exhaust patterns or infiltration between intake and exhaust air flows.
- Entrainment of contaminated outdoor air through intake flows will result in indoor air contamination. There are a variety of contaminated air sources, ranging from industrial effluent to VOCs put off by nearby construction work.[64] A recent study revealed that in urban European buildings equipped with ventilation systems lacking outdoor air filtration, the exposure to outdoor-originating pollutants indoors resulted in more Disability-Adjusted Life Years (DALYs) than exposure to indoor-emitted pollutants.[65]

See also

[edit]

- Architectural engineering
- Biological safety

- Cleanroom
- Environmental tobacco smoke
- Fume hood
- Head-end power
- Heating, ventilation, and air conditioning
- Heat recovery ventilation
- Mechanical engineering
- Room air distribution
- Sick building syndrome
- Siheyuan
- Solar chimney
- Tulou
- Windcatcher

References

[edit]

1. **^** *Malone, Alanna. "The Windcatcher House". Architectural Record: Building for Social Change. McGraw-Hill. Archived from the original on 22 April 2012.*
2. **^** *ASHRAE (2021). "Ventilation and Infiltration". ASHRAE Handbook—Fundamentals. Peachtree Corners, GA: ASHRAE. ISBN 978-1-947192-90-4.*
3. ^ ***a b*** Whole-House Ventilation | Department of Energy
4. **^** de Gids W.F., Jicha M., 2010. "Ventilation Information Paper 32: Hybrid Ventilation Archived 2015-11-17 at the Wayback Machine", Air Infiltration and Ventilation Centre (AIVC), 2010
5. **^** *Schiavon, Stefano (2014). "Adventitious ventilation: a new definition for an old mode?". Indoor Air.* ***24*** *(6): 557–558. Bibcode:2014InAir..24..557S. doi:10.1111/ina.12155. ISSN 1600-0668. PMID 25376521.*
6. **^** *ANSI/ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality*, ASHRAE, Inc., Atlanta, GA, US
7. **^** *Belias, Evangelos; Licina, Dusan (2024). "European residential ventilation: Investigating the impact on health and energy demand". Energy and Buildings.* ***304*** *113839. Bibcode:2024EneBu.30413839B. doi:10.1016/j.enbuild.2023.113839.*
8. **^** *Belias, Evangelos; Licina, Dusan (2022). "Outdoor PM2. 5 air filtration: optimising indoor air quality and energy". Buildings & Cities.* ***3*** *(1): 186–203. doi:10.5334/bc.153.*
9. **^** *Belias, Evangelos; Licina, Dusan (2024). "European residential ventilation: Investigating the impact on health and energy demand". Energy and Buildings.* ***304*** *113839. Bibcode:2024EneBu.30413839B. doi:10.1016/j.enbuild.2023.113839.*
10. **^** *Belias, Evangelos; Licina, Dusan (2023). "Influence of outdoor air pollution on European residential ventilative cooling potential". Energy and Buildings.* ***289*** *113044. Bibcode:2023EneBu.28913044B. doi:10.1016/j.enbuild.2023.113044.*
11. ^ ***a b*** Sun, Y., Zhang, Y., Bao, L., Fan, Z. and Sundell, J., 2011. Ventilation and dampness in dorms and their associations with allergy among college students in China: a case-control study. Indoor Air, 21(4), pp.277-283.
12. **^** Kavanaugh, Steve. Infiltration and Ventilation In Residential Structures. February 2004

13. **^** *M.H. Sherman. "ASHRAE's First Residential Ventilation Standard" (PDF). Lawrence Berkeley National Laboratory. Archived from the original (PDF) on 29 February 2012.*
14. ^ ***a b*** ASHRAE Standard 62
15. **^** How Natural Ventilation Works by Steven J. Hoff and Jay D. Harmon. Ames, IA: Department of Agricultural and Biosystems Engineering, Iowa State University, November 1994.
16. **^** *"Natural Ventilation – Whole Building Design Guide". Archived from the original on 21 July 2012.*
17. **^** *Shaqe, Erlet. Sustainable Architectural Design.*
18. **^** *"Natural Ventilation for Infection Control in Health-Care Settings" (PDF). World Health Organization (WHO), 2009. Retrieved 5 July 2021.*
19. **^** *Escombe, A. R.; Oeser, C. C.; Gilman, R. H.; et al. (2007). "Natural ventilation for the prevention of airborne contagion". PLOS Med.* ***4*** *(68): e68. doi: 10.1371/journal.pmed.0040068. PMC 1808096. PMID 17326709.*
20. **^** Centers For Disease Control and Prevention (CDC) *"Improving Ventilation In Buildings". 11 February 2020.*
21. **^** Centers For Disease Control and Prevention (CDC) *"Guidelines for Environmental Infection Control in Health-Care Facilities". 22 July 2019.*
22. **^** Dr. Edward A. Nardell Professor of Global Health and Social Medicine, Harvard Medical School *"If We're Going to Live With COVID-19, It's Time to Clean Our Indoor Air Properly". Time. February 2022.*
23. **^** *"A Paradigm Shift to Combat Indoor Respiratory Infection - 21st century" (PDF). University of Leeds.*, Morawska, L, Allen, J, Bahnfleth, W et al. (36 more authors) (2021) A paradigm shift to combat indoor respiratory infection. Science, 372 (6543). pp. 689-691. ISSN 0036-8075
24. **^** Video *"Building Ventilation What Everyone Should Know". YouTube. 17 June 2022.*
25. **^** *Mudarri, David (January 2010). Public Health Consequences and Cost of Climate Change Impacts on Indoor Environments (PDF) (Report). The Indoor Environments Division, Office of Radiation and Indoor Air, U.S. Environmental Protection Agency. pp. 38–39, 63.*
26. **^** *"Climate Change a Systems Perspective". Cassbeth.*
27. **^** Raatschen W. (ed.), 1990: "Demand Controlled Ventilation Systems: State of the Art Review Archived 2014-05-08 at the Wayback Machine", Swedish Council for Building Research, 1990
28. **^** Mansson L.G., Svennberg S.A., Liddament M.W., 1997: "Technical Synthesis Report. A Summary of IEA Annex 18. Demand Controlled Ventilating Systems Archived 2016-03-04 at the Wayback Machine", UK, Air Infiltration and Ventilation Centre (AIVC), 1997
29. **^** *ASHRAE (2006). "Interpretation IC 62.1-2004-06 Of ANSI/ASHRAE Standard 62.1-2004 Ventilation For Acceptable Indoor Air Quality" (PDF). American Society of Heating, Refrigerating, and Air-Conditioning Engineers. p. 2. Archived from the original (PDF) on 12 August 2013. Retrieved 10 April 2013.*
30. **^** Fahlen P., Andersson H., Ruud S., 1992: "Demand Controlled Ventilation Systems: Sensor Tests Archived 2016-03-04 at the Wayback Machine", Swedish National

Testing and Research Institute, Boras, 1992
31. **^** Raatschen W., 1992: "Demand Controlled Ventilation Systems: Sensor Market Survey Archived 2016-03-04 at the Wayback Machine", Swedish Council for Building Research, 1992
32. **^** Mansson L.G., Svennberg S.A., 1993: "Demand Controlled Ventilation Systems: Source Book Archived 2016-03-04 at the Wayback Machine", Swedish Council for Building Research, 1993
33. **^** *Lin X, Lau J & Grenville KY. (2012). "Evaluation of the Validity of the Assumptions Underlying CO_2-Based Demand-Controlled Ventilation by a Literature review" (PDF). ASHRAE Transactions NY-14-007 (RP-1547). Archived from the original (PDF) on 14 July 2014. Retrieved 10 July 2014.*
34. **^** *ASHRAE (2010). "ANSI/ASHRAE Standard 90.1-2010: Energy Standard for Buildings Except for Low-Rise Residential Buildings". American Society of Heating Ventilation and Air Conditioning Engineers, Atlanta, GA.*
35. ^ ***a b*** *"Ventilation. - 1926.57". Osha.gov. Archived from the original on 2 December 2012. Retrieved 10 November 2012.*
36. **^** Air Infiltration and Ventilation Centre (AIVC). "What is smart ventilation?", AIVC, 2018
37. **^** *"Home". Wapa.gov. Archived from the original on 26 July 2011. Retrieved 10 November 2012.*
38. **^** ASHRAE, Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc, Atlanta, 2002.
39. **^** *"Stone Pages Archaeo News: Neolithic Vinca was a metallurgical culture". www.stonepages.com. Archived from the original on 30 December 2016. Retrieved 11 August 2016.*
40. ^ ***a b*** *Porter, Dale H. (1998). The Life and Times of Sir Goldsworthy Gurney: Gentleman scientist and inventor, 1793–1875. Associated University Presses, Inc. pp. 177–79. ISBN 0-934223-50-5.*
41. **^** *"The Towers of Parliament". www.parliament.UK. Archived from the original on 17 January 2012.*
42. **^** *Alfred Barry (1867). "The life and works of Sir Charles Barry, R.A., F.R.S., &c. &c". Retrieved 29 December 2011.*
43. ^ ***a b*** *Robert Bruegmann. "Central Heating and Ventilation: Origins and Effects on Architectural Design" (PDF).*
44. **^** *Russell, Colin A; Hudson, John (2011). Early Railway Chemistry and Its Legacy. Royal Society of Chemistry. p. 67. ISBN 978-1-84973-326-7. Retrieved 29 December 2011.*
45. **^** *Milne, Lynn. "McWilliam, James Ormiston". Oxford Dictionary of National Biography (online ed.). Oxford University Press. doi:10.1093/ref:odnb/17747.* (Subscription or UK public library membership required.)
46. **^** *Philip D. Curtin (1973). The image of Africa: British ideas and action, 1780–1850. Vol. 2. University of Wisconsin Press. p. 350. ISBN 978-0-299-83026-7. Retrieved 29 December 2011.*
47. **^** *"William Loney RN – Background". Peter Davis. Archived from the original on 6 January 2012. Retrieved 7 January 2012.*

48. **^** *Sturrock, Neil; Lawsdon-Smith, Peter (10 June 2009). "David Boswell Reid's Ventilation of St. George's Hall, Liverpool". The Victorian Web. Archived from the original on 3 December 2011. Retrieved 7 January 2012.*
49. **^** *Lee, Sidney, ed. (1896). "Reid, David Boswell" . Dictionary of National Biography. Vol. 47. London: Smith, Elder & Co.*
50. **^** *Great Britain: Parliament: House of Lords: Science and Technology Committee (15 July 2005). Energy Efficiency: 2nd Report of Session 2005–06. The Stationery Office. p. 224. ISBN 978-0-10-400724-2. Retrieved 29 December 2011.*
51. ^ ***a b c*** *Janssen, John (September 1999). "The History of Ventilation and Temperature Control" (PDF). ASHRAE Journal. American Society of Heating Refrigeration and Air Conditioning Engineers, Atlanta, GA. Archived (PDF) from the original on 14 July 2014. Retrieved 11 June 2014.*
52. **^** Tredgold, T. 1836. "The Principles of Warming and Ventilation – Public Buildings". London: M. Taylor
53. **^** Billings, J.S. 1886. "The principles of ventilation and heating and their practical application 2d ed., with corrections" *Archived copy. OL 22096429M.*
54. **^** *"Immediately Dangerous to Life or Health Concentrations (IDLH): Carbon dioxide – NIOSH Publications and Products". CDC. May 1994. Archived from the original on 20 April 2018. Retrieved 30 April 2018.*
55. **^** Lemberg WH, Brandt AD, and Morse, K. 1935. "A laboratory study of minimum ventilation requirements: ventilation box experiments". ASHVE Transactions, V. 41
56. **^** Yaglou CPE, Riley C, and Coggins DI. 1936. "Ventilation Requirements" ASHVE Transactions, v.32
57. **^** Tiller, T.R. 1973. ASHRAE Transactions, v. 79
58. **^** Berg-Munch B, Clausen P, Fanger PO. 1984. "Ventilation requirements for the control of body odor in spaces occupied by women". Proceedings of the 3rd Int. Conference on Indoor Air Quality, Stockholm, Sweden, V5
59. **^** *Joshi, SM (2008). "The sick building syndrome". Indian J Occup Environ Med.* ***12*** *(2): 61–64. doi:10.4103/0019-5278.43262. PMC 2796751. PMID 20040980.* in section 3 "Inadequate ventilation"
60. **^** "Standard 62.1-2004: Stricter or Not?" ASHRAE IAQ Applications, Spring 2006. *"Archived copy" (PDF). Archived from the original (PDF) on 14 July 2014. Retrieved 12 June 2014.*cite web: CS1 maint: archived copy as title (link) accessed 11 June 2014
61. **^** Apte, Michael G. Associations between indoor CO_2 concentrations and sick building syndrome symptoms in U.S. office buildings: an analysis of the 1994–1996 BASE study data." Indoor Air, Dec 2000: 246–58.
62. ^ ***a b c*** Stanke D. 2006. "Explaining Science Behind Standard 62.1-2004". ASHRAE IAQ Applications, V7, Summer 2006. *"Archived copy" (PDF). Archived from the original (PDF) on 14 July 2014. Retrieved 12 June 2014.*cite web: CS1 maint: archived copy as title (link) accessed 11 June 2014
63. **^** Stanke, DA. 2007. "Standard 62.1-2004: Stricter or Not?" ASHRAE IAQ Applications, Spring 2006. *"Archived copy" (PDF). Archived from the original (PDF) on 14 July 2014. Retrieved 12 June 2014.*cite web: CS1 maint: archived copy as title (link) accessed 11 June 2014

64. **^** US EPA. Section 2: Factors Affecting Indoor Air Quality. *"Archived copy" (PDF). Archived from the original (PDF) on 24 October 2008. Retrieved 30 April 2009.*cite web: CS1 maint: archived copy as title (link)
65. **^** *Belias, Evangelos; Licina, Dusan (2024). "European residential ventilation: Investigating the impact on health and energy demand". Energy and Buildings.* ***304*** *113839. Bibcode:2024EneBu.30413839B. doi:10.1016/j.enbuild.2023.113839.*

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  - EBC Annex 27 Evaluation and Demonstration of Domestic Ventilation Systems
  - EBC Annex 35 Control Strategies for Hybrid Ventilation in New and Retrofitted Office Buildings (HYBVENT)
  - EBC Annex 62 Ventilative Cooling

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- ASHRAE Standard 62.2 – Ventilation for Acceptable Indoor Air Quality in Residential Buildings

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Heating, ventilation, and air conditioning

Fundamental concepts	○ Air changes per hour (ACH) ○ Bake-out ○ Building envelope ○ Convection ○ Dilution ○ Domestic energy consumption ○ Enthalpy ○ Fluid dynamics ○ Gas compressor ○ Heat pump and refrigeration cycle ○ Heat transfer ○ Humidity ○ Infiltration ○ Latent heat ○ Noise control ○ Outgassing ○ Particulates ○ Psychrometrics ○ Sensible heat ○ Stack effect ○ Thermal comfort ○ Thermal destratification ○ Thermal mass ○ Thermodynamics ○ Vapour pressure of water

Technology

- Absorption-compression heat pump
- Absorption refrigerator
- Air barrier
- Air conditioning
- Antifreeze
- Automobile air conditioning
- Autonomous building
- Building insulation materials
- Central heating
- Central solar heating
- Chilled beam
- Chilled water
- Constant air volume (CAV)
- Coolant
- Cross ventilation
- Dedicated outdoor air system (DOAS)
- Deep water source cooling
- Demand controlled ventilation (DCV)
- Displacement ventilation
- District cooling
- District heating
- Electric heating
- Energy recovery ventilation (ERV)
- Firestop
- Forced-air
- Forced-air gas
- Free cooling
- Heat recovery ventilation (HRV)
- Hybrid heat
- Hydronics
- Ice storage air conditioning
- Kitchen ventilation
- Mixed-mode ventilation
- Microgeneration
- Passive cooling
- Passive daytime radiative cooling
- Passive house
- Passive ventilation
- Radiant heating and cooling
- Radiant cooling
- Radiant heating
- Radon mitigation
- Refrigeration
- Renewable heat
- Room air distribution
- Solar air heat
- Solar combisystem
- Solar cooling
- Solar heating
- Thermal insulation

- Air conditioner inverter
- Air door
- Air filter
- Air handler
- Air ionizer
- Air-mixing plenum
- Air purifier
- Air source heat pump
- Attic fan
- Automatic balancing valve
- Back boiler
- Barrier pipe
- Blast damper
- Boiler
- Centrifugal fan
- Ceramic heater
- Chiller
- Condensate pump
- Condenser
- Condensing boiler
- Convection heater
- Compressor
- Cooling tower
- Damper
- Dehumidifier
- Duct
- Economizer
- Electrostatic precipitator
- Evaporative cooler
- Evaporator
- Exhaust hood
- Expansion tank
- Fan
- Fan coil unit
- Fan filter unit
- Fan heater
- Fire damper
- Fireplace
- Fireplace insert
- Freeze stat
- Flue
- Freon
- Fume hood
- Furnace
- Gas compressor
- Gas heater
- Gasoline heater
- Grease duct

Components

- Grille
- Ground-coupled heat exchanger

Measurement and control	○ Air flow meter ○ Aquastat ○ BACnet ○ Blower door ○ Building automation ○ Carbon dioxide sensor ○ Clean air delivery rate (CADR) ○ Control valve ○ Gas detector ○ Home energy monitor ○ Humidistat ○ HVAC control system ○ Infrared thermometer ○ Intelligent buildings ○ LonWorks ○ Minimum efficiency reporting value (MERV) ○ Normal temperature and pressure (NTP) ○ OpenTherm ○ Programmable communicating thermostat ○ Programmable thermostat ○ Psychrometrics ○ Room temperature ○ Smart thermostat ○ Standard temperature and pressure (STP) ○ Thermographic camera ○ Thermostat ○ Thermostatic radiator valve
Professions, trades, and services	○ Architectural acoustics ○ Architectural engineering ○ Architectural technologist ○ Building services engineering ○ Building information modeling (BIM) ○ Deep energy retrofit ○ Duct cleaning ○ Duct leakage testing ○ Environmental engineering ○ Hydronic balancing ○ Kitchen exhaust cleaning ○ Mechanical engineering ○ Mechanical, electrical, and plumbing ○ Mold growth, assessment, and remediation ○ Refrigerant reclamation ○ Testing, adjusting, balancing

Industry organizations	◦ AHRI ◦ AMCA ◦ ASHRAE ◦ ASTM International ◦ BRE ◦ BSRIA ◦ CIBSE ◦ Institute of Refrigeration ◦ IIR ◦ LEED ◦ SMACNA ◦ UMC
Health and safety	◦ Indoor air quality (IAQ) ◦ Passive smoking ◦ Sick building syndrome (SBS) ◦ Volatile organic compound (VOC)
See also	◦ ASHRAE Handbook ◦ Building science ◦ Fireproofing ◦ Glossary of HVAC terms ◦ Warm Spaces ◦ World Refrigeration Day ◦ Template:Fire protection ◦ Template:Home automation ◦ Template:Solar energy

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