Air Quality

- **Mapping Duct Layouts for Cleaner Airflow in Mobile Homes**
  Mapping Duct Layouts for Cleaner Airflow in Mobile Homes Inspecting Vent Connections for Improved Air Quality Minimizing Drafts Through Sealed Mobile Home Duct Systems Scheduling Regular Cleanings for Mobile Home Ventilation Evaluating Filter Efficiency for Enhanced Mobile Home Air Quality Addressing Mold Risks in Mobile Home Ductwork Installing Air Purification Systems in Mobile Homes Checking Air Pressure to Reduce Allergens in Mobile Home Interiors Identifying Common Leaks in Flexible Mobile Home Ducts Balancing Humidity Levels for Healthier Mobile Home Air Considering UV Technology for Mobile Home Air Treatment Using Diagnostic Tools to Assess Air Quality in Mobile Homes
- **Preparing Mobile Home HVAC Units for Intense Summer Heat**
  Preparing Mobile Home HVAC Units for Intense Summer Heat Protecting Mobile Home Furnaces During Low Temperature Periods Coping with Storm Related Damage to Mobile Home Air Conditioners Adjusting Climate Control in Mobile Homes for Coastal Humidity Handling Power Outages in Mobile Home Heating Systems Planning Winterization Steps for Mobile Home HVAC Equipment Adapting Mobile Homes to Rapid Seasonal Swings in Temperature Evaluating Wind Exposure Factors for Mobile Home AC Placement Addressing Extended Rainy Periods in Mobile Home Ventilation Considering Local Building Codes for Mobile Home Climate Adaptations Balancing Heat Needs in Mobile Homes Across Different Regions Checking Insurance Coverage for Storm Damaged Mobile Home AC Units
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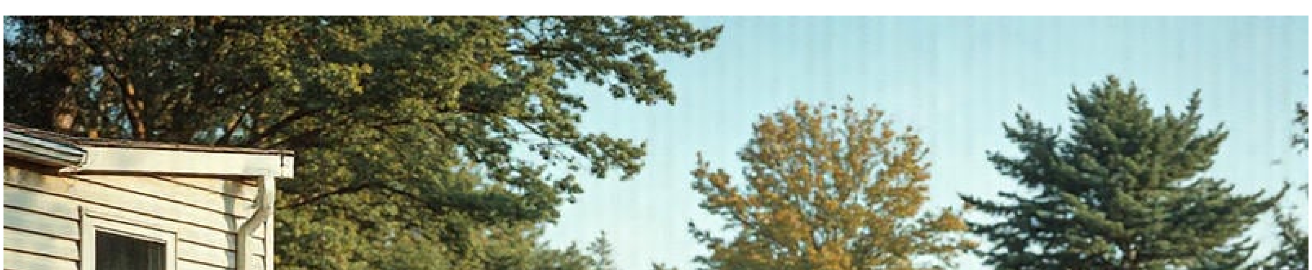

Evaluating Wind Exposure Factors for Mobile Home AC Placement

Importance of Efficient Duct Layouts for Airflow

When it comes to mobile homes, efficient air conditioning is not just a matter of comfort but also one of necessity. The unique structure and placement of mobile homes mean that various environmental factors can significantly influence the efficiency of air conditioning systems. Among these factors, wind exposure stands out as a critical element that requires careful evaluation.

Wind exposure affects the efficiency of air conditioning systems in mobile homes in several ways. Energy-efficient HVAC units can significantly reduce utility costs in mobile homes **best hvac system for mobile home** crawl space. Firstly, consistent wind patterns can impact the external temperature control mechanisms by dispersing heat away from or towards the unit. If a mobile home is placed in an area with high wind exposure, this natural airflow can assist in cooling down the exterior components of an AC system, potentially reducing the workload on the compressor and other mechanical parts. This natural assistance could lead to energy savings and prolonged life for the AC unit.

However, excessive wind exposure isn't universally beneficial and can sometimes be detrimental to AC efficiency. High winds may cause physical damage to external units or compromise their structural integrity over time through wear and tear. Additionally, if not adequately protected or strategically positioned, strong winds could lead to debris accumulation around the AC unit vents, impeding airflow and reducing overall system performance.

The orientation of a mobile home concerning predominant wind directions is another crucial factor. If an air conditioning unit is positioned in such a way that it faces prevailing winds directly without any barriers or buffers like trees or fences, it might experience excessive strain during extreme windy conditions. This orientation might necessitate more frequent maintenance checks and repairs due to increased mechanical stress.

Moreover, wind exposure can influence internal temperature regulation within a mobile home itself. Homes located in areas prone to strong winds may experience drafts if they are not properly insulated or sealed, thereby forcing air conditioning units to work harder to maintain desired indoor temperatures.

To mitigate potential negative impacts while maximizing benefits from natural airflow, several strategies can be employed when evaluating wind exposure factors for mobile home AC placement. Installing protective barriers around outdoor units-be it through landscaping solutions like hedges or engineered structures-can shield them from direct gusts while still allowing for sufficient ventilation spaces necessary for optimal operation.

Additionally, regular inspection routines should be established focusing specifically on cleaning out any debris collected around exterior components due either directly by high winds themselves or indirectly via nearby vegetation being blown into proximity during storms etc., ensuring unobstructed functionality continues unabated throughout all seasons regardless environmental conditions encountered therein at any given moment day/night alike irrespective location globally speaking whatsoever whatsoever always remember though too much good thing sometimes indeed bad so balance key here ultimately defining factor successful outcome desired end result sought after achieved finally once everything considered factored accordingly adjusted where needed required beforehand planning phase outset outset inception conceptualization phase initial stages project development process entire venture undertaking involved parties stakeholders concerned alike agreement harmony consensus mutual understanding cooperation collaboration teamwork synergy collective effort contribution participation involvement engagement commitment dedication perseverance determination focus attention detail precision accuracy meticulousness thoroughness diligence conscientiousness responsibility accountability ownership leadership initiative drive ambition motivation inspiration enthusiasm zeal passion fervor eagerness earnestness sincerity authenticity genuineness honesty integrity transparency openness truthfulness reliability dependability trustworthiness credibility respectability decency civility politeness courtesy kindness generosity compassion empathy sympathy understanding patience tolerance acceptance inclusion diversity equity equality fairness justice morality ethics values principles standards norms rules regulations guidelines policies procedures protocols best practices benchmarks criteria metrics indicators measurements evaluations assessments appraisals audits reviews feedback surveys reports analyses studies research investigations inquiries exploration discovery innovation creativity ingenuity originality imagination vision foresight insight wisdom knowledge expertise proficiency skill competence capability capacity aptitude talent gift knack flair mastery command authority influence power control supervision management administration organization coordination

Common Challenges in Mobile Home Ventilation —

Mobile home parks are unique residential settings that present both opportunities and challenges when it comes to placing air conditioning units. One of the crucial considerations in this context is evaluating wind exposure factors, which can significantly impact the efficiency and longevity of these units. Understanding the nuances of wind exposure in mobile home parks is essential for ensuring optimal placement of AC systems, thereby enhancing comfort and reducing energy consumption.

Firstly, the geographical location of a mobile home park plays a pivotal role in determining wind exposure. Parks situated in coastal regions or open plains often experience stronger winds compared to those nestled in valleys or surrounded by natural windbreaks such as trees or hills. The prevailing wind direction is another critical factor; understanding whether winds typically blow from a specific direction can guide strategic placement of AC units to minimize direct wind impact.

The layout of the mobile home park itself also influences wind patterns. Factors such as the spacing between homes, orientation, and arrangement on the lot can create microenvironments with varying levels of wind exposure. For instance, closely spaced homes might shield each other from strong gusts but could also inadvertently funnel winds into narrow corridors, increasing pressure on certain units. Therefore, careful analysis of park design can help identify optimal positions where AC units are least exposed to detrimental wind effects.

Furthermore, individual mobile homes vary in their susceptibility to wind based on structural design elements like roof shape and eave length. Homes with low-profile roofs may experience less dynamic pressure than those with steeply pitched designs, affecting where an AC unit should be placed for maximum protection against high winds.

Additionally, overhanging eaves can offer some shelter but may also redirect airflow onto other parts of a unit if not properly accounted for.

Vegetation within and around a mobile home park serves as another significant factor influencing wind exposure. Trees and shrubs act as natural barriers that can break up strong winds before they reach vulnerable structures. However, reliance on vegetation must be balanced with maintenance considerations since fallen branches during storms could pose risks to equipment integrity.

Finally, human-made structures such as fences or sheds contribute to local wind dynamics by either obstructing airflow or creating turbulence that affects nearby AC placements. Strategically positioning these structures relative to air conditioning units helps mitigate adverse impacts while maximizing protective benefits.

In conclusion, evaluating factors influencing wind exposure is vital for effective placement of air conditioning systems in mobile home parks. By considering geographical location, park layout, structural features of individual homes, surrounding vegetation, and additional man-made constructions holistically; residents can optimize cooling efficiency while safeguarding against weather-related damages-ultimately leading toward sustainable living solutions tailored specifically for this distinctive housing environment.

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Techniques for Mapping Duct Layouts

Assessing wind patterns and intensity is a critical component when evaluating wind exposure factors, particularly for the strategic placement of air conditioning units in mobile homes. The inherently portable nature of mobile homes means they are often more vulnerable to environmental elements compared to permanent structures. Therefore, understanding how wind influences these environments can help optimize comfort, ensure energy efficiency, and enhance the longevity of AC systems.

The first step in assessing wind patterns involves collecting comprehensive data on local meteorological conditions. This includes historical weather data, which provides insights into prevailing winds-their direction, speed, and seasonal variations. Wind roses are a valuable tool in this context; they graphically represent wind speed and direction over a specific period, allowing homeowners or installers to identify dominant wind directions that could impact AC efficiency.

Once prevailing wind patterns are understood, the next focus should be on microclimate analysis surrounding the mobile home site. Factors such as nearby geographical features-hills, bodies of water, or urban structures-can significantly alter local wind behavior by creating turbulence or channeling effects. For example, a mobile home situated near a large building might experience increased wind speeds due to the Venturi effect-a phenomenon where airflow accelerates through constricted spaces.

Wind tunnel testing or computational fluid dynamics (CFD) simulations can provide detailed insights into these localized impacts by modeling how air flows around specific configurations and obstructions. These methods allow for visualizing potential areas of high pressure where winds may be intensified or zones of low pressure where calm conditions prevail.

Measuring real-time wind intensity at prospective AC placement sites is another method that ensures accurate assessment. Anemometers installed temporarily can capture current data on-site over different times and conditions to inform decisions about optimal positioning.

Additionally, understanding building aerodynamics is crucial when considering AC placement for mobile homes. Mobile homes typically have a lightweight structure with less aerodynamic resistance than traditional buildings. As such, high winds can exert significant force on their exteriors. Placing an AC unit on a side facing prevailing winds might not only reduce its efficiency but also increase wear and tear due to constant exposure.

To mitigate potential issues from improper placement influenced by wind factors, experts recommend installing protective barriers like fences or strategically planting vegetation around the AC unit without obstructing airflow directly into it. This serves dual purposes: reducing direct exposure to strong gusts and utilizing natural elements as buffers against extreme temperatures.

In conclusion, evaluating wind exposure factors for mobile home AC placement requires a multifaceted approach that combines historical data analysis with modern technological tools like CFD simulations and practical field measurements. By considering both macro-scale patterns and localized influences on airflow dynamics around mobile structures, it's possible to position air conditioning units in ways that maximize efficiency while minimizing mechanical strain from environmental forces. This strategic planning not only enhances comfort levels inside mobile homes but also contributes towards sustainable energy consumption practices tailored specifically for these adaptable living spaces.

Tools and Technologies for Accurate Duct Mapping

When considering the placement of air conditioning units for mobile homes, one often overlooked factor is wind exposure. Mobile homes, due to their relatively lightweight construction and elevated positioning, are particularly susceptible to wind-related challenges. This makes the strategic placement of AC units an essential consideration not only for optimal cooling efficiency but also for minimizing potential damage caused by wind impact.

To begin with, understanding the nature of wind exposure is crucial. Wind can exert significant pressure on structures; hence, knowing the predominant wind directions and speeds in a particular area is vital. This knowledge allows homeowners and installers to identify areas that are more sheltered from direct gusts or turbulent airflow patterns. For instance, placing an AC unit on the leeward side of a mobile home-away from prevailing winds-can significantly reduce its exposure to direct wind forces.

Moreover, elevation plays a critical role in determining wind impact on AC units. Placing units closer to ground level can offer some protection against strong winds while still maintaining efficient cooling performance. However, this must be balanced against potential risks such as flooding or debris accumulation during storms. Installing deflectors or barriers around the unit can also help shield it from harsh winds without impeding airflow necessary for proper functioning.

Another strategy involves leveraging natural or existing structural features of the landscape and home design. Trees, hedges, or fences can act as natural windbreaks if strategically used; however, care must be taken not to obstruct airflow around the AC unit completely. Additionally, utilizing architectural elements such as pergolas or awnings can provide added protection while serving dual purposes like shading and aesthetic improvement.

Incorporating technological advancements into installation strategies further aids in mitigating wind impact challenges. Modern AC units often come with enhanced design features specifically aimed at improving stability and resilience under adverse weather conditions. Opting for models engineered with robust casings and mounts suitable for high-wind environments ensures better durability over time.

Ultimately, evaluating all these factors collectively provides a comprehensive approach towards optimizing AC placement in mobile homes facing significant wind exposure risks. By considering environmental variables alongside technical specifications during installation planning stages-from site selection through equipment choice-homeowners ensure both effective operation and longevity of their air conditioning systems amidst challenging climatic conditions prevalent today.

Through thoughtful planning focused on reducing vulnerability associated with high-wind scenarios coupled alongside advances within HVAC technology sector itself there exists ample opportunity achieve balance between comfort desired indoors whilst safeguarding valuable investments outside where they remain integral part everyday life inside any mobile home setting!

Best Practices for Cleaner Airflow

When discussing the installation of air conditioning units in mobile homes situated in wind-prone areas, it is crucial to evaluate a myriad of factors related to wind exposure.

The delicate interplay between the natural elements and structural integrity can significantly influence the success of such installations. By examining case studies on successful AC installations under these challenging conditions, we gain valuable insights into best practices and innovative solutions.

Mobile homes, due to their lightweight construction, are particularly susceptible to the forces exerted by strong winds. Therefore, one of the primary considerations in AC placement is ensuring that the unit can withstand severe weather conditions without compromising its functionality or safety. Successful case studies often highlight the importance of selecting appropriate mounting techniques. For instance, using reinforced brackets and secure anchoring systems can prevent detachment during high-wind events-a common failure point in inadequate installations.

Another critical factor is positioning. Strategic placement of AC units can mitigate wind exposure risks considerably. Ideally, an air conditioner should be installed on the leeward side of a mobile home-this is typically the side facing away from prevailing winds-to reduce direct impact from gusts. Additionally, shielding devices such as windbreaks or barriers can offer extra protection by deflecting or absorbing wind currents before they reach the unit.

The material choice for both the AC housing and its components must also be considered meticulously in these environments. Durable materials like stainless steel or heavy-duty plastics that resist corrosion and wear are favored in cases where exposure to harsh weather elements is inevitable.

Successful examples also emphasize regular maintenance schedules tailored for high-risk zones. Routine inspections ensure that all fastenings remain secure over time and that any potential issues are addressed promptly before they escalate into significant problems.

Moreover, incorporating advanced technology solutions has proven beneficial in some cases. Smart sensors that monitor environmental conditions and dynamically adjust operational settings help maintain optimal performance while minimizing strain on mechanical parts during adverse weather scenarios.

Ultimately, evaluating wind exposure factors for mobile home AC placement involves a comprehensive approach combining practical engineering solutions with strategic planning and foresight. By learning from successful installations documented through case studies, industry professionals can better equip themselves to tackle similar challenges head-on-ensuring effective climate control without sacrificing safety or reliability even in wind-prone areas.

These insights not only benefit individual homeowners but also contribute to broader developments within sustainable building practices for mobile living spaces-a rapidly evolving landscape where resilience against natural forces becomes increasingly paramount.

Case Studies of Improved Air Quality in Mobile Homes

When considering the placement of an air conditioning (AC) unit for a mobile home, evaluating wind exposure factors is crucial, particularly in regions prone to high-wind conditions. The performance and longevity of an AC system can be significantly impacted by how well it is protected from environmental elements such as wind. In this context, understanding maintenance tips for enhancing AC performance becomes essential.

Mobile homes are often situated in open areas where they are more vulnerable to strong winds. This exposure not only affects the structural integrity of the home itself but also poses challenges for external installations like AC units. Therefore, it is vital to assess the potential impact of wind on these systems and take preventive measures to ensure optimal performance.

One of the first steps in evaluating wind exposure factors is identifying the predominant wind direction in your area. By knowing which way the winds typically blow, you can strategically place your AC unit on a side of the mobile home that offers some natural protection, such as near a wall or behind a barrier like shrubs or fencing. This reduces direct wind impact and helps maintain consistent airflow around the unit's coils.

Additionally, securing your AC unit is paramount in preventing damage during high-wind events. Ensure that it is firmly mounted on a stable platform or base that can withstand gusts without tipping over or shifting position. Consider using heavy-duty brackets or straps specifically designed for anchoring appliances in windy environments.

Regular maintenance plays an equally important role in enhancing AC performance under high-wind conditions. Start by inspecting the unit frequently for any debris accumulation caused by swirling winds. Leaves, twigs, and other materials can block vents and restrict airflow, leading to inefficient cooling and increased energy consumption.

Moreover, clean or replace filters regularly to prevent clogs that could exacerbate issues related to restricted airflow. During windy periods, dust and dirt are more likely to get trapped within filters, so maintaining them becomes even more critical.

The condenser coils should also be cleaned periodically since they are exposed directly to outdoor conditions. Dirty coils reduce heat transfer efficiency and force the system to work harder than necessary-this strain can lead to premature wear or failure.

Lastly, consider installing a protective cover when your AC unit is not in use for extended periods (such as during colder months). This simple measure shields it from harsh weather while keeping out unwanted debris until it's needed again.

In summary, evaluating wind exposure factors for mobile home AC placement involves thoughtful consideration of location coupled with diligent upkeep practices tailored toward combating challenges posed by high winds effectively. Through strategic positioning combined with vigilant care routines-including securing equipment properly along with consistent cleaning efforts-you'll ensure enhanced operational efficiency alongside prolonged durability despite adverse weather conditions inherent within windy locales.

About Fan coil unit

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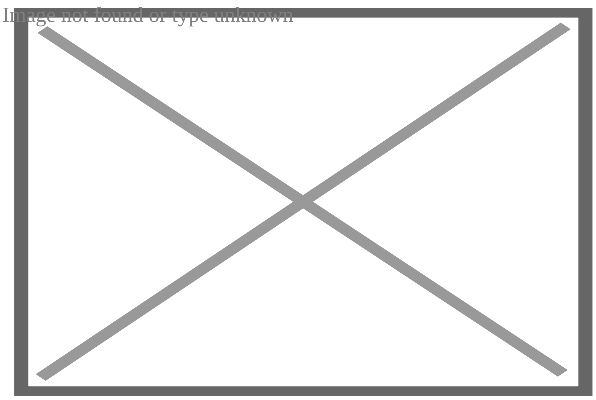
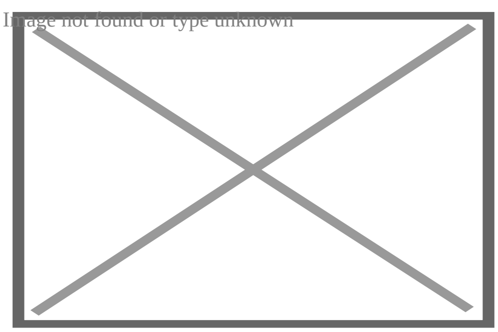
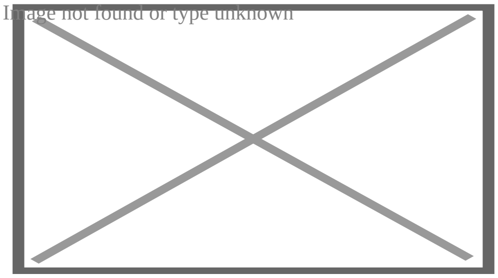


Refrigerant based Fan-Coil Unit. Other variants utilize a chilled, or heated water loop for space cooling, or heating, respectively.





A **fan coil unit** (**FCU**), also known as a **Vertical Fan Coil Unit** (**VFCU**), is a device consisting of a heat exchanger (coil) and a fan. FCUs are commonly used in HVAC systems of residential, commercial, and industrial buildings that use ducted split air conditioning or central plant cooling. FCUs are typically connected to ductwork and a thermostat to regulate the temperature of one or more spaces and to assist the main air handling unit for each space if used with chillers. The thermostat controls the fan speed and/or the flow of water or refrigerant to the heat exchanger using a control valve.

Due to their simplicity, flexibility, and easy maintenance, fan coil units can be more economical to install than ducted 100% fresh air systems (VAV) or central heating systems with air handling units or chilled beams. FCUs come in various configurations, including horizontal (ceiling-mounted) and vertical (floor-mounted), and can be used in a wide range of applications, from small residential units to large commercial and industrial buildings.

Noise output from FCUs, like any other form of air conditioning, depends on the design of the unit and the building materials surrounding it. Some FCUs offer noise levels as low as NR25 or NC25.

The output from an FCU can be established by looking at the temperature of the air entering the unit and the temperature of the air leaving the unit, coupled with the volume of air being moved through the unit. This is a simplistic statement, and there is further reading on sensible heat ratios and the specific heat capacity of air, both of which have an effect on thermal performance.

Design and operation

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Fan Coil Unit covers a range of products and will mean different things to users, specifiers, and installers in different countries and regions, particularly in relation to product size and output capability.

Fan Coil Unit falls principally into two main types: blow through and draw through. As the names suggest, in the first type the fans are fitted behind the heat exchanger, and in the other type the fans are fitted in front the coil such that they draw air through it. Draw through units are considered thermally superior, as ordinarily they make better use of the heat exchanger. However they are more expensive, as they require a chassis to hold the fans whereas a blow-through unit typically consists of a set of fans bolted straight to a coil.

A fan coil unit may be concealed or exposed within the room or area that it serves.

An exposed fan coil unit may be wall-mounted, freestanding or ceiling mounted, and will typically include an appropriate enclosure to protect and conceal the fan coil unit itself, with return air grille and supply air diffuser set into that enclosure to distribute the air.

A concealed fan coil unit will typically be installed within an accessible ceiling void or services zone. The return air grille and supply air diffuser, typically set flush into the ceiling, will be ducted to and from the fan coil unit and thus allows a great degree of flexibility for locating the grilles to suit the ceiling layout and/or the partition layout within a space. It is quite common for the return air not to be ducted and to use the ceiling void as a return air plenum.

The coil receives hot or cold water from a central plant, and removes heat from or adds heat to the air through heat transfer. Traditionally fan coil units can contain their own internal thermostat, or can be wired to operate with a remote thermostat. However, and as is common in most modern buildings with a Building Energy

Management System (BEMS), the control of the fan coil unit will be by a local digital controller or outstation (along with associated room temperature sensor and control valve actuators) linked to the BEMS via a communication network, and therefore adjustable and controllable from a central point, such as a supervisors head end computer.

Fan coil units circulate hot or cold water through a coil in order to condition a space. The unit gets its hot or cold water from a central plant, or mechanical room containing equipment for removing heat from the central building's closed-loop. The equipment used can consist of machines used to remove heat such as a chiller or a cooling tower and equipment for adding heat to the building's water such as a boiler or a commercial water heater.

Hydronic fan coil units can be generally divided into two types: Two-pipe fan coil units or four-pipe fan coil units. Two-pipe fan coil units have one supply and one return pipe. The supply pipe supplies either cold or hot water to the unit depending on the time of year. Four-pipe fan coil units have two supply pipes and two return pipes. This allows either hot or cold water to enter the unit at any given time. Since it is often necessary to heat and cool different areas of a building at the same time, due to differences in internal heat loss or heat gains, the four-pipe fan coil unit is most commonly used.

Fan coil units may be connected to piping networks using various topology designs, such as "direct return", "reverse return", or "series decoupled". See ASHRAE Handbook "2008 Systems & Equipment", Chapter 12.

Depending upon the selected chilled water temperatures and the relative humidity of the space, it's likely that the cooling coil will dehumidify the entering air stream, and as a by product of this process, it will at times produce a condensate which will need to be carried to drain. The fan coil unit will contain a purpose designed drip tray with drain connection for this purpose. The simplest means to drain the condensate from multiple fan coil units will be by a network of pipework laid to falls to a suitable point. Alternatively a condensate pump may be employed where space for such gravity pipework is limited.

The fan motors within a fan coil unit are responsible for regulating the desired heating and cooling output of the unit. Different manufacturers employ various methods for controlling the motor speed. Some utilize an AC transformer, adjusting the taps to modulate the power supplied to the fan motor. This adjustment is typically performed during the commissioning stage of building construction and remains fixed for the lifespan of the unit.

Alternatively, certain manufacturers employ custom-wound Permanent Split Capacitor (PSC) motors with speed taps in the windings. These taps are set to the desired speed levels for the specific design of the fan coil unit. To enable local control, a simple speed selector switch (Off-High-Medium-Low) is provided for the occupants of the room. This switch is often integrated into the room thermostat and can be manually set or automatically controlled by a digital room thermostat.

For automatic fan speed and temperature control, Building Energy Management Systems are employed. The fan motors commonly used in these units are typically AC Shaded Pole or Permanent Split Capacitor motors. Recent advancements include the use of brushless DC designs with electronic commutation. Compared to units equipped with asynchronous 3-speed motors, fan coil units utilizing brushless motors can reduce power consumption by up to 70%.[1]

Fan coil units linked to ducted split air conditioning units use refrigerant in the cooling coil instead of chilled coolant and linked to a large condenser unit instead of a chiller. They might also be linked to liquid-cooled condenser units which use an intermediate coolant to cool the condenser using cooling towers.

DC/EC motor powered units

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These motors are sometimes called DC motors, sometimes EC motors and occasionally DC/EC motors. DC stands for direct current and EC stands for electronically commutated.

DC motors allow the speed of the fans within a fan coil unit to be controlled by means of a 0-10 Volt input control signal to the motor/s, the transformers and speed switches associated with AC fan coils are not required. Up to a signal voltage of 2.5 Volts (which may vary with different fan/motor manufacturers) the fan will be in a stopped condition but as the signal voltage is increased, the fan will seamlessly increase in speed until the maximum is reached at a signal Voltage of 10 Volts. fan coils will generally operate between approximately 4 Volts and 7.5 Volts because below 4 Volts the air volumes are ineffective and above 7.5 Volts the fan coil is likely to be too noisy for most commercial applications.

The 0-10 Volt signal voltage can be set via a simple potentiometer and left or the 0-10 Volt signal voltage can be delivered to the fan motors by the terminal controller on each of the Fan Coil Units. The former is very simple and cheap but the latter opens up the opportunity to continuously alter the fan speed depending on various external conditions/influences. These conditions/criteria could be the 'real time' demand for either heating or cooling, occupancy levels, window switches, time clocks or any number of other inputs from either the unit itself, the Building Management System or both.

The reason that these DC Fan Coil Units are, despite their apparent relative complexity, becoming more popular is their improved energy efficiency levels compared to their AC motor-driven counterparts of only a few years ago. A straight swap, AC to DC, will reduce electrical consumption by 50% but applying Demand and Occupancy dependent fan speed control can take the savings to as much as 80%. In areas of the world where there are legally enforceable energy efficiency requirements for fan coils (such as the UK), DC Fan Coil Units are rapidly becoming the only choice.

Areas of use

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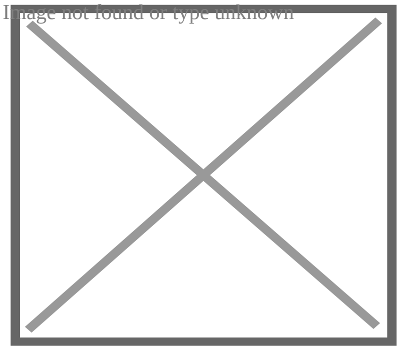

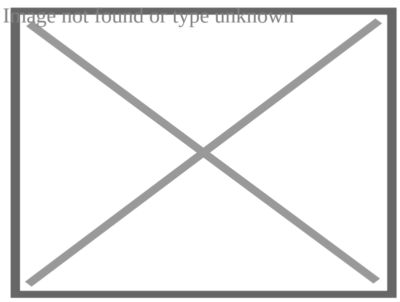

In high-rise buildings, fan coils may be vertically stacked, located one above the other from floor to floor and all interconnected by the same piping loop.

Fan coil units are an excellent delivery mechanism for hydronic chiller boiler systems in large residential and light commercial applications. In these applications the fan coil units are mounted in bathroom ceilings and can be used to provide unlimited comfort zones - with the ability to turn off unused areas of the structure to save energy.

Installation

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In high-rise residential construction, typically each fan coil unit requires a rectangular through-penetration in the concrete slab on top of which it sits. Usually, there are either 2 or 4 pipes made of ABS, steel or copper that go through the floor. The pipes are usually insulated with refrigeration insulation, such as acrylonitrile butadiene/polyvinyl chloride (AB/PVC) flexible foam (Rubatex or Armaflex brands) on all pipes, or at least on the chilled water lines to prevent condensate from forming.

Unit ventilator

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A unit ventilator is a fan coil unit that is used mainly in classrooms, hotels, apartments and condominium applications. A unit ventilator can be a wall mounted or ceiling hung cabinet, and is designed to use a fan to blow outside air across a coil, thus conditioning and ventilating the space which it is serving.

European market

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The Fan Coil is composed of one quarter of 2-pipe-units and three quarters of 4-pipe-units, and the most sold products are "with casing" (35%), "without casing" (28%), "cassette" (18%) and "ducted" (16%).[2]

The market by region was split in 2010 as follows:

Region	Sales Volume in units[2]	Share
Benelux	33 725	2.6%
France	168 028	13.2%
Germany	63 256	5.0%
Greece	33 292	2.6%
Italy	409 830	32.1%
Poland	32 987	2.6%
Portugal	22 957	1.8%
Russia, Ukraine and CIS countries	87 054	6.8%
Scandinavia and Baltic countries	39 124	3.1%
Spain	91 575	7.2%

Turkey	70 682	5.5%
UK and Ireland	69 169	5.4%
Eastern Europe	153 847	12.1%

See also

[edit]
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Wikimedia Commons has media related to ***Fan coil units***.

- Thermal insulation
- HVAC
- Construction
- Intumescent
- Firestop

References

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1. **^** *"Fan Coil Unit". Heinen & Hopman. Retrieved 2023-08-30.*
2. ^ ***a b*** *"Home". Eurovent Market Intelligence.*

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Heating, ventilation, and air conditioning

Fundamental concepts	◦ Air changes per hour ◦ 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

- 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

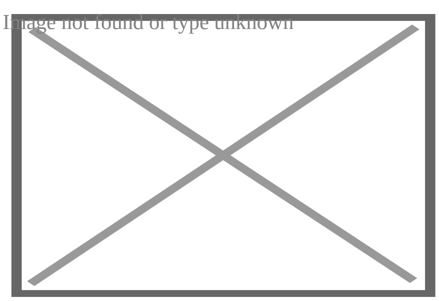
Measurement and control	◦ Air flow meter ◦ Aquastat ◦ BACnet ◦ Blower door ◦ Building automation ◦ Carbon dioxide sensor ◦ Clean air delivery rate (CADR) ◦ Control valve ◦ Gas detector ◦ Home energy monitor ◦ Humidistat ◦ HVAC control system ◦ Infrared thermometer ◦ Intelligent buildings ◦ LonWorks ◦ 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:Home automation
- Template:Solar energy

About Indoor air quality



An air filter being cleaned

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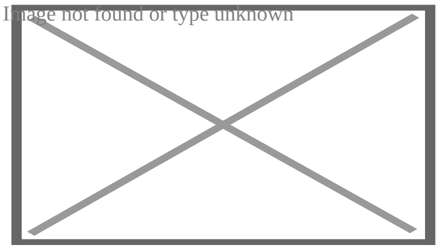

Air pollution from a factory

Air

- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
- Exhaust gas
- Haze
- Global dimming
- Global distillation
- Indoor air quality
- Non-exhaust emissions
- Ozone depletion
- Particulates
- Persistent organic pollutant
- Smog
- Soot
- Volatile organic compound

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- Electronic waste
- Foam food container
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- Green waste
- Hazardous waste
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- Post-consumer waste
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    - Nuclear famine
    - Nuclear winter
- Scorched earth
- Unexploded ordnance
- War and environmental law

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Categories

- By country

- Image not found or type unknown icon Environment portal
- Image not found or type unknown icon Ecology portal

Indoor air quality (**IAQ**) is the air quality within buildings and structures. Poor indoor air quality due to **indoor air pollution** is known to affect the health, comfort, and well-being of building occupants. It has also been linked to sick building syndrome, respiratory issues, reduced productivity, and impaired learning in schools. Common pollutants of indoor air include: secondhand tobacco smoke, air pollutants from indoor combustion, radon, molds and other allergens, carbon monoxide, volatile organic compounds, legionella and other bacteria, asbestos fibers, carbon dioxide,[1] ozone and particulates.

Source control, filtration, and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality. Although ventilation is an integral component of maintaining good indoor air quality, it may not be satisfactory alone.[2] In scenarios where outdoor pollution would deteriorate indoor air quality, other treatment devices such as filtration may also be necessary.[3]

IAQ is evaluated through collection of air samples, monitoring human exposure to pollutants, analysis of building surfaces, and computer modeling of air flow inside buildings. IAQ is part of indoor environmental quality (IEQ), along with other factors that exert an influence on physical and psychological aspects of life indoors (e.g., lighting, visual quality, acoustics, and thermal comfort).[4]

Indoor air pollution is a major health hazard in developing countries and is commonly referred to as "household air pollution" in that context.[5] It is mostly relating to cooking and heating methods by burning biomass fuel, in the form of wood, charcoal, dung, and crop residue, in indoor environments that lack proper ventilation. Millions of people, primarily women and children, face serious health risks. In total, about three billion people in developing countries are affected by this problem. The World Health Organization (WHO) estimates that cooking-related indoor air pollution causes 3.8 million annual deaths.[6] The Global Burden of Disease study estimated the number of deaths in 2017 at 1.6 million.[7]

Definition

[edit]

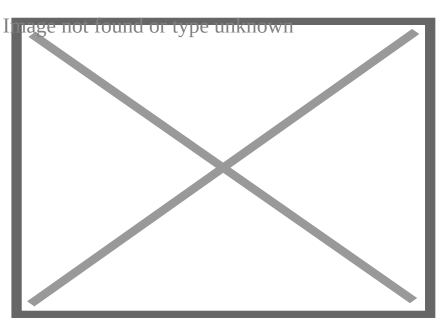
For health reasons it is crucial to breathe clean air, free from chemicals and toxicants as much as possible. It is estimated that humans spend approximately 90% of their lifetime indoors[8] and that indoor air pollution in some places can be much worse than that of the ambient air.[9][10]

Various factors contribute to high concentrations of pollutants indoors, ranging from influx of pollutants from external sources, off-gassing by furniture, furnishings including carpets, indoor activities (cooking, cleaning, painting, smoking, etc. in homes to using office equipment in offices), thermal comfort parameters such as temperature, humidity, airflow and physio-chemical properties of the indoor air.[*citation needed*] Air pollutants can enter a building in many ways, including through open doors or windows. Poorly maintained air conditioners/ventilation systems can harbor mold, bacteria, and other contaminants, which are then circulated throughout indoor spaces, contributing to respiratory problems and allergies.

There have been many debates among indoor air quality specialists about the proper definition of indoor air quality and specifically what constitutes "acceptable" indoor air quality.

Health effects

[edit]



Share of deaths from indoor air pollution. Darker colors mean higher numbers.

IAQ is significant for human health as humans spend a large proportion of their time in indoor environments. Americans and Europeans on average spend approximately 90% of their time indoors.[11][12]

The World Health Organization (WHO) estimates that 3.2 million people die prematurely every year from illnesses attributed to indoor air pollution caused by indoor cooking, with over 237 thousand of these being children under 5. These include around an eighth of all global ischaemic heart disease, stroke, and lung cancer deaths. Overall the WHO estimated that poor indoor air quality resulted in the loss of 86 million healthy life years in 2019.[13]

Studies in the UK and Europe show exposure to indoor air pollutants, chemicals and biological contamination can irritate the upper airway system, trigger or exacerbate asthma and other respiratory or cardiovascular conditions, and may even have carcinogenic effects.[14][15][16][17][18][19]

Poor indoor air quality can cause sick building syndrome. Symptoms include burning of the eyes, scratchy throat, blocked nose, and headaches.[20]

Common pollutants

[edit]

Generated by indoor combustion

[edit]
Main article: Household air pollution
Further information: Energy poverty and cooking

a 3-stone stove

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A traditional wood-fired 3-stone stove in Guatemala, which causes indoor air pollution

Indoor combustion, such as for cooking or heating, is a major cause of indoor air pollution and causes significant health harms and premature deaths. Hydrocarbon fires cause air pollution. Pollution is caused by both biomass and fossil fuels of various types, but some forms of fuels are more harmful than others.

Indoor fire can produce black carbon particles, nitrogen oxides, sulfur oxides, and mercury compounds, among other emissions.[21] Around 3 billion people cook over open fires or on rudimentary cook stoves. Cooking fuels are coal, wood, animal dung, and crop residues.[22] IAQ is a particular concern in low and middle-income countries where such practices are common.[23]

Cooking using natural gas (also called fossil gas, methane gas or simply gas) is associated with poorer indoor air quality. Combustion of gas produces nitrogen dioxide and carbon monixide, and can lead to increased concentrations of nitrogen dioxide throughout the home environment which is linked to respiratory issues and diseases.[24][25]

Carbon monoxide

[edit]

Main article: Carbon monoxide poisoning

One of the most acutely toxic indoor air contaminants is carbon monoxide (CO), a colourless and odourless gas that is a by-product of incomplete combustion. Carbon monoxide may be emitted from tobacco smoke and generated from malfunctioning fuel burning stoves (wood, kerosene, natural gas, propane) and fuel burning heating systems (wood, oil, natural gas) and from blocked flues connected to these appliances.[26] In developed countries the main sources of indoor CO emission come from cooking and heating devices that burn fossil fuels and are faulty, incorrectly installed or poorly maintained.[27] Appliance malfunction may be due to faulty installation or lack of maintenance and proper use.[26] In low- and middle-income countries the most common sources of CO in homes are burning biomass fuels and cigarette smoke.[27]

Health effects of CO poisoning may be acute or chronic and can occur unintentionally or intentionally (self-harm). By depriving the brain of oxygen, acute exposure to carbon monoxide may have effects on the neurological system (headache, nausea, dizziness, alteration in consciousness and subjective weakness), the cardiovascular and respiratory systems (myocardial infarction, shortness of breath, or rapid breathing, respiratory failure). Acute exposure can also lead to long-term neurological effects such as cognitive and behavioural changes. Severe CO poisoning may lead to unconsciousness, coma and death. Chronic exposure to low concentrations of carbon monoxide may lead to lethargy, headaches, nausea, flu-like symptoms and neuropsychological and cardiovascular issues.[28][26]

The WHO recommended levels of indoor CO exposure in 24 hours is 4 mg/m^3.[29] Acute exposure should not exceed 10 mg/m^3 in 8 hours, 35 mg/m^3 in one hour and 100 mg/m^3 in 15 minutes.[27]

Secondhand tobacco smoke

[edit]

Main article: Passive smoking

Secondhand smoke is tobacco smoke which affects people other than the 'active' smoker. It is made up of the exhaled smoke (15%) and mostly of smoke coming from the burning end of the cigarette, known as sidestream smoke (85%).[30]

Secondhand smoke contains more than 7000 chemicals, of which hundreds are harmful to health.[30] Secondhand tobacco smoke includes both a gaseous and a particulate materials which, with particular hazards arising from levels of carbon monoxide and very small particulates (fine particulate matter, especially PM2.5 and PM10) which get into the bronchioles and alveoles in the lung.[31] Inhaling secondhand smoke on multiple occasions can cause asthma, pneumonia, lung cancer, and sudden infant death syndrome, among other conditions.[32]

Thirdhand smoke (THS) refers to chemicals that settle on objects and bodies indoors after smoking. Exposure to thirdhand smoke can happen even after the actual cigarette smoke is not present anymore and affect those entering the indoor environment much later. Toxic substances of THS can react with other chemicals in the air and produce new toxic chemicals that are otherwise not present in cigarettes.[33]

The only certain method to improve indoor air quality as regards secondhand smoke is to eliminate smoking indoors.[34] Indoor e-cigarette use also increases home particulate matter concentrations.[35]

Particulates

[edit]

Atmospheric particulate matter, also known as particulates, can be found indoors and can affect the health of occupants. Indoor particulate matter can come from different indoor sources or be created as secondary aerosols through indoor gas-to-particle reactions. They can also be outdoor particles that enter indoors. These indoor particles vary widely in size, ranging from nanomet (nanoparticles/ultrafine particles emitted from combustion sources) to micromet (resuspensed dust).[36] Particulate matter can also be produced through cooking activities. Frying produces higher concentrations than boiling or grilling and cooking meat produces higher concentrations than cooking vegetables.[37] Preparing a Thanksgiving dinner can produce very high concentrations of particulate matter, exceeding 300 $\mu g/m^3$.[38]

Particulates can penetrate deep into the lungs and brain from blood streams, causing health problems such as heart disease, lung disease, cancer and preterm birth.[39]

Generated from building materials, furnishing and consumer products

[edit]
See also: Building materials and Red List building materials

Volatile organic compounds

[edit]

Volatile organic compounds (VOCs) include a variety of chemicals, some of which may have short- and long-term adverse health effects. There are numerous sources of VOCs indoors, which means that their concentrations are consistently higher indoors (up to ten times higher) than outdoors.[40] Some VOCs are emitted directly indoors, and some are formed through the subsequent chemical reactions that can occur in the gas-phase, or on surfaces.[41][42] VOCs presenting health hazards include benzene, formaldehyde, tetrachloroethylene and trichloroethylene.[43]

VOCs are emitted by thousands of indoor products. Examples include: paints, varnishes, waxes and lacquers, paint strippers, cleaning and personal care products, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.[44]

Chlorinated drinking water releases chloroform when hot water is used in the home. Benzene is emitted from fuel stored in attached garages.

Human activities such as cooking and cleaning can also emit VOCs.[45][46] Cooking can release long-chain aldehydes and alkanes when oil is heated and terpenes can be released when spices are prepared and/or cooked.[45] Leaks of natural gas from cooking appliances have been linked to elevated levels of VOCs including benzene in homes in the USA.[47] Cleaning products contain a range of VOCs, including monoterpenes, sesquiterpenes, alcohols and esters. Once released into the air, VOCs can undergo reactions with ozone and hydroxyl radicals to produce other VOCs, such as formaldehyde.[46]

Health effects include eye, nose, and throat irritation; headaches, loss of coordination, nausea; and damage to the liver, kidney, and central nervous system.[48]

Testing emissions from building materials used indoors has become increasingly common for floor coverings, paints, and many other important indoor building materials and finishes.[49] Indoor materials such as gypsum boards or carpet act as VOC 'sinks', by trapping VOC vapors for extended periods of time, and releasing them by outgassing. The VOCs can also undergo transformation at the surface through interaction with ozone.[42] In both cases, these delayed emissions can result in chronic and low-level exposures to VOCs.[50]

Several initiatives aim to reduce indoor air contamination by limiting VOC emissions from products. There are regulations in France and in Germany, and numerous voluntary ecolabels and rating systems containing low VOC emissions criteria such as EMICODE,[51] M1,[52] Blue Angel[53] and Indoor Air Comfort[54] in Europe, as well as California Standard CDPH Section 01350[55] and several others in the US. Due to these initiatives an increasing number of low-emitting products became available to purchase.

At least 18 microbial VOCs (MVOCs) have been characterised[56][57] including 1-octen-3-ol (mushroom alcohol), 3-Methylfuran, 2-pentanol, 2-hexanone, 2-

heptanone, 3-octanone, 3-octanol, 2-octen-1-ol, 1-octene, 2-pentanone, 2-nonanone, borneol, geosmin, 1-butanol, 3-methyl-1-butanol, 3-methyl-2-butanol, and thujopsene. The last four are products of *Stachybotrys chartarum*, which has been linked with sick building syndrome.[56]

Asbestos fibers

[edit]

Many common building materials used before 1975 contain asbestos, such as some floor tiles, ceiling tiles, shingles, fireproofing, heating systems, pipe wrap, taping muds, mastics, and other insulation materials. Normally, significant releases of asbestos fiber do not occur unless the building materials are disturbed, such as by cutting, sanding, drilling, or building remodelling. Removal of asbestos-containing materials is not always optimal because the fibers can be spread into the air during the removal process. A management program for intact asbestos-containing materials is often recommended instead.

When asbestos-containing material is damaged or disintegrates, microscopic fibers are dispersed into the air. Inhalation of asbestos fibers over long exposure times is associated with increased incidence of lung cancer, mesothelioma, and asbestosis. The risk of lung cancer from inhaling asbestos fibers is significantly greater for smokers. The symptoms of disease do not usually appear until about 20 to 30 years after the first exposure to asbestos.

Although all asbestos is hazardous, products that are friable, e.g. sprayed coatings and insulation, pose a significantly higher hazard as they are more likely to release fibers to the air.[58]

Microplastics

[edit]
Main article: Microplastics

See also: Renovation and Particulates

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Microplastic is a type of airborne particulates and is found to prevail in air.[59][60][61][62] A 2017 study found indoor airborne microfiber concentrations between 1.0 and 60.0 microfibers per cubic meter (33% of which were found to be microplastics).[63] Airborne microplastic dust can be produced during renovation, building, bridge and road reconstruction projects[64] and the use of power tools.[65]

Ozone

[edit]
See also: Ground-level ozone

Indoors ozone (O_3) is produced by certain high-voltage electric devices (such as air ionizers), and as a by-product of other types of pollution. It appears in lower concentrations indoors than outdoors, usually at 0.2-0.7 of the outdoor concentration.[66] Typically, most ozone is lost to surface reactions indoors, rather than to reactions in air, due to the large surface to volume ratios found indoors.[67]

Outdoor air used for ventilation may have sufficient ozone to react with common indoor pollutants as well as skin oils and other common indoor air chemicals or surfaces. Particular concern is warranted when using "green" cleaning products based on citrus or terpene extracts, because these chemicals react very quickly with ozone to form toxic and irritating chemicals[46] as well as fine and ultrafine particles.[68] Ventilation with outdoor air containing elevated ozone concentrations may complicate remediation attempts.[69]

The WHO standard for ozone concentration is 60 $\mu g/m^3$ for long-term exposure and 100 $\mu g/m^3$ as the maximum average over an 8-hour period.[29] The EPA standard for ozone concentration is 0.07 ppm average over an 8-hour period.[70]

Biological agents

[edit]

Mold and other allergens

[edit]
Main articles: Indoor mold and Mold health issues

Occupants in buildings can be exposed to fungal spores, cell fragments, or mycotoxins which can arise from a host of means, but there are two common classes: (a) excess moisture induced growth of mold colonies and (b) natural substances released into the air such as animal dander and plant pollen.[71]

While mold growth is associated with high moisture levels,[72] it is likely to grow when a combination of favorable conditions arises. As well as high moisture levels, these conditions include suitable temperatures, pH and nutrient sources.[73] Mold grows primarily on surfaces, and it reproduces by releasing spores, which can travel and settle in different locations. When these spores experience appropriate conditions, they can germinate and lead to mycelium growth.[74] Different mold species favor different environmental conditions to germinate and grow, some being more hydrophilic (growing at higher levels of relative humidity) and other more xerophilic (growing at levels of relative humidity as low as 75–80%).[74][75]

Mold growth can be inhibited by keeping surfaces at conditions that are further from condensation, with relative humidity levels below 75%. This usually translates to a relative humidity of indoor air below 60%, in agreement with the guidelines for thermal comfort that recommend a relative humidity between 40 and 60 %. Moisture buildup in buildings may arise from water penetrating areas of the building envelope or fabric, from plumbing leaks, rainwater or groundwater penetration, or from condensation due to improper ventilation, insufficient heating or poor thermal quality of the building envelope.[76] Even something as simple as drying clothes indoors on radiators can increase the risk of mold growth, if the humidity produced is not able to escape the building via ventilation.[77]

Mold predominantly affects the airways and lungs. Known effects of mold on health include asthma development and exacerbation,[78] with children and elderly at greater risk of more severe health impacts.[79] Infants in homes with mold have a much greater risk of developing asthma and allergic rhinitis.[80][71] More than half of adult workers in moldy or humid buildings suffer from nasal or sinus symptoms due to mold exposure.[71] Some varieties of mold contain toxic compounds (mycotoxins). However, exposure to hazardous levels of mycotoxin via inhalation is not possible in most cases, as toxins are produced by the fungal body and are not at significant levels in the released spores.

Legionella

[edit]

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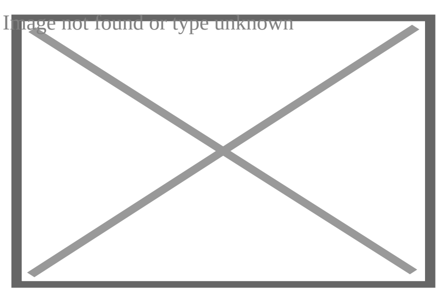
Legionnaires' disease is caused by a waterborne bacterium *Legionella* that grows best in slow-moving or still, warm water. The primary route of exposure is through the creation of an aerosol effect, most commonly from evaporative cooling towers or showerheads. A common source of *Legionella* in commercial buildings is from poorly placed or maintained evaporative cooling towers, which often release water in an aerosol which may enter nearby ventilation intakes. Outbreaks in medical facilities and nursing homes, where patients are immuno-suppressed and immuno-weak, are the most commonly reported cases of Legionellosis. More than one case has involved outdoor fountains at public attractions. The presence of *Legionella* in commercial building water supplies is highly under-reported, as healthy people require heavy exposure to acquire infection.

Legionella testing typically involves collecting water samples and surface swabs from evaporative cooling basins, shower heads, faucets/taps, and other locations where warm water collects. The samples are then cultured and colony forming units (cfu) of Legionella are quantified as cfu/liter.

Legionella is a parasite of protozoans such as amoeba, and thus requires conditions suitable for both organisms. The bacterium forms a biofilm which is resistant to chemical and antimicrobial treatments, including chlorine. Remediation for *Legionella* outbreaks in commercial buildings vary, but often include very hot water flushes (160 °F (71 °C)), sterilisation of standing water in evaporative cooling basins, replacement of shower heads, and, in some cases, flushes of heavy metal salts. Preventive measures include adjusting normal hot water levels to allow for 120 °F (49 °C) at the tap, evaluating facility design layout, removing faucet aerators, and periodic testing in suspect areas.

Other bacteria

[edit]



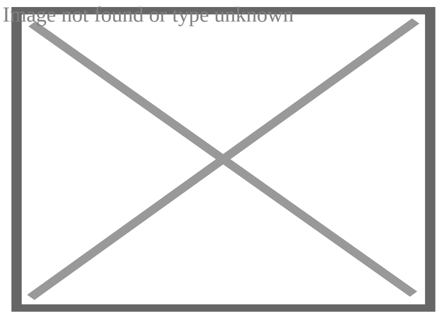
Airborne bacteria

There are many bacteria of health significance found in indoor air and on indoor surfaces. The role of microbes in the indoor environment is increasingly studied using modern gene-based analysis of environmental samples. Currently, efforts are under way to link microbial ecologists and indoor air scientists to forge new methods for analysis and to better interpret the results.[81]

A large fraction of the bacteria found in indoor air and dust are shed from humans. Among the most important bacteria known to occur in indoor air are Mycobacterium tuberculosis, Staphylococcus aureus, Streptococcus pneumoniae.[*citation n*

Virus

[edit]



Ninth floor layout of the Metropole Hotel in Hong Kong, showing where an outbreak of the severe acute respiratory syndrome (SARS) occurred

Viruses can also be a concern for indoor air quality. During the 2002–2004 SARS outbreak, virus-laden aerosols were found to have seeped into bathrooms from the bathroom floor drains, exacerbated by the draw of bathroom exhaust fans, resulting in the rapid spread of SARS in Amoy Gardens in Hong Kong.[82][83] Elsewhere in Hong Kong, SARS CoV RNA was found on the carpet and in the air intake vents of the Metropole Hotel, which showed that secondary environmental contamination could generate infectious aerosols and resulted in superspreading events.[84]

Carbon dioxide

[edit]

Humans are the main indoor source of carbon dioxide (CO_2) in most buildings. Indoor CO_2 levels are an indicator of the adequacy of outdoor air ventilation relative to indoor occupant density and metabolic activity.

Indoor CO_2 levels above 500 ppm can lead to higher blood pressure and heart rate, and increased peripheral blood circulation.[85] With CO_2 concentrations above 1000 ppm cognitive performance might be affected, especially when doing complex tasks, making decision making and problem solving slower but not less accurate.[86][87] However, evidence on the health effects of CO_2 at lower concentrations is conflicting and it is difficult to link CO_2 to health impacts at exposures below 5000 ppm – reported health outcomes may be due to the presence of human bioeffluents, and other indoor air pollutants related to inadequate ventilation.[88]

Indoor carbon dioxide concentrations can be used to evaluate the quality of a room or a building's ventilation.[89] To eliminate most complaints caused by CO_2, the total indoor CO_2 level should be reduced to a difference of no greater than 700 ppm above outdoor levels.[90] The National Institute for Occupational Safety and Health (NIOSH) considers that indoor air concentrations of carbon dioxide that exceed 1000 ppm are a marker suggesting inadequate ventilation.[91] The UK standards for schools say that carbon dioxide levels of 800 ppm or lower indicate that the room is well-ventilated.[92] Regulations and standards from around the world show that CO_2 levels below 1000 ppm represent good IAQ, between 1000 and 1500 ppm represent moderate IAQ and greater than 1500 ppm represent poor IAQ.[88]

Carbon dioxide concentrations in closed or confined rooms can increase to 1,000 ppm within 45 minutes of enclosure. For example, in a 3.5-by-4-metre (11 ft × 13 ft) sized office, atmospheric carbon dioxide increased from 500 ppm to over 1,000 ppm within 45 minutes of ventilation cessation and closure of windows and doors.[93]

Radon

[edit]

Main article: Radon

Radon is an invisible, radioactive atomic gas that results from the radioactive decay of radium, which may be found in rock formations beneath buildings or in certain building materials themselves.

Radon is probably the most pervasive serious hazard for indoor air in the United States and Europe. It is a major cause of lung cancer, responsible for 3–14% of cases in countries, leading to tens of thousands of deaths.[94]

Radon gas enters buildings as a soil gas. As it is a heavy gas it will tend to accumulate at the lowest level. Radon may also be introduced into a building through drinking water particularly from bathroom showers. Building materials can be a rare source of radon, but little testing is carried out for stone, rock or tile products brought into building sites; radon accumulation is greatest for well insulated homes.[95] There are simple do-it-yourself kits for radon gas testing, but a licensed professional can also check homes.

The half-life for radon is 3.8 days, indicating that once the source is removed, the hazard will be greatly reduced within a few weeks. Radon mitigation methods include sealing concrete slab floors, basement foundations, water drainage systems, or by increasing ventilation.[96] They are usually cost effective and can greatly reduce or even eliminate the contamination and the associated health risks.[*citation needed*

Radon is measured in picocuries per liter of air (pCi/L) or becquerel per cubic meter (Bq m^{-3}). Both are measurements of radioactivity. The World Health Organization (WHO) sets the ideal indoor radon levels at 100 Bq/m–^{3}.[97] In the United States, it is recommend to fix homes with radon levels at or above 4 pCi/L. At the same time it is also recommends that people think about fixing their homes for radon levels between 2 pCi/L and 4 pCi/L.[98] In the United Kingdom the ideal is presence of radon indoors is 100 Bq/m–^{3}. Action needs to be taken in homes with 200 Bq/m^{-3} or more.[99]

Interactive maps of radon affected areas are available for various regions and countries of the world.[100][101][102]

IAQ and climate change

[edit]
See also: Effects of climate change on human health

Indoor air quality is linked inextricably to outdoor air quality. The Intergovernmental Panel on Climate Change (IPCC) has varying scenarios that predict how the climate will change in the future.[103] Climate change can affect indoor air quality by increasing the level of outdoor air pollutants such as ozone and particulate matter, for example through emissions from wildfires caused by extreme heat and drought.[104][105] Numerous predictions for how indoor air pollutants will change have been made,[106][107][108][109] and models have attempted to predict how the forecasted IPCC scenarios will vary indoor air quality and indoor comfort parameters such as humidity and temperature.[110]

The net-zero challenge requires significant changes in the performance of both new and retrofitted buildings. However, increased energy efficient housing will trap pollutants inside, whether produced indoors or outdoors, and lead to an increase in human exposure.[111][112]

Indoor air quality standards and monitoring

[edit]

Quality guidelines and standards

[edit]

For occupational exposure, there are standards, which cover a wide range of chemicals, and applied to healthy adults who are exposed over time at workplaces (usually industrial environments).These are published by organisations such as Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), the UK Health and Safety Executive (HSE).

There is no consensus globally about indoor air quality standards, or health-based guidelines. However, there are regulations from some individual countries and from health organisations. For example, the World Health Organization (WHO) has published health-based global air quality guidelines for the general population that are applicable both to outdoor and indoor air,[29] as well as the WHO IAQ guidelines for selected compounds,[113] whereas the UK Health Security Agency published IAQ guidelines for selected VOCs.[114] The Scientific and Technical Committee (STC34) of the International Society of Indoor Air Quality and Climate (ISIAQ) created an open database that collects indoor environmental quality guidelines worldwide.[115] The database is focused on indoor air quality (IAQ), but is currently extended to include standards, regulations, and guidelines related to ventilation, comfort, acoustics, and lighting.[116][117]

Real-time monitoring

[edit]

Since indoor air pollutants can adversely affect human health, it is important to have real-time indoor air quality assessment/monitoring system that can help not only in the improvement of indoor air quality but also help in detection of leaks, spills in a work environment and boost energy efficiency of buildings by providing real-time feedback to the heating, ventilation, and air conditioning (HVAC) system(s).[118] Additionally, there have been enough studies that highlight the correlation between poor indoor air quality and loss of performance and productivity of workers in an office setting.[119]

Combining the Internet of Things (IoT) technology with real-time IAQ monitoring systems has tremendously gained momentum and popularity as interventions can be done based on the real-time sensor data and thus help in the IAQ improvement.[120]

Improvement measures

[edit]

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See also: Air purifier, Air conditioner, Air filter, Cleanroom, Particulates § Controlling technologies and measures, Pollution control, and Ventilation (architecture)

Further information: Fan (machine), Dehumidifier, and Heater

Indoor air quality can be addressed, achieved or maintained during the design of new buildings or as mitigating measures in existing buildings. A hierarchy of measures has been proposed by the Institute of Air Quality Management. It emphasises removing pollutant sources, reducing emissions from any remaining sources, disrupting pathways between sources and the people exposed, protecting people from exposure to pollutants, and removing people from areas with poor air quality.[121]

A report assisted by the Institute for Occupational Safety and Health of the German Social Accident Insurance can support in the systematic investigation of individual health problems arising at indoor workplaces, and in the identification of practical solutions.[122]

Source control

[edit]

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HVAC design

[edit]

Main articles: HVAC, Air handler, and Ventilation (architecture)

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Environmentally sustainable design concepts include aspects of commercial and residential heating, ventilation and air-conditioning (HVAC) technologies. Among several considerations, one of the topics attended to is the issue of indoor air quality throughout the design and construction stages of a building's life.[*citation needed*]

One technique to reduce energy consumption while maintaining adequate air quality, is demand-controlled ventilation. Instead of setting throughput at a fixed air replacement rate, carbon dioxide sensors are used to control the rate dynamically, based on the emissions of actual building occupants.[*citation needed*]

One way of quantitatively ensuring the health of indoor air is by the frequency of effective turnover of interior air by replacement with outside air. In the UK, for example, classrooms are required to have 2.5 outdoor air changes per hour. In halls, gym, dining, and physiotherapy spaces, the ventilation should be sufficient to limit carbon dioxide to 1,500 ppm. In the US, ventilation in classrooms is based on the amount of outdoor air per occupant plus the amount of outdoor air per unit of floor area, not air changes per hour. Since carbon dioxide indoors comes from occupants and outdoor air, the adequacy of ventilation per occupant is indicated by the concentration indoors minus the concentration outdoors. The value of 615 ppm above the outdoor concentration indicates approximately 15 cubic feet per minute of outdoor air per adult occupant doing sedentary office work where outdoor air contains over 400 ppm[[123]] (global average as of 2023). In classrooms, the requirements in the ASHRAE standard 62.1, Ventilation for Acceptable Indoor Air Quality, would typically result in about 3 air changes per hour, depending on the occupant density. As the occupants are not the only source of pollutants, outdoor air ventilation may need to be higher when unusual or strong sources of pollution exist indoors.

When outdoor air is polluted, bringing in more outdoor air can actually worsen the overall quality of the indoor air and exacerbate some occupant symptoms related to outdoor air pollution. Generally, outdoor country air is better than indoor city air.[*citation*

The use of air filters can trap some of the air pollutants. Portable room air cleaners with HEPA filters can be used if ventilation is poor or outside air has high level of PM 2.5.[122] Air filters are used to reduce the amount of dust that reaches the wet coils.[citation needed] Dust can serve as food to grow molds on the wet coils and ducts and can reduce the efficiency of the coils.[citation needed]

The use of trickle vents on windows is also valuable to maintain constant ventilation. They can help prevent mold and allergen build up in the home or workplace. They can also reduce the spread of some respiratory infections.[124]

Moisture management and humidity control requires operating HVAC systems as designed. Moisture management and humidity control may conflict with efforts to conserve energy. For example, moisture management and humidity control requires systems to be set to supply make-up air at lower temperatures (design levels), instead of the higher temperatures sometimes used to conserve energy in cooling-dominated climate conditions. However, for most of the US and many parts of Europe and Japan, during the majority of hours of the year, outdoor air temperatures are cool enough that the air does not need further cooling to provide thermal comfort indoors.[citation needed] However, high humidity outdoors creates the need for careful attention to humidity levels indoors. High humidity give rise to mold growth and moisture indoors is associated with a higher prevalence of occupant respiratory problems.[citation needed]

The "dew point temperature" is an absolute measure of the moisture in air. Some facilities are being designed with dew points in the lower 50s °F, and some in the upper and lower 40s °F.[citation needed] Some facilities are being designed using desiccant wheels with gas-fired heaters to dry out the wheel enough to get the required dew points.[citation needed] On those systems, after the moisture is removed from the make-up air, a cooling coil is used to lower the temperature to the desired level.[citation needed]

Commercial buildings, and sometimes residential, are often kept under slightly positive air pressure relative to the outdoors to reduce infiltration. Limiting infiltration helps with moisture management and humidity control.

Dilution of indoor pollutants with outdoor air is effective to the extent that outdoor air is free of harmful pollutants. Ozone in outdoor air occurs indoors at reduced concentrations because ozone is highly reactive with many chemicals found indoors. The products of the reactions between ozone and many common indoor pollutants include organic compounds that may be more odorous, irritating, or toxic than those from which they are formed. These products of ozone chemistry include formaldehyde, higher molecular weight aldehydes, acidic aerosols, and fine and ultrafine particles, among others. The higher the outdoor ventilation rate, the higher the indoor ozone concentration and the more likely the reactions will occur, but even at low levels, the reactions will take place. This suggests that ozone should be removed from ventilation air, especially in areas where outdoor ozone levels are frequently high.

Effect of indoor plants

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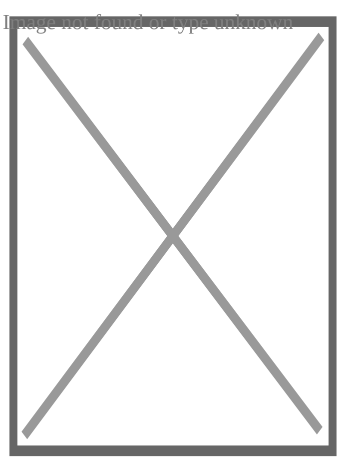

Spider plants *(Chlorophytum comosum)* absorb some airborne contaminants.

Houseplants together with the medium in which they are grown can reduce components of indoor air pollution, particularly volatile organic compounds (VOC) such as benzene, toluene, and xylene. Plants remove CO_2 and release oxygen and water, although the quantitative impact for house plants is small. The interest in using potted plants for removing VOCs was sparked by a 1989 NASA study conducted in sealed chambers designed to replicate the environment on space stations. However, these results suffered from poor replication[125] and are not applicable to typical buildings, where outdoor-to-indoor air exchange already removes VOCs at a rate that could only be matched by the placement of 10–1000 plants/m^2 of a building's floor space.[126]

Plants also appear to reduce airborne microbes and molds, and to increase humidity.[127] However, the increased humidity can itself lead to increased levels of mold and even VOCs.[128]

Since extremely high humidity is associated with increased mold growth, allergic responses, and respiratory responses, the presence of additional moisture from houseplants may not be desirable in all indoor settings if watering is done inappropriately.[129]

Institutional programs

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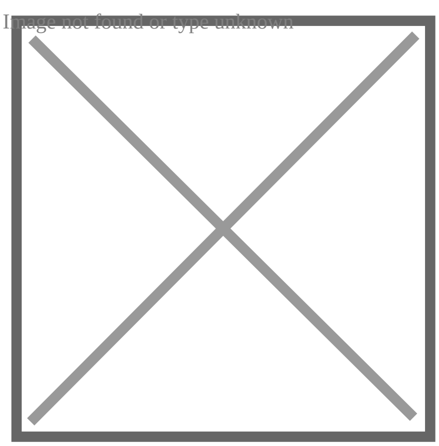

EPA graphic about asthma triggers

The topic of IAQ has become popular due to the greater awareness of health problems caused by mold and triggers to asthma and allergies.

In the US, the Environmental Protection Agency (EPA) has developed an "IAQ Tools for Schools" program to help improve the indoor environmental conditions in educational institutions. The National Institute for Occupational Safety and Health conducts Health Hazard Evaluations (HHEs) in workplaces at the request of employees, authorized representative of employees, or employers, to determine whether any substance normally found in the place of employment has potentially toxic effects, including indoor air quality.[130]

A variety of scientists work in the field of indoor air quality, including chemists, physicists, mechanical engineers, biologists, bacteriologists, epidemiologists, and computer scientists. Some of these professionals are certified by organizations such as the American Industrial Hygiene Association, the American Indoor Air Quality Council and the Indoor Environmental Air Quality Council.

In the UK, under the Department for Environment Food and Rural Affairs, the Air Quality Expert Group considers current knowledge on indoor air quality and provides advice to government and devolved administration ministers.[131]

At the international level, the International Society of Indoor Air Quality and Climate (ISIAQ), formed in 1991, organizes two major conferences, the Indoor Air and the Healthy Buildings series.[132]

See also

[edit]

- Environmental management
- Healthy building
- Indoor bioaerosol
- Microbiomes of the built environment
- Olfactory fatigue

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guest rooms but in the common areas of the ninth floor, such as the corridor or elevator hall. These areas could have been contaminated through body fluids (e.g., vomitus, expectorated sputum), respiratory droplets, or suspended small-particle aerosols generated by the index case-patient; other guests were then infected by fomites or aerosols while passing through these same areas. Efficient spread of SARS CoV through small-particle aerosols was observed in several superspreading events in health care settings, during an airplane flight, and in an apartment complex (12–14,16–19). This process of environmental contamination that generated infectious aerosols likely best explains the pattern of disease transmission at the Hotel Metropole."

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External links

[edit]

- US Environmental Protection Agency info on IAQ
- Best Practices for Indoor Air Quality when Remodeling Your Home, US EPA
- Addressing Indoor Environmental Concerns During Remodeling, US EPA
- Renovation and Repair, Part of Indoor Air Quality Design Tools for Schools, US EPA
- The 9 Foundations of a Healthy Building, Harvard T.H. Chan School of Public Health

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Pollution

History

Air

- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
  - Biofuel
  - Biomass
  - Joss paper
  - Open burning of waste
- Construction
  - Renovation
- Demolition
- Exhaust gas
  - Diesel exhaust
- Haze
  - Smoke
- Indoor air quality
- Internal combustion engine
- Global dimming
- Global distillation
- Mining
- Ozone depletion
- Particulates
  - Asbestos
  - Metal working
  - Oil refining
  - Wood dust
  - Welding
- Persistent organic pollutant
- Smelting
- Smog
- Soot
  - Black carbon
- Volatile organic compound
- Waste

Biological

- Biological hazard
- Genetic pollution
- Introduced species
    - Invasive species

Digital

- Information pollution

Electromagnetic

- Light
    - Ecological light pollution
    - Overillumination
- Radio spectrum pollution

Natural

- Ozone
- Radium and radon in the environment
- Volcanic ash
- Wildfire

Noise

- Transportation
    - Land
    - Water
    - Air
    - Rail
    - Sustainable transport
- Urban
- Sonar
    - Marine mammals and sonar
- Industrial
- Military
- Abstract
- Noise control

Radiation	◦ Actinides ◦ Bioremediation ◦ Nuclear fission ◦ Nuclear fallout ◦ Plutonium ◦ Poisoning ◦ Radioactivity ◦ Uranium ◦ Electromagnetic radiation and health ◦ Radioactive waste

Soil	◦ Agricultural pollution
	    ◦ Herbicides
	    ◦ Manure waste
	    ◦ Pesticides
	◦ Land degradation
	◦ Bioremediation
	◦ Open defecation
	◦ Electrical resistance heating
	◦ Soil guideline values
	◦ Phytoremediation

Solid waste	◦ Advertising mail
	◦ Biodegradable waste
	◦ Brown waste
	◦ Electronic waste
	    ◦ Battery recycling
	◦ Foam food container
	◦ Food waste
	◦ Green waste
	◦ Hazardous waste
	    ◦ Biomedical waste
	    ◦ Chemical waste
	    ◦ Construction waste
	    ◦ Lead poisoning
	    ◦ Mercury poisoning
	    ◦ Toxic waste
	◦ Industrial waste
	    ◦ Lead smelting
	◦ Litter
	◦ Mining
	    ◦ Coal mining
	    ◦ Gold mining
	    ◦ Surface mining
	    ◦ Deep sea mining
	    ◦ Mining waste
	    ◦ Uranium mining
	◦ Municipal solid waste
	    ◦ Garbage
	◦ Nanomaterials
	◦ Plastic pollution
	    ◦ Microplastics
	◦ Packaging waste
	◦ Post-consumer waste
	◦ Waste management
	    ◦ Landfill
	    ◦ Thermal treatment

Space	◦ Satellite ◦ Air travel
Visual	◦ Clutter (advertising) ◦ Traffic signs ◦ Overhead power lines ◦ Vandalism
War	◦ Chemical warfare ◦ Herbicidal warfare (Agent Orange) ◦ Nuclear holocaust (Nuclear fallout – nuclear famine – nuclear winter) ◦ Scorched earth ◦ Unexploded ordnance ◦ War and environmental law

Water	◦ Agricultural wastewater
	◦ Biological pollution
	◦ Diseases
	◦ Eutrophication
	◦ Firewater
	◦ Freshwater
	◦ Groundwater
	◦ Hypoxia
	◦ Industrial wastewater
	◦ Marine
	    ◦ debris
	◦ Monitoring
	◦ Nonpoint source pollution
	◦ Nutrient pollution
	◦ Ocean acidification
	◦ Oil exploitation
	◦ Oil exploration
	◦ Oil spill
	◦ Pharmaceuticals
	◦ Sewage
	    ◦ Septic tanks
	    ◦ Pit latrine
	◦ Shipping
	◦ Stagnation
	◦ Sulfur water
	◦ Surface runoff
	◦ Thermal
	◦ Turbidity
	◦ Urban runoff
	◦ Water quality

Topics	◦ Pollutants ◦ Heavy metals ◦ Paint ◦ Brain health and pollution
Misc	◦ Area source ◦ Debris ◦ Dust ◦ Garbology ◦ Legacy pollution ◦ Midden ◦ Point source ◦ Waste
Responses	◦ Cleaner production ◦ Industrial ecology ◦ Pollution haven hypothesis ◦ Pollutant release and transfer register ◦ Polluter pays principle ◦ Pollution control ◦ Waste minimisation ◦ Zero waste
Lists	◦ Diseases ◦ Law by country ◦ Most polluted cities ◦ Least polluted cities by $PM_{2.5}$ ◦ Most polluted countries ◦ Most polluted rivers ◦ Treaties

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Natural resources

Air

- Pollution / quality
  - Ambient standards (US)
  - Index
  - Indoor
  - Law
    - Clean Air Act (US)
  - Ozone depletion
- Emissions
  - Airshed
  - Trading
  - Deforestation (REDD)

Energy

- Bio
- Law
- Resources
- Fossil fuels (gas, peak coal, peak gas, peak oil)
- Geothermal
- Hydro
- Nuclear
- Solar
  - sunlight
  - shade
- Wind

Land

- Agricultural
  - arable
    - peak farmland
- Degradation
- Field
- Landscape
  - cityscape
  - seascape
  - soundscape
  - viewshed
- Law
  - property
- Management
  - habitat conservation
- Minerals
  - gemstone
  - industrial
  - ore
    - metal
  - mining
    - law
    - sand
  - peak
    - copper
    - phosphorus
  - rights
- Soil
  - conservation
  - fertility
  - health
  - resilience
- Use
  - planning
  - reserve

Life

- Biodiversity
- Bioprospecting
  - biopiracy
- Biosphere
- Bushfood
- Bushmeat
- Fisheries
  - climate change
  - law
  - management
- Forests
  - genetic resources
  - law
  - management
  - non-timber products
- Game
  - law
- Marine conservation
- Meadow
- Pasture
- Plants
  - FAO Plant Treaty
  - food
  - genetic resources
  - gene banks
  - herbal medicines
  - UPOV Convention
  - wood
- Rangeland
- Seed bank
- Wildlife
  - conservation
  - management

Water	Types / location	○ Aquifer
		  ○ storage and recovery
		○ Drinking
		○ Fresh
		○ Groundwater
		  ○ pollution
		  ○ recharge
		  ○ remediation
		○ Hydrosphere
		○ Ice
		  ○ bergs
		  ○ glacial
		  ○ polar
		○ Irrigation
		  ○ *huerta*
		○ Marine
		○ Rain
		  ○ harvesting
		○ Stormwater
		○ Surface water
		○ Sewage
		  ○ reclaimed water
		○ Watershed

	Aspects	○ Desalination ○ Floods ○ Law ○ Leaching ○ Sanitation ○ improved ○ Scarcity ○ Security ○ Supply ○ Efficiency ○ Conflict ○ Conservation

Related

- Commons
  - enclosure
  - global
  - land
  - tragedy of
- Economics
  - ecological
  - land
- Ecosystem services
- Exploitation
  - overexploitation
  - Earth Overshoot Day
- Management
  - adaptive
- Natural capital
  - accounting
  - good
- Natural heritage
- Nature reserve
  - remnant natural area
- Systems ecology
- Urban ecology
- Wilderness

Resource

- Common-pool
- Conflict (perpetuation)
- Curse
- Depletion
- Extraction
- Nationalism
- Renewable / Non-renewable

Politics

- Oil war
- Petrostate
- Resource war

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Occupational safety and health

Occupational diseases and injuries

- Acrodynia
- Asbestosis
- Asthma
- Barotrauma
- Berylliosis
- Brucellosis
- Burnout
- Byssinosis ("brown lung")
- Cardiovascular
- Chalicosis
- Chronic solvent-induced encephalopathy
- Chronic stress
- Chimney sweeps' carcinoma
- Coalworker's pneumoconiosis ("black lung")
- Concussions in sport
- Decompression sickness
- De Quervain syndrome
- Erethism
- Exposure to human nail dust
- Farmer's lung
- Fiddler's neck
- Flock worker's lung
- Glassblower's cataract
- Golfer's elbow
- Hearing loss
- Hospital-acquired infection
- Indium lung
- Laboratory animal allergy
- Lead poisoning
- Low back pain
- Mesothelioma
- Metal fume fever
- Mule spinners' cancer
- Noise-induced hearing loss
- Phossy jaw
- Pneumoconiosis

- Occupational hazard
  - Biological hazard
  - Chemical hazard
  - Physical hazard
  - Psychosocial hazard

Occupational hygiene

- Occupational stress
- Hierarchy of hazard controls
- Prevention through design
- Exposure assessment
- Occupational exposure limit
- Occupational epidemiology
- Workplace health surveillance
- Environmental health
- Industrial engineering

Professions

- Occupational health nursing
- Occupational health psychology
- Occupational medicine
- Occupational therapist
- Safety engineering

Agencies and organizations	International	◦ European Agency for Safety and Health at Work ◦ International Labour Organization ◦ World Health Organization
	National	◦ Canadian Centre for Occupational Health and Safety (Canada) ◦ Istituto nazionale per l'assicurazione contro gli infortuni sul lavoro (Italy) ◦ National Institute for Safety and Health at Work (Spain) ◦ Health and Safety Executive (UK) ◦ Occupational Safety and Health Administration ◦ National Institute for Occupational Safety and Health (US)
Standards	◦ Bangladesh Accord ◦ OHSAS 18001 ◦ ISO 45001 ◦ Occupational Safety and Health Convention, 1981 ◦ Worker Protection Standard (US) ◦ Working Environment Convention, 1977	

Safety	◦ Checklist
	◦ Code of practice
	◦ Contingency plan
	◦ Diving safety
	◦ Emergency procedure
	◦ Emergency evacuation
	◦ Hazard
	◦ Hierarchy of hazard controls
	    ◦ Hazard elimination
	    ◦ Administrative controls
	    ◦ Engineering controls
	    ◦ Hazard substitution
	    ◦ Personal protective equipment
	◦ Job safety analysis
	◦ Lockout-tagout
	◦ Permit To Work
	◦ Operations manual
	◦ Redundancy (engineering)
	◦ Risk assessment
	◦ Safety culture
	◦ Standard operating procedure

Legislation	◦ Immediately dangerous to life or health ◦ Diving regulations ◦ Occupational Safety and Health Act (United States) ◦ Potty parity (United States) ◦ Right to sit (United States) ◦ Workers' right to access the toilet

See also

- Aerosol
- Break
- Break room
- Drug policy
- Effects of overtime
- Environment, health and safety
- Environmental toxicology
- Ergonomics
- Fire Fighter Fatality Investigation and Prevention Program
- Hawks Nest Tunnel disaster
- Health physics
- Hostile work environment
- Indoor air quality
- International Chemical Safety Card
- Job strain
- National Day of Mourning (Canada)
- NIOSH air filtration rating
- Overwork
- Process safety
- Public health
- Quality of working life
- Risk management
- Safety data sheet
- Source control
- Toxic tort
- Toxic workplace
- Workers' compensation
- Workplace hazard controls for COVID-19
- Workplace health promotion

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    - Occupational diseases
    - Journals
    - Organizations
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Heating, ventilation, and air conditioning

Fundamental concepts	◦ Air changes per hour ◦ 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

- 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

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:Home automation
- Template:Solar energy

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About Durham Supply Inc

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Things To Do in Tulsa County

Photo

Gathering Place

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Photo

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Philbrook Museum of Art

4.8 (3790)

Photo

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The Cave House

4.6 (249)

Photo

The Tulsa Arts District

4.7 (22)

Photo

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Golden Driller Statue

4.6 (1935)

Photo

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Guthrie Green

4.7 (3055)

Driving Directions in Tulsa County

Driving Directions From Oakwood Homes to Durham Supply Inc

Driving Directions From Best Western Airport to Durham Supply Inc

Driving Directions From Subway to Durham Supply Inc

Driving Directions From Tuff Shed Tulsa to Durham Supply Inc

Driving Directions From Tulsa to Durham Supply Inc

Driving Directions From Reception Jehovah's Witnesses to Durham Supply Inc

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Driving Directions From The Outsiders House Museum to Durham Supply Inc

Driving Directions From The Tulsa Arts District to Durham Supply Inc

Driving Directions From Tulsa Botanic Garden to Durham Supply Inc

Driving Directions From Tulsa Zoo to Durham Supply Inc

Driving Directions From The Blue Dome to Durham Supply Inc

Driving Directions From Tulsa Botanic Garden to Durham Supply Inc

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Reviews for Durham Supply Inc

Durham Supply Inc

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Gerald Clifford Brewster

(5)

We will see, the storm door I bought says on the tag it's 36x80, but it's 34x80. If they return it.......they had no problems returning it. And it was no fault of there's, you measure a mobile home door different than a standard door!

Durham Supply Inc

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Ty Spears

(5)

Bought a door/storm door combo. Turns out it was the wrong size. They swapped it out, quick and easy no problems. Very helpful in explaining the size differences from standard door sizes.

Durham Supply Inc

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B Mann

(5)

I was in need of some items for a double wide that I am remodeling and this place is the only place in town that had what I needed (I didn't even try the other rude place)while I was there I learned the other place that was in Tulsa that also sold mobile home supplies went out of business (no wonder the last time I was in there they were VERY RUDE and high priced) I like the way Dunham does business they answered all my questions and got me the supplies I needed, very friendly, I will be back to purchase the rest of my items when the time comes.

Durham Supply Inc

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Dennis Champion

(5)

Durham supply and Royal supply seems to find the most helpful and friendly people to work in their stores, we are based out of Kansas City out here for a few remodels and these guys treated us like we've gone there for years.

Evaluating Wind Exposure Factors for Mobile Home AC Placement**View GBP**

Check our other pages :

- **Checking Insurance Coverage for Storm Damaged Mobile Home AC Units**
- **Addressing Mold Risks in Mobile Home Ductwork**
- **Checking Air Pressure to Reduce Allergens in Mobile Home Interiors**
- **Balancing Heat Needs in Mobile Homes Across Different Regions**

Royal Supply Inc

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Google Business Profile

Company Website : **https://royal-durhamsupply.com/locations/oklahoma-city-oklahoma/**

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