Retrofit HVAC

- **Reviewing Key Safety Measures for Mobile Home HVAC Work**
  Reviewing Key Safety Measures for Mobile Home HVAC Work Understanding PPE Guidelines for Mobile Home Furnace Repair Following OSHA Standards During Mobile Home AC Installations Noting Electrical Hazard Precautions in Mobile Home HVAC Projects Planning Lockout Procedures for Mobile Home Heating Maintenance Checking for Proper Ventilation in Mobile Home HVAC Crawl Spaces Confirming Compliance with HUD Requirements for Mobile Home Ducts Conducting On Site Safety Assessments Before Mobile Home AC Repairs Checking Gas Line Integrity in Mobile Home Heating Systems Identifying Combustion Clearance Issues in Mobile Home Furnaces Monitoring Air Quality Factors During Mobile Home HVAC Upkeep Coordinating Exit Strategies for Emergencies in Mobile Home HVAC Work
- **Identifying Warning Signs of Outdated Components**
  Identifying Warning Signs of Outdated Components Converting Older Units to High Efficiency Models Examining Duct Layout for Better Distribution Adjusting Equipment Size to Fit Modern Needs Evaluating Newer Options to Replace Electric Heaters Implementing Airflow Balancing Techniques Overcoming Physical Constraints in Legacy Structures Transitioning to Improved Refrigerants for Compliance Strengthening Insulation to Enhance Performance Matching Compatibility of Controls and Existing Wiring Coordinating Expert Consultations for Complex Projects Planning Timelines for Effective System Upgrades
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Importance of Safety in Mobile Home HVAC Work

Ductwork in mobile homes plays a critical role in ensuring efficient heating and cooling, contributing to the overall comfort and energy efficiency of these residences. Unlike traditional homes, mobile homes have unique construction features, which necessitate specialized approaches to ductwork installation and maintenance. To ensure safety and performance standards are met, compliance with the U.S. Department of Housing and Urban Development (HUD) requirements is essential.

At the heart of any mobile home's heating and cooling system lies its ductwork, a network of conduits responsible for distributing air throughout the dwelling. These ducts are typically made from lightweight materials like flexible aluminum or fiberglass due to space constraints within the home structure. The design must accommodate the compact framework of mobile homes, often leading to creative routing solutions that maximize space efficiency without compromising airflow.

Ductwork in mobile homes is often smaller and requires precise installation **mobile home hvac ductwork** energy.

Compliance with HUD requirements ensures that ductwork systems in mobile homes meet specific standards critical for safety and functionality. HUD's Manufactured Home Construction and Safety Standards mandate guidelines for various components of manufactured housing, including HVAC systems and their associated ductwork. These regulations cover aspects such as material quality, insulation properties, proper sealing techniques, and adequate support structures to prevent sagging or damage over time.

Confirming compliance with these standards begins at the installation phase. Ducts must be correctly sized to provide sufficient air distribution while minimizing energy loss. Proper sealing is crucial; leaks can lead to significant energy inefficiency by allowing conditioned air to escape before reaching designated areas within the home. Insulation also plays a pivotal role in maintaining energy efficiency by reducing thermal loss through duct walls.

Regular inspection and maintenance further ensure ongoing compliance with HUD standards. Over time, ducts can accumulate dust and debris or suffer from physical damage which could impede performance or lead to health concerns related to indoor air quality. Routine checks help identify potential issues early on, allowing homeowners or professionals to address them promptly.

Moreover, adherence to HUD requirements offers peace of mind regarding safety considerations-crucially important in environments where malfunctioning systems may pose fire hazards due to heat buildup or faulty electrical connections within confined spaces typical of mobile home designs.

In conclusion, understanding the intricacies of ductwork in mobile homes coupled with strict adherence to HUD standards is vital for achieving optimal performance from HVAC systems while ensuring resident safety. Through careful planning during installation, regular maintenance checks, and vigilant attention towards compliance protocols, homeowners can enjoy comfortable living conditions alongside enhanced energy efficiency-a perfect blend that underscores the importance of rigorous construction norms in manufactured housing sectors.

Common Hazards Associated with Mobile Home HVAC Systems —

Ensuring that mobile home duct systems comply with the standards set by the U.S. Department of Housing and Urban Development (HUD) is crucial for both safety and efficiency. HUD, which governs the construction and design of manufactured homes, has established a comprehensive set of compliance standards to ensure that these living spaces are safe, energy-efficient, and comfortable for occupants.

One of the key aspects HUD focuses on is the quality and integrity of ductwork in manufactured homes. The duct system is essential for distributing heating and cooling throughout a home. Poorly designed or installed ducts can lead to significant energy losses, uneven temperature distribution, and even pose health risks due to poor air quality.

Firstly, HUD requires that all duct systems in mobile homes be constructed using materials that meet specific durability and thermal resistance standards. These materials must withstand varying temperatures without degrading over time. This requirement ensures that the ducts can maintain their integrity under different environmental conditions.

Moreover, HUD mandates strict protocols for sealing duct joints. Proper sealing prevents air leaks that can reduce efficiency by allowing conditioned air to escape before it reaches its intended destination. Leaks not only waste energy but also increase utility costs for homeowners. By adhering to HUD's sealing requirements, manufacturers help ensure that mobile homes remain energy-efficient.

Additionally, HUD specifies installation criteria for duct systems in manufactured homes. Ducts must be properly sized and configured to accommodate the home's unique layout. Improper sizing or configuration can result in insufficient airflow or excessive noise levels within the home.

HUD also emphasizes regular inspection and maintenance as part of its compliance standards. Regular inspections help identify potential issues such as blockages or damage caused by pests or other environmental factors. Early detection allows for timely repairs, ensuring that the duct system continues to function efficiently.

Furthermore, proper insulation plays a vital role in confirming compliance with HUD requirements for mobile home ducts. Adequate insulation minimizes heat gain or loss during air transportation through ducts, enhancing overall HVAC system performance while maintaining comfortable indoor temperatures.

In conclusion, confirming compliance with HUD requirements for mobile home ducts involves meeting rigorous standards related to material quality, joint sealing practices, installation techniques, regular maintenance checks-and ensuring effective insulation measures are taken into account during design phases too! By following these guidelines closely-and keeping abreast developments within industry best practices-manufacturers will contribute towards creating safer environments where residents enjoy improved comfort levels alongside reduced operating costs thanks largely due efficient use resources available them today!

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Essential Safety Gear and Equipment for Technicians

Meeting the U.S. Department of Housing and Urban Development (HUD) requirements for mobile home ducts can be a complex task, given the specific standards set to ensure safety, efficiency, and comfort in manufactured homes. These regulations are crucial as they impact both the energy efficiency and air quality within mobile homes. However, several common issues and challenges often arise when attempting to confirm compliance with these HUD duct requirements.

One of the primary challenges is understanding and interpreting the technical specifications outlined by HUD. The guidelines encompass various aspects of ductwork design, including materials, installation practices, sealing methods, and insulation levels. For many contractors or homeowners unfamiliar with these technicalities, deciphering these detailed requirements can be daunting. Misinterpretations can lead to non-compliance and potentially costly retrofits.

Another significant issue lies in the quality of materials used in duct construction. HUD mandates specific material standards to ensure durability and performance under varying conditions. Using substandard materials not only risks failing inspections but also affects long-term functionality, leading to inefficiencies such as heat loss or drafts within the home.

Installation practices present additional challenges. Proper installation is critical for ensuring that ducts perform effectively without leaks or blockages that could compromise airflow or indoor air quality. Unfortunately, improper installation is a common problem due to either lack of expertise or oversight during construction phases. This can result in inefficiencies that increase utility costs for homeowners over time.

Furthermore, confirming compliance often involves rigorous inspection processes which may not always be straightforward. Inspectors need to verify that all aspects of the duct system adhere strictly to HUD's guidelines-a process that requires meticulous attention to detail. In some cases, existing structures may make it difficult for inspectors to access certain parts of the ductwork without invasive procedures.

Lastly, there is an ongoing challenge related to keeping up with updates in HUD regulations as technologies and best practices evolve over time. Staying informed about changes in requirements demands continuous education and adaptation on behalf of manufacturers and installers alike.

In conclusion, while complying with HUD's duct requirements for mobile homes ensures safe and efficient living environments, it comes replete with its own set of challenges-from understanding complex regulations and using appropriate materials to ensuring precise installation practices and navigating thorough inspections-all requiring diligence from everyone involved in the construction process. Addressing these issues proactively can help facilitate smoother compliance confirmation processes while promoting better outcomes for mobile home residents across the nation.

Proper Procedures for Handling Refrigerants and Chemicals

Inspecting and confirming compliance with HUD standards is a critical aspect of ensuring safety, efficiency, and quality in mobile home construction and maintenance. HUD, the U.S. Department of Housing and Urban Development, has established stringent guidelines to uphold these standards, particularly concerning mobile home ducts. These ducts are integral to the home's heating, ventilation, and air conditioning (HVAC) systems, playing a crucial role in maintaining indoor air quality and energy efficiency.

The first step in inspecting mobile home ducts for HUD compliance is to familiarize oneself with the specific requirements laid out by HUD. This involves reviewing the Manufactured Home Construction and Safety Standards (CFR Title 24), which detail the necessary specifications for ductwork materials, installation procedures, and performance criteria. Understanding these guidelines is essential for inspectors to accurately assess whether a mobile home's duct system meets federal standards.

Once familiar with the regulations, inspectors should conduct a thorough visual inspection of the ductwork. This process includes examining the materials used in construction to ensure they meet HUD's durability and safety standards. Inspectors should check for any signs of damage or wear that could compromise the system's integrity or performance. Additionally, they must verify that all connections are secure and that there are no leaks or blockages that could impede airflow or result in energy loss.

Beyond visual inspection, testing is an important part of confirming compliance with HUD standards. Inspectors might employ methods such as pressure tests to determine if there are any significant air leaks within the duct system. These tests help pinpoint areas where heat loss might occur, allowing homeowners to address issues that could lead to higher energy bills or discomfort within the living space.

Furthermore, inspectors should ensure that the installation complies with design standards regarding layout and sizing. Properly sized ducts contribute significantly to efficient HVAC operation by balancing airflow throughout different sections of a mobile home. An inadequately designed system can cause uneven heating or cooling and place undue strain on HVAC components.

Documentation plays a pivotal role in this process as well. Inspectors must meticulously record their findings during inspections for accountability purposes and future reference. Clear documentation helps homeowners understand necessary corrective actions if any non-compliance issues are discovered.

Finally, education is an ongoing step in maintaining compliance with HUD requirements for mobile home ducts. Homeowners should be informed about regular maintenance practices that can prolong their systems' life span while ensuring continued adherence to established standards.

In summary, confirming compliance with HUD requirements for mobile home ducts involves understanding regulatory frameworks; conducting detailed inspections; performing necessary tests; ensuring proper design implementation; documenting findings comprehensively; educating stakeholders on best practices-all aimed at promoting safe living conditions through effective HVAC operations within these unique dwellings.

Electrical Safety Protocols for Mobile Home HVAC Work

Ensuring compliance with the U.S. Department of Housing and Urban Development (HUD) requirements for mobile home ducts is a critical aspect of maintaining standards in manufactured housing. This process involves detailed documentation and reporting procedures that serve as a foundation for compliance verification. These protocols not only help safeguard the structural integrity and safety of mobile homes but also ensure that residents are provided with quality living conditions.

The first step in confirming compliance involves understanding HUD's specific requirements regarding mobile home ducts. These requirements are designed to ensure that duct systems are properly installed, sealed, and insulated, reducing the risk of energy inefficiencies or hazards such as carbon monoxide leaks. Familiarity with these regulations is crucial for manufacturers, inspectors, and other stakeholders involved in the production and maintenance of mobile homes.

Once familiarized with the regulatory framework, the next step is to establish comprehensive documentation procedures. Documentation begins during the design phase, where plans must clearly specify duct layouts, materials used, and insulation methods conforming to HUD standards. These documents serve as a blueprint for construction teams and provide inspectors with essential details needed to assess compliance during subsequent inspections.

During construction, maintaining accurate records is vital. Every stage from installation to testing should be documented meticulously. Photographs, written reports, and test results become part of an ongoing record demonstrating adherence to HUD guidelines. This documentation serves not only as evidence of compliance but also as a reference point should any issues arise post-installation.

Reporting procedures are equally important in verifying compliance with HUD requirements. Regular inspections by qualified professionals ensure that all aspects of ductwork meet established standards. Inspectors must compile thorough reports detailing their findings at each inspection stage. These reports should highlight any non-compliance issues found along with recommended corrective actions.

The culmination of this process is a final audit conducted by either HUD-approved inspectors or third-party agencies specializing in manufactured housing standards. The audit verifies that all documentation aligns with actual onsite conditions and confirms that reported information accurately reflects the state of duct installations.

Effective communication between manufacturers, installers, inspectors, and regulatory bodies is essential throughout this entire process. Any identified discrepancies need swift resolution through documented corrective actions followed by re-inspection if necessary.

In conclusion, robust documentation and reporting procedures form the backbone of confirming compliance with HUD requirements for mobile home ducts. By ensuring meticulous record-keeping at every stage along with comprehensive reporting practices during inspections, stakeholders can confidently verify conformity to regulatory standards while upholding quality assurance in manufactured housing environments. This dedication not only fulfills legal obligations but also enhances trust among consumers who rely on these certifications when choosing safe living spaces within mobile homes.

Best Practices for Ensuring Structural Integrity During Installation and Maintenance

Ensuring compliance with the U.S. Department of Housing and Urban Development (HUD) requirements for mobile home ducts is a critical aspect of maintaining the safety, efficiency, and habitability of these homes. Regular maintenance and inspections play an indispensable role in confirming this compliance, offering numerous benefits that extend beyond mere adherence to regulations.

To begin with, regular maintenance ensures that the duct systems within mobile homes operate efficiently. Ducts are responsible for distributing heated or cooled air from HVAC systems throughout the home. Over time, these ducts may accumulate dust, debris, or even develop leaks. Such issues can significantly impede airflow efficiency, leading to increased energy consumption and higher utility bills for residents. By conducting routine inspections and maintenance, problems such as leaks or blockages can be identified early and rectified promptly, ensuring optimal system performance.

Furthermore, maintaining compliance with HUD requirements is not just about efficiency but also about health and safety. Poorly maintained ductwork can become a breeding ground for mold and other allergens if moisture accumulates within them. This poses significant health risks to residents, particularly those with respiratory conditions like asthma or allergies. Regular inspections help identify any potential health hazards early on, allowing for swift remediation before they escalate into more serious issues.

Compliance with HUD standards also ensures that mobile homes meet certain structural integrity criteria. The integrity of duct systems contributes to the overall stability of temperature control within the home environment. If ducts are compromised due to neglect or disrepair, it could lead to uneven heating or cooling distribution which might affect other structural components over time due to expansion and contraction cycles associated with temperature fluctuations.

From a regulatory standpoint, adhering strictly to HUD's guidelines through regular upkeep avoids potential legal ramifications for homeowners and property managers alike. Non-compliance can result in fines or other penalties which could have been easily avoided through diligent attention to maintenance schedules and inspection routines.

In conclusion, regular maintenance and inspections are vital in confirming compliance with HUD requirements for mobile home ducts. They ensure efficient operation of HVAC systems while safeguarding the health of occupants by preventing allergen build-up within ductwork. Additionally, these practices protect homeowners from potential legal issues related to non-compliance while preserving the structural integrity of their homes through consistent environmental stability provided by well-maintained duct systems. Ultimately, investing in routine checks not only upholds regulatory standards but also enhances quality of life for those residing in mobile homes.

About Mobile home

This article is about the prefabricated structure. For the vehicle, see Recreational vehicle. For other uses, see Mobile home (disambiguation).
"Static Caravan" redirects here. For the record label, see Static Caravan Recordings.
"House on wheels" redirects here. For the South Korean variety show, see House on Wheels.

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The examples and perspective in this article **deal primarily with the United States and do not represent a worldwide view of the subject**. You may improve this article, discuss the issue on the talk page, or create a new article, as appropriate. *(April 2017) (Learn how and when to remove this message)*

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Mobile homes with detached single car garages

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Part of a series on

Living spaces

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Main

- House: detached
- semi-detached
- terraced
- Apartment
- Bungalow
- Cottage
- Ecohouse
- Green home
- Housing project
- Human outpost
- I-house
- Ranch
- Tenement
- Condominium
- Mixed-use development
- Hotel
- Hostel
- Castle
- Public housing
- Squat
- Flophouse
- Shack
- Slum
- Shanty town
- Villa

Issues

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- Toxic hotspot
- Vagrancy

Society and politics

- Housing First
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Other

- Alternative lifestyle
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- Ecovillage
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- Hospital
- Local community
- Log house
- Natural building
- Nursing home
- Orphanage
- Prison
- Psychiatric hospital
- Residential care
- Residential treatment center
- Retirement community
- Retirement home
- Supportive housing
- Supported living

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Housing portal

A **mobile home** (also known as a **house trailer**, **park home**, **trailer**, or **trailer home**) is a prefabricated structure, built in a factory on a permanently attached chassis before being transported to site (either by being towed or on a trailer). Used as permanent homes, or for holiday or temporary accommodation, they are often left permanently or semi-permanently in one place, but can be moved, and may be required to move from time to time for legal reasons.

Mobile homes share the same historic origins as travel trailers, but today the two are very different, with travel trailers being used primarily as temporary or vacation homes. Behind the cosmetic work fitted at installation to hide the base, mobile homes have strong trailer frames, axles, wheels, and tow-hitches.

History

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In the United States, this form of housing goes back to the early years of cars and motorized highway travel.[1] It was derived from the travel trailer (often referred to during the early years as "house trailers" or "trailer coaches"), a small unit with wheels attached permanently, often used for camping or extended travel. The original rationale for this type of housing was its mobility. Units were initially marketed primarily to people whose lifestyle required mobility. However, in the 1950s, the homes began to be marketed primarily as an inexpensive form of housing designed to be set up and left in a location for long periods of time or even permanently installed with a masonry foundation. Previously, units had been eight feet or fewer in width, but in 1956, the 10-foot (3.0 m) wide home ("ten-wide") was introduced, along with the new term "mobile home".[2]

The homes were given a rectangular shape, made from pre-painted aluminum panels, rather than the streamlined shape of travel trailers, which were usually painted after assembly. All of this helped increase the difference between these homes and home/travel trailers. The smaller, "eight-wide" units could be moved simply with a car, but the larger, wider units ("ten-wide", and, later, "twelve-wide") usually required the services of a professional trucking company, and, often, a special moving permit from a state highway department. During the late 1960s and early 1970s, the homes were made even longer and wider, making the mobility of the units more difficult. Nowadays, when a factory-built home is moved to a location, it is usually kept there permanently and the mobility of the units has considerably decreased. In some states, mobile homes have been taxed as personal property if the wheels remain attached, but as real estate if the wheels are removed. Removal of the tongue and axles may also be a requirement for real estate classification.

Manufactured home

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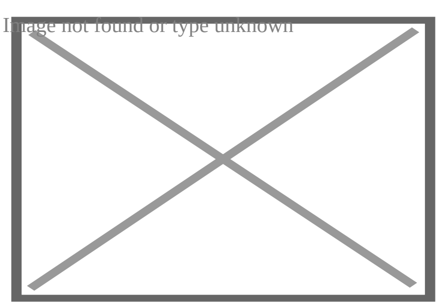
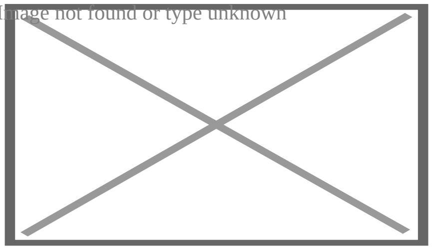
Main article: Manufactured housing



Example of a modern manufactured home in New Alexandria, Pennsylvania.
28 by 60 feet (8.5 m × 18.3 m)



Manufactured home foundation

Mobile homes built in the United States since June 1976, legally referred to as manufactured homes, are required to meet FHA certification requirements and come with attached metal certification tags. Mobile homes permanently installed on owned land are rarely mortgageable, whereas FHA code manufactured homes are mortgageable through VA, FHA, and Fannie Mae.

Many people who could not afford a traditional site-built home, or did not desire to commit to spending a large sum of money on housing, began to see factory-built homes as a viable alternative for long-term housing needs. The units were often marketed as an alternative to apartment rental. However, the tendency of the units of this era to depreciate rapidly in resale value[*citation needed*] made using them as collateral for loans much riskier than traditional home loans. Terms were usually limited to less than the thirty-year term typical of the general home-loan market, and interest rates were considerably higher.[*citation needed*] In that way, mobile home loans resembled motor vehicle loans more than traditional home mortgage loans.

Construction and sizes

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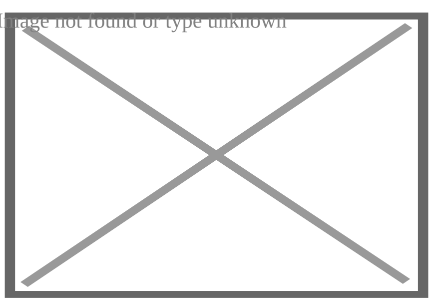

Exterior wall assemblies being set in place during manufacture

Mobile homes come in two major sizes, *single-wides* and *double-wides*. Single-wides are 18 feet (5.5 m) or less in width and 90 feet (27 m) or less in length and can be towed to their site as a single unit. Double-wides are 20 feet (6.1 m) or more wide and are 90 feet (27 m) in length or less and are towed to their site in two separate units, which are then joined. *Triple-wides* and even homes with four, five, or more units are also built but less frequently.

While site-built homes are rarely moved, single-wide owners often "trade" or sell their home to a dealer in the form of the reduction of the purchase of a new home. These "used" homes are either re-sold to new owners or to park owners who use them as inexpensive rental units. Single-wides are more likely to be traded than double-wides because removing them from the site is easier. In fact, only about 5% of all double-wides will ever be moved.[*citation needed*]

While an EF1 tornado might cause minor damage to a site-built home, it could do significant damage to a factory-built home, especially an older model or one that is not properly secured. Also, structural components (such as windows) are typically weaker than those in site-built homes.[3] 70 miles per hour (110 km/h) winds can destroy a mobile home in a matter of minutes. Many brands offer optional hurricane straps, which can be used to tie the home to anchors embedded in the ground.

Regulations

[edit]

United States

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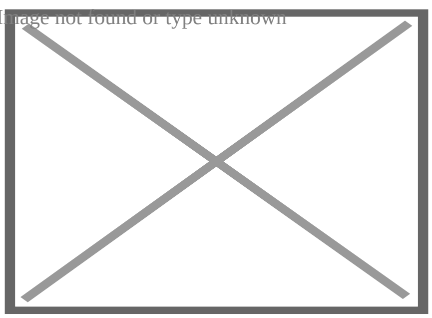

Home struck by tornado

In the United States, mobile homes are regulated by the US Department of Housing and Urban Development (HUD), via the Federal National Manufactured Housing Construction and Safety Standards Act of 1974. This national regulation has allowed many manufacturers to distribute nationwide because they are immune to the jurisdiction of local building authorities.[4] [5]
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By contrast, producers of modular homes must abide by state and local building codes.

There are, however, wind zones adopted by HUD that home builders must follow. For example, statewide, Florida is at least wind zone 2. South Florida is wind zone 3, the strongest wind zone. After Hurricane Andrew in 1992, new standards were adopted for home construction. The codes for building within these wind zones were significantly amended, which has greatly increased their durability. During the 2004 hurricanes in Florida, these standards were put to the test, with great success. Yet, older models continue to face the exposed risk to high winds because of the attachments applied such as carports, porch and screen room additions. Such areas are exposed to "wind capture" which apply extreme force to the underside of the integrated roof panel systems, ripping the fasteners through the roof pan causing a series of events which destroys the main roof system and the home.

The popularity of the factory-built homes caused complications the legal system was not prepared to handle. Originally, factory-built homes tended to be taxed as vehicles rather than real estate, which resulted in very low property tax rates for their inhabitants. That caused local governments to reclassify them for taxation purposes.

However, even with that change, rapid depreciation often resulted in the home occupants paying far less in property taxes than had been anticipated and budgeted. The ability to move many factory-built homes rapidly into a relatively small area resulted in strains to the infrastructure and governmental services of the affected areas, such as inadequate water pressure and sewage disposal, and highway congestion. That led jurisdictions to begin placing limitations on the size and density of developments.

Early homes, even those that were well-maintained, tended to depreciate over time, much like motor vehicles. That is in contrast to site-built homes which include the land they are built on and tend to appreciate in value. The arrival of mobile homes in an area tended to be regarded with alarm, in part because of the devaluation of the housing potentially spreading to preexisting structures.

This combination of factors has caused most jurisdictions to place zoning regulations on the areas in which factory-built homes are placed, and limitations on the number and density of homes permitted on any given site. Other restrictions, such as minimum size requirements, limitations on exterior colors and finishes, and foundation mandates have also been enacted. There are many jurisdictions that will not allow the placement of any additional factory-built homes. Others have strongly limited or forbidden all single-wide models, which tend to depreciate more rapidly than modern double-wide models.

Apart from all the practical issues described above, there is also the constant discussion about legal fixture and chattels and so the legal status of a trailer is or could be affected by its incorporation to the land or not. This sometimes involves such factors as whether or not the wheels have been removed.

North Carolina

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The North Carolina Board of Transportation allowed 14-foot-wide homes on the state's roads, but until January 1997, 16-foot-wide homes were not allowed. 41 states allowed 16-foot-wide homes, but they were not sold in North Carolina. Under a trial program approved January 10, 1997, the wider homes could be delivered on specific roads at certain times of day and travel 10 mph below the speed limit, with escort vehicles in front and behind.[6][7] Eventually, all homes had to leave the state on interstate highways.[8]

In December 1997, a study showed that the wider homes could be delivered safely, but some opponents still wanted the program to end.[9] On December 2, 1999, the NC Manufactured Housing Institute asked the state Board of Transportation to expand the program to allow deliveries of 16-foot-wide homes within North Carolina.[8] A month later, the board extended the pilot program by three months but did not vote to allow shipments within the state.[10] In June 2000, the board voted to allow 16-foot-side homes to be shipped to other states on more two-lane roads, and to allow shipments in the state east of US 220. A third escort was required, including a law enforcement officer on two-lane roads.[11]

New York

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In New York State, the Homes and Community Renewal agency tracks mobile home parks and provides regulations concerning them. For example, the agency requires park owners to provide residents with a $15,000 grant if residents are forced to move when the land is transferred to a new owner. Residents are also granted the right of first refusal for a sale of the park, however, if the owner does not evict tenants for five years, the land sale can go ahead. State law also restricts the annual increase in land lot fee to a cap of 3 percent, unless the landowner demonstrates hardship in a local court, and can then raise the land lot fee by up to 6 percent in a year.[12]

Mobile home parks

[edit]
Main article: Trailer park

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Meadow Lanes Estates Mobile Home Park, Ames, Iowa, August 2010, during a flood

Mobile homes are often sited in land lease communities known as trailer parks (also 'trailer courts', 'mobile home parks', 'mobile home communities', 'manufactured home communities', 'factory-built home communities' etc.); these communities allow homeowners to rent space on which to place a home. In addition to providing space, the site often provides basic utilities such as water, sewer, electricity, or natural gas and other amenities such as mowing, garbage removal, community rooms, pools, and playgrounds.

There are over 38,000[13] trailer parks in the United States ranging in size from 5 to over 1,000 home sites. Although most parks appeal to meeting basic housing needs, some communities specialize towards certain segments of the market. One subset of mobile home parks, retirement communities, restrict residents to those age 55 and older. Another subset of mobile home parks, seasonal communities, are located in popular vacation destinations or are used as a location for summer homes. In New York State, as of 2019, there were 1,811 parks with 83,929 homes.[12]

Newer homes, particularly double-wides, tend to be built to much higher standards than their predecessors and meet the building codes applicable to most areas. That has led to a reduction in the rate of value depreciation of most used units.[14]

Additionally, modern homes tend to be built from materials similar to those used in site-built homes rather than inferior, lighter-weight materials. They are also more likely to physically resemble site-built homes. Often, the primary differentiation in appearance is that factory-built homes tend to have less of a roof slope so that they can be readily transported underneath bridges and overpasses.[*citation needed*]

The number of double-wide units sold exceeds the number of single-wides, which is due in part to the aforementioned zoning restrictions. Another reason for higher sales is the spaciousness of double-wide units, which are now comparable to site-built homes. Single-wide units are still popular primarily in rural areas, where there are fewer restrictions. They are frequently used as temporary housing in areas affected by natural disasters when restrictions are temporarily waived.[*citation needed*]

Another recent trend has been parks in which the owner of the mobile home owns the lot on which their unit is parked. Some of these communities simply provide land in a homogeneous neighborhood, but others are operated more like condominiums with club homes complete with swimming pools and meeting rooms which are shared by all of the residents, who are required to pay membership fees and dues.

By country

[edit]

Mobile home (or mobile-homes) are used in many European campgrounds to refer to fixed caravans, purpose-built cabins, and even large tents, which are rented by the week or even year-round as cheap accommodation, similar to the US concept of a trailer park. Like many other US loanwords, the term is not used widely in Britain.[*citation neede*

United Kingdom

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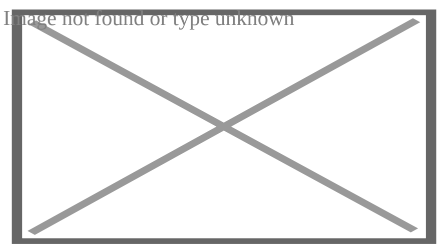

A mobile home marketed as a holiday home

Mobile Homes or Static Caravans are popular across the United Kingdom. They are more commonly referred to as Park Homes or Leisure Lodges, depending on if they are marketed as a residential dwelling or as a second holiday home residence.

Residential Mobile homes (park homes) are built to the BS3632 standard. This standard is issued by the British Standards Institute. The institute is a UK body who produce a range of standards for businesses and products to ensure they are fit for purpose. The majority of residential parks in the UK have a minimum age limit for their residents, and are generally marketed as retirement or semi-retirement parks. Holiday Homes, static caravans or holiday lodges aren't required to be built to BS3632 standards, but many are built to the standard.

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A static caravan park on the cliffs above Beer, Devon, England

In addition to mobile homes, static caravans are popular across the UK. Static caravans have wheels and a rudimentary chassis with no suspension or brakes and are therefore transported on the back of large flatbed lorries, the axle and wheels being used for movement to the final location when the static caravan is moved by tractor or 4×4. A static caravan normally stays on a single plot for many years and has many of the modern conveniences normally found in a home.

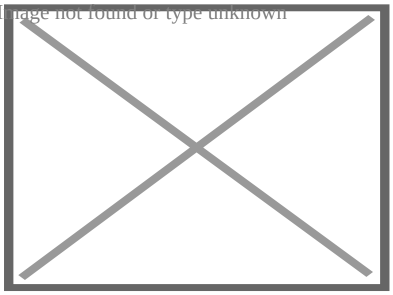
Mobile homes are designed and constructed to be transportable by road in one or two sections. Mobile homes are no larger than 20 m × 6.8 m (65 ft 7 in × 22 ft 4 in) with an internal maximum height of 3.05 m (10 ft 0 in). Legally, mobile homes can still be defined as "caravans".

Static holiday caravans generally have sleeping accommodation for 6 to 10 people in 2, 3 or 4 bedrooms and on convertible seating in the lounge referred to as a 'pull out bed'. They tend towards a fairly "open-plan" layout, and while some units are double glazed and centrally heated for year-round use, cheaper models without double glazing or central heating are available for mainly summer use. Static caravan holiday homes are intended for leisure use and are available in 10 and 12 ft (3.0 and 3.7 m) widths, a small number in 13 and 14 ft (4.0 and 4.3 m) widths, and a few 16 ft (4.9 m) wide, consisting of two 8 ft (2.4 m) wide units joined. Generally, holiday homes are clad in painted steel panels, but can be clad in PVC, timber or composite materials. Static caravans are sited on caravan parks where the park operator of the site leases a plot to the caravan owner. There are many holiday parks in the UK in which one's own static caravan can be owned. There are a few of these parks in areas that are prone to flooding and anyone considering buying a sited static caravan needs to take particular care in checking that their site is not liable to flooding.

Static caravans can be rented on an ad-hoc basis or purchased. Purchase prices range from £25,000 to £100,000. Once purchased, static caravans have various ongoing costs including insurance, site fees, local authority rates, utility charges, winterisation and depreciation. Depending on the type of caravan and the park these costs can range from £1,000 to £40,000 per year.[15] Some park owners used to have unfair conditions in their lease contracts but the Office of Fair Trading has produced a guidance document available for download called Unfair Terms in Holiday Caravan Agreements which aims to stop unfair practices.

Israel

[edit]
Main article: Caravan (Israel)



Posting of *caravan* in Mitzpe Hila, Israel, 1982

Many Israeli settlements and outposts are originally composed of caravans (Hebrew: ÃƒÆ’Ã†â€™Ãƒâ€ Ã¢â‚¬â„¢ÃƒÆ’Ã¢â‚¬Â ÃƒÂ¢Ã¢â€šÂ¬Ã¢â€žÂ¢ÃƒÆ’Ã†â€™ÃƒÂ¢Ã¢â€šÂ¬Ã…Â
caravan; pl.
ÃƒÆ’Ã†â€™Ãƒâ€ Ã¢â‚¬â„¢ÃƒÆ’Ã¢â‚¬Â ÃƒÂ¢Ã¢â€šÂ¬Ã¢â€žÂ¢ÃƒÆ’Ã†â€™ÃƒÂ¢Ã¢â€šÂ¬Ã…Â
caravanim). They are constructed of light metal, are not insulated but can be outfitted with heating and air-conditioning units, water lines, recessed lighting, and floor tiling to function in a full-service capacity. Starting in 2005, prefabricated homes, named *caravillas* (Hebrew:
ÃƒÆ’Ã†â€™Ãƒâ€ Ã¢â‚¬â„¢ÃƒÆ’Ã¢â‚¬Â ÃƒÂ¢Ã¢â€šÂ¬Ã¢â€žÂ¢ÃƒÆ’Ã†â€™ÃƒÂ¢Ã¢â€šÂ¬Ã…Â
), a portmanteau of the words caravan, and villa, begin to replace mobile homes in many Israeli settlements.

Difference from modular homes

[edit]
Main article: Modular home

Because of similarities in the manufacturing process, some companies build both types in their factories. Modular homes are transported on flatbed trucks rather than being towed, and lack axles and an automotive-type frame. However, some modular homes are towed behind a semi-truck or toter on a frame similar to that of a trailer. The home is usually in two pieces and is hauled by two separate trucks. Each frame has five or more axles, depending on the size of the home. Once the home has reached its location, the axles and the tongue of the frame are then removed, and the home is set on a concrete foundation by a large crane.

Both styles are commonly referred to as factory-built housing, but that term's technical use is restricted to a class of homes regulated by the Federal National Mfd. Housing Construction and Safety Standards Act of 1974.

Most zoning restrictions on the homes have been found to be inapplicable or only applicable to modular homes. That occurs often after considerable litigation on the topic by affected jurisdictions and by plaintiffs failing to ascertain the difference. Most modern modulars, once fully assembled, are indistinguishable from site-built homes. Their roofs are usually transported as separate units. Newer modulars also come with roofs that can be raised during the setting process with cranes. There are also modulars with 2 to 4 storeys.

Gallery

[edit]

Construction starts with the frame.

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  Construction starts with the frame.
  Interior wall assemblies are attached.
- Image not found or type unknown
  Interior wall assemblies are attached.
  Roof assembly is set atop home.
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  Roof assembly is set atop home.

Drywall is completed.

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  Drywall is completed.
  Home is ready for delivery to site.

- Image not found or type unknown
  Home is ready for delivery to
  site.
- A modern "triple wide" home, designed to look like an adobe home

  Image not found or type unknown
  A modern "triple wide"
  home, designed to look like
  an adobe home
  A mobile home is being moved, California.

- Image not found or type unknown
  A mobile home
  is being moved,
  California.

- A mobile home being prepared for transport

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A mobile home being prepared for transport

See also

[edit]

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- Housing portal
- All Parks Alliance for Change
- Campervan
- Construction trailer
- Houseboat
- Manufactured housing
- Modular home
- Motorhome
- Nomadic wagons
- Recreational vehicle
- Reefer container housing units
- Small house movement
- Trailer (vehicle)
- Trailer Park Boys
- Trailer trash
- Vardo
- Prefabricated home

References

[edit]

1. **^** *"Part 17, Mobile Home Parks". ny.gov.*
2. **^** *"Mobile Manufactured Homes". ct.gov. Retrieved 28 March 2018.*
3. **^** *"Caravan Repairs? Great Caravan Repair Deals!". canterburycaravans.com.au.*
4. **^** *"Titles for Mobile Homes". AAA Digest of Motor Laws.*
5. **^** *Andrews, Jeff (January 29, 2018). "HUD to explore deregulating manufactured housing". Curbed. Archived from the original on 2018-01-29. Retrieved 2019-04-19.*
6. **^** *Hackett, Thomas (January 11, 1997). "Extra-wide homes to take to the road". News & Observer. p. A3.*

7. **^** *Mitchell, Kirsten B. (January 10, 1997). "Wider trailer transport OK'd". Star-News. p. 1A.*
8. ^ ***a b*** *Whitacre, Dianne (December 2, 1999). "Mobile-Home Makers Look to Squeeze on N.C. Roads". The Charlotte Observer. p. 1C.*
9. **^** *"Study: Keep Curbs on Transporting Wide Mobile Homes". The Charlotte Observer. December 1, 1997. p. 4C.*
10. **^** *Bonner, Lynn (January 7, 2000). "Program for wide mobile homes extended". News & Observer. p. A3.*
11. **^** *"Wide mobile homes given final approval". News & Observer. June 3, 2000. p. A3.*
12. ^ ***a b*** *Liberatore, Wendy (January 23, 2022). "Saratoga County's mobile home parks - a sign of an affordable housing crisis". www.timesunion.com. Retrieved January 23, 2022.*
13. **^** *"Database of Mobile Home Parks in the United States". Retrieved 2009-02-17.*
14. **^** *"Homes". Answers.com. Retrieved 2006-09-12.*
15. **^** *"Cost of a static caravan or lodge". StaticCaravanExpert. 28 December 2020. Retrieved 2021-03-07.*

Further reading

[edit]

- Benson, J. E. (1990). Good neighbors: Ethnic relations in Garden City trailer courts. *Urban Anthropology*,19, 361–386.
- Burch-Brown, C. (1996). *Trailers*. Charlottesville: University Press of Virginia. Text by David Rigsbee.
- Geisler, C. C., & Mitsuda, H. (1987). Mobile-home growth, regulation, and discrimination in upstate New York. *Rural Sociology*, 52, 532–543.
- Hart, J. F., Rhodes, M. J., & Morgan, J. T. (2002). *The unknown world of the mobile home*. Baltimore: Johns Hopkins University Press.
- MacTavish, K. A., & Salamon, S. (2001). Mobile home park on the prairie: A new rural community form. *Rural Sociology*, 66, 487–506.
- Moore, B. (2006). Trailer trash: The world of trailers and mobile homes in the Southwest. Laughlin: *Route 66 Magazine*.
- Thornburg, D. A. (1991). *Galloping bungalows: The rise and demise of the American house trailer*. Hamden: Archon Books.
- Wallis, A. D. (1991). *Wheel estate: The rise and decline of mobile homes*. New York: Oxford University Press.

External links

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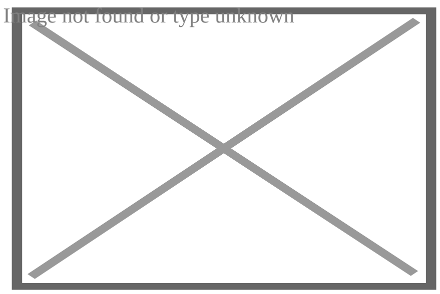
Wikimedia Commons has media related to ***Mobile homes***.

- Regulating body in the UK
- US Federal Manufactured Home Construction and Safety Standards

About Indoor air quality



An air filter being cleaned

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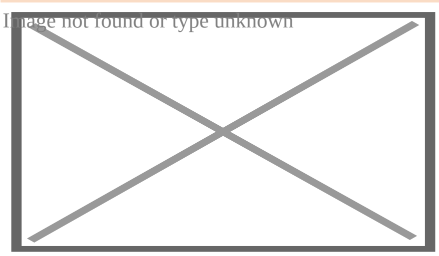

Air pollution from a factory

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

Biological

- Biological hazard
- Genetic
- Illegal logging
- Introduced species
  - Invasive species

Digital

- Information

Electromagnetic

- Light
  - Ecological
  - Overillumination
- Radio spectrum

Natural

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

Noise

- Transportation
- Health effects from noise
- Marine mammals and sonar
- Noise barrier
- Noise control
- Soundproofing

Radiation

- Actinides
- Bioremediation
- Depleted uranium
- Nuclear fission
- Nuclear fallout
- Plutonium
- Poisoning
- Radioactivity
- Uranium
- Radioactive waste

Soil

- Agricultural
- Land degradation
- Bioremediation
- Defecation
- Electrical resistance heating
- Illegal mining
- Soil guideline values
- Phytoremediation

Solid waste

- Advertising mail
- Biodegradable waste
- Brown waste
- Electronic waste
- Foam food container
- Food waste
- Green waste
- Hazardous waste
- Industrial waste
- Litter
- Mining
- Municipal solid waste
- Nanomaterials
- Plastic
- Packaging waste
- Post-consumer waste
- Waste management

Space

- Space debris

Thermal

- Urban heat island

Visual

- Air travel
- Advertising clutter
- Overhead power lines
- Traffic signs
- Urban blight
- 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
- Biosolids
- Diseases
- Eutrophication
- Firewater
- Freshwater
- Groundwater
- Hypoxia
- Industrial wastewater
- Marine
- Monitoring
- Nonpoint source
- Nutrient
- Ocean acidification
- Oil spill
- Pharmaceuticals
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- Septic tanks
- Sewage
- Shipping
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- Sulfur water
- Surface runoff
- Turbidity
- Urban runoff
- Water quality
- Wastewater

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  - Paint

Misc

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- Brain health and pollution
- Debris
- Dust
- Garbology
- Legacy
- Midden
- Point source
- Waste
  - Toxic

Lists

- Diseases
- Law by country
- Most polluted cities
- Least polluted cities by PM2.5
- Treaties
- Most polluted rivers

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]

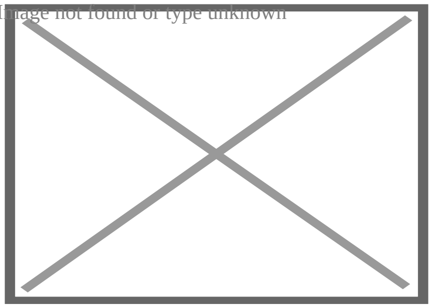
For health reasons it is crucial to breathe clean air, free from chemicals and toxicants as much as possible. It is estimated that humans spend approximately 90% of their lifetime indoors[8] and that indoor air pollution in some places can be much worse than that of the ambient air.[9][10]

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 ?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 ?g/m^3 for long-term exposure and 100 ?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

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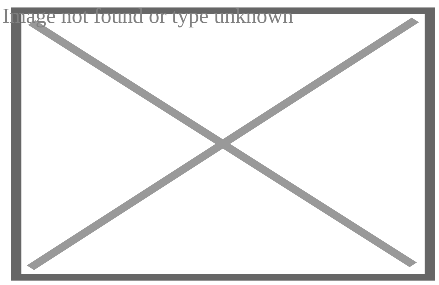

Airborne bacteria

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 needed*]

Virus

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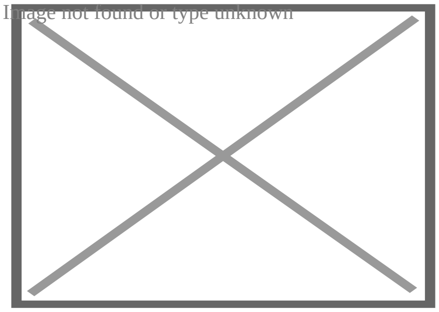

Ninth floor layout of the Metropole Hotel in Hong Kong, showing where an outbreak of the severe acute respiratory syndrome (SARS) occurred

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

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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 needed*]

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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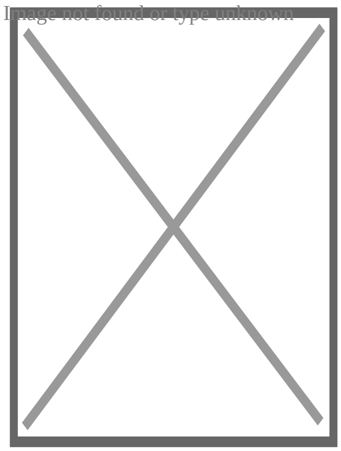

Spider plants *(Chlorophytum comosum)* absorb some airborne contaminants.

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

References

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1. **^** *Carroll, GT; Kirschman, DL; Mammana, A (2022). "Increased CO2 levels in the operating room correlate with the number of healthcare workers present: an imperative for intentional crowd control". Patient Safety in Surgery.* ***16*** *(35): 35. doi: 10.1186/s13037-022-00343-8. PMC 9672642. PMID 36397098.*
2. **^** *ANSI/ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality*, ASHRAE, Inc., Atlanta, GA, US
3. **^** *Belias, Evangelos; Licina, Dusan (2022). "Outdoor PM2. 5 air filtration: optimising indoor air quality and energy". Building & Cities.* ***3*** *(1): 186–203. doi: 10.5334/bc.153.*
4. **^** *KMC Controls (September 24, 2015). "What's Your IQ on IAQ and IEQ?". Archived from the original on April 12, 2021. Retrieved April 12, 2021.*[*unreliable source?*]
5. **^** *Bruce, N; Perez-Padilla, R; Albalak, R (2000). "Indoor air pollution in developing countries: a major environmental and public health challenge". Bulletin of the World Health Organization.* ***78*** *(9): 1078–92. PMC 2560841. PMID 11019457.*
6. **^** *"Household air pollution and health: fact sheet". WHO. May 8, 2018. Archived from the original on November 12, 2021. Retrieved November 21, 2020.*
7. **^** *Ritchie, Hannah; Roser, Max (2019). "Access to Energy". Our World in Data. Archived from the original on November 1, 2021. Retrieved April 1, 2021. " According to the Global Burden of Disease study 1.6 million people died prematurely in 2017 as a result of indoor air pollution ... But it's worth noting that the WHO publishes a substantially larger number of indoor air pollution deaths.."*
8. **^** *Klepeis, Neil E; Nelson, William C; Ott, Wayne R; Robinson, John P; Tsang, Andy M; Switzer, Paul; Behar, Joseph V; Hern, Stephen C; Engelmann, William H (July 2001). "The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants". Journal of Exposure Science & Environmental Epidemiology.* ***11*** *(3): 231–252. Bibcode:2001JESEE..11..231K. doi:10.1038/sj.jea.7500165. PMID 11477521. S2CID 22445147. Archived from the original on March 28, 2023. Retrieved March 30, 2024.*
9. **^** U.S. Environmental Protection Agency. Office equipment: design, indoor air emissions, and pollution prevention opportunities. Air and Energy Engineering Research Laboratory, Research Triangle Park, 1995.
10. **^** U.S. Environmental Protection Agency. Unfinished business: a comparative assessment of environmental problems, EPA-230/2-87-025a-e (NTIS PB88-127030). Office of Policy, Planning and Evaluation, Washington, DC, 1987.
11. **^** *Klepeis, Neil E; Nelson, William C; Ott, Wayne R; Robinson, John P; Tsang, Andy M; Switzer, Paul; Behar, Joseph V; Hern, Stephen C; Engelmann, William H (July 1, 2001). "The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants". Journal of Exposure Science & Environmental Epidemiology.* ***11*** *(3): 231–252. Bibcode:2001JESEE..11..231K. doi:10.1038/sj.jea.7500165. ISSN 1559-0631. PMID 11477521. Archived from the*

original on November 13, 2023. Retrieved November 13, 2023.

12. **^** "Combined or multiple exposure to health stressors in indoor built environments: an evidence-based review prepared for the WHO training workshop "Multiple environmental exposures and risks": 16–18 October 2013, Bonn, Germany". World Health Organization. Regional Office for Europe. 2014. Archived from the original on November 6, 2023. Retrieved April 10, 2024.
13. **^** "Household air pollution". World Health Organization. December 15, 2023. Archived from the original on November 12, 2021. Retrieved April 10, 2024.
14. **^** Clark, Sierra N.; Lam, Holly C. Y.; Goode, Emma-Jane; Marczylo, Emma L.; Exley, Karen S.; Dimitroulopoulou, Sani (August 2, 2023). "The Burden of Respiratory Disease from Formaldehyde, Damp and Mould in English Housing". Environments. **10** (8): 136. doi:10.3390/environments10080136. ISSN 2076-3298.
15. **^** "Chief Medical Officer (CMO): annual reports". GOV.UK. November 16, 2023. Retrieved May 5, 2024.
16. **^** "Project information | Indoor air quality at home | Quality standards | NICE". www.nice.org.uk. Retrieved May 5, 2024.
17. **^** "The inside story: Health effects of indoor air quality on children and young people". RCPCH. Retrieved May 5, 2024.
18. **^** Halios, Christos H.; Landeg-Cox, Charlotte; Lowther, Scott D.; Middleton, Alice; Marczylo, Tim; Dimitroulopoulou, Sani (September 15, 2022). "Chemicals in European residences – Part I: A review of emissions, concentrations and health effects of volatile organic compounds (VOCs)". Science of the Total Environment. **839**: 156201. Bibcode:2022ScTEn.83956201H. doi:10.1016/j.scitotenv.2022.156201. ISSN 0048-9697. PMID 35623519.
19. **^** "Literature review on chemical pollutants in indoor air in public settings for children and overview of their health effects with a focus on schools, kindergartens and day-care centres". www.who.int. Retrieved May 5, 2024.
20. **^** Burge, P S (February 2004). "Sick building syndrome". Occupational and Environmental Medicine. **61** (2): 185–190. doi:10.1136/oem.2003.008813. PMC 1740708. PMID 14739390.
21. **^** Apte, K; Salvi, S (2016). "Household air pollution and its effects on health". F1000Research. **5**: 2593. doi:10.12688/f1000research.7552.1. PMC 5089137. PMID 27853506. "Burning of natural gas not only produces a variety of gases such as sulfur oxides, mercury compounds, and particulate matter but also leads to the production of nitrogen oxides, primarily nitrogen dioxide...The burning of biomass fuel or any other fossil fuel increases the concentration of black carbon in the air"
22. **^** "Improved Clean Cookstoves". Project Drawdown. February 7, 2020. Archived from the original on December 15, 2021. Retrieved December 5, 2020.
23. **^** WHO indoor air quality guidelines: household fuel combustion. Geneva: World Health Organization. 2014. ISBN 978-92-4-154888-5.
24. **^** "Clearing the Air: Gas Cooking and Pollution in European Homes". CLASP. November 8, 2023. Retrieved May 5, 2024.
25. **^** Seals, Brady; Krasner, Andee. "Gas Stoves: Health and Air Quality Impacts and Solutions". RMI. Retrieved May 5, 2024.

26. ^ ***a b c*** *Myers, Isabella (February 2022). The efficient operation of regulation and legislation: An holistic approach to understanding the effect of Carbon Monoxide on mortality (PDF). CO Research Trust.*
27. ^ ***a b c*** *Penney, David; Benignus, Vernon; Kephalopoulos, Stylianos; Kotzias, Dimitrios; Kleinman, Michael; Verrier, Agnes (2010), "Carbon monoxide", WHO Guidelines for Indoor Air Quality: Selected Pollutants, World Health Organization, ISBN 978-92-890-0213-4, OCLC 696099951, archived from the original on March 8, 2021, retrieved March 18, 2024*
28. **^** *"Carbon monoxide: toxicological overview". UK Health Security Agency. May 24, 2022. Retrieved April 17, 2024.*
29. ^ ***a b c*** *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide (PDF). World Health Organization. 2021. hdl:10665/345329. ISBN 978-92-4-003422-8.*[page needed]
30. ^ ***a b*** *Soleimani, Farshid; Dobaradaran, Sina; De-la-Torre, Gabriel E.; Schmidt, Torsten C.; Saeedi, Reza (March 2022). "Content of toxic components of cigarette, cigarette smoke vs cigarette butts: A comprehensive systematic review". Science of the Total Environment.* ***813****: 152667. Bibcode:2022ScTEn.81352667S. doi:10.1016/j.scitotenv.2021.152667. PMID 34963586.*
31. **^** *"Considering smoking as an air pollution problem for environmental health* | *Environmental Performance Index". Archived from the original on September 25, 2018. Retrieved March 21, 2018.*
32. **^** *Arfaeinia, Hossein; Ghaemi, Maryam; Jahantigh, Anis; Soleimani, Farshid; Hashemi, Hassan (June 12, 2023). "Secondhand and thirdhand smoke: a review on chemical contents, exposure routes, and protective strategies". Environmental Science and Pollution Research.* ***30*** *(32): 78017–78029. Bibcode:2023ESPR...3078017A. doi:10.1007/s11356-023-28128-1. PMC 10258487. PMID 37306877.*
33. **^** *Arfaeinia, Hossein; Ghaemi, Maryam; Jahantigh, Anis; Soleimani, Farshid; Hashemi, Hassan (June 12, 2023). "Secondhand and thirdhand smoke: a review on chemical contents, exposure routes, and protective strategies". Environmental Science and Pollution Research.* ***30*** *(32): 78017–78029. Bibcode:2023ESPR...3078017A. doi:10.1007/s11356-023-28128-1. ISSN 1614-7499. PMC 10258487. PMID 37306877.*
34. **^** *Health, CDC's Office on Smoking and (May 9, 2018). "Smoking and Tobacco Use; Fact Sheet; Secondhand Smoke". Smoking and Tobacco Use. Archived from the original on December 15, 2021. Retrieved January 14, 2019.*
35. **^** *Fernández, E; Ballbè, M; Sureda, X; Fu, M; Saltó, E; Martínez-Sánchez, JM (December 2015). "Particulate Matter from Electronic Cigarettes and Conventional Cigarettes: a Systematic Review and Observational Study". Current Environmental Health Reports.* ***2*** *(4): 423–9. Bibcode:2015CEHR....2..423F. doi:10.1007/s40572-015-0072-x. PMID 26452675.*
36. **^** *Vu, Tuan V.; Harrison, Roy M. (May 8, 2019). "Chemical and Physical Properties of Indoor Aerosols". In Harrison, R. M.; Hester, R. E. (eds.). Indoor Air Pollution. The Royal Society of Chemistry (published 2019). ISBN 978-1-78801-803-6.*

37. **^** *Abdullahi, Karimatu L.; Delgado-Saborit, Juana Maria; Harrison, Roy M. (February 13, 2013). "Emissions and indoor concentrations of particulate matter and its specific chemical components from cooking: A review". Atmospheric Environment.* ***71****: 260–294. Bibcode:2013AtmEn..71..260A. doi:10.1016/j.atmosenv.2013.01.061. Archived from the original on May 21, 2023. Retrieved April 11, 2024.*
38. **^** *Patel, Sameer; Sankhyan, Sumit; Boedicker, Erin K.; DeCarlo, Peter F.; Farmer, Delphine K.; Goldstein, Allen H.; Katz, Erin F.; Nazaroff, William W; Tian, Yilin; Vanhanen, Joonas; Vance, Marina E. (June 16, 2020). "Indoor Particulate Matter during HOMEChem: Concentrations, Size Distributions, and Exposures". Environmental Science & Technology.* ***54*** *(12): 7107–7116. Bibcode:2020EnST...54.7107P. doi:10.1021/acs.est.0c00740. ISSN 0013-936X. PMID 32391692. Archived from the original on April 28, 2023. Retrieved April 11, 2024.*
39. **^** *Thangavel, Prakash; Park, Duckshin; Lee, Young-Chul (June 19, 2022). "Recent Insights into Particulate Matter (PM2.5)-Mediated Toxicity in Humans: An Overview". International Journal of Environmental Research and Public Health.* ***19*** *(12): 7511. doi:10.3390/ijerph19127511. ISSN 1660-4601. PMC 9223652. PMID 35742761.*
40. **^** *You, Bo; Zhou, Wei; Li, Junyao; Li, Zhijie; Sun, Yele (November 4, 2022). "A review of indoor Gaseous organic compounds and human chemical Exposure: Insights from Real-time measurements". Environment International.* ***170****: 107611. Bibcode:2022EnInt.17007611Y. doi:10.1016/j.envint.2022.107611. PMID 36335895.*
41. **^** *Weschler, Charles J.; Carslaw, Nicola (March 6, 2018). "Indoor Chemistry". Environmental Science & Technology.* ***52*** *(5): 2419–2428. Bibcode:2018EnST...52.2419W. doi:10.1021/acs.est.7b06387. ISSN 0013-936X. PMID 29402076. Archived from the original on November 15, 2023. Retrieved April 11, 2024.*
42. ^ ***a b*** *Carter, Toby J.; Poppendieck, Dustin G.; Shaw, David; Carslaw, Nicola (January 16, 2023). "A Modelling Study of Indoor Air Chemistry: The Surface Interactions of Ozone and Hydrogen Peroxide". Atmospheric Environment.* ***297****: 119598. Bibcode:2023AtmEn.29719598C. doi:10.1016/j.atmosenv.2023.119598.*
43. **^** *Tsai, Wen-Tien (March 26, 2019). "An overview of health hazards of volatile organic compounds regulated as indoor air pollutants". Reviews on Environmental Health.* ***34*** *(1): 81–89. doi:10.1515/reveh-2018-0046. PMID 30854833.*
44. **^** *"U.S. EPA IAQ – Organic chemicals". Epa.gov. August 5, 2010. Archived from the original on September 9, 2015. Retrieved March 2, 2012.*
45. ^ ***a b*** *Davies, Helen L.; O'Leary, Catherine; Dillon, Terry; Shaw, David R.; Shaw, Marvin; Mehra, Archit; Phillips, Gavin; Carslaw, Nicola (August 14, 2023). "A measurement and modelling investigation of the indoor air chemistry following cooking activities". Environmental Science: Processes & Impacts.* ***25*** *(9): 1532–1548. doi:10.1039/D3EM00167A. ISSN 2050-7887. PMID 37609942.*

46. ^ ***a b c*** *Harding-Smith, Ellen; Shaw, David R.; Shaw, Marvin; Dillon, Terry J.; Carslaw, Nicola (January 23, 2024). "Does green mean clean? Volatile organic emissions from regular versus green cleaning products". Environmental Science: Processes & Impacts.* ***26*** *(2): 436–450. doi:10.1039/D3EM00439B. ISSN 2050-7887. PMID 38258874.*
47. **^** *Lebel, Eric D.; Michanowicz, Drew R.; Bilsback, Kelsey R.; Hill, Lee Ann L.; Goldman, Jackson S. W.; Domen, Jeremy K.; Jaeger, Jessie M.; Ruiz, Angélica; Shonkoff, Seth B. C. (November 15, 2022). "Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California". Environmental Science & Technology.* ***56*** *(22): 15828–15838. Bibcode:2022EnST...5615828L. doi:10.1021/acs.est.2c02581. ISSN 0013-936X. PMC 9671046. PMID 36263944.*
48. **^** *"Volatile Organic Compounds' Impact on Indoor Air Quality". United States Environmental Protection Agency. August 18, 2014. Retrieved May 23, 2024.*
49. **^** *"About VOCs". January 21, 2013. Archived from the original on January 21, 2013. Retrieved September 16, 2019.*
50. **^** *Oanh, Nguyen Thi Kim; Hung, Yung-Tse (2005). "Indoor Air Pollution Control". Advanced Air and Noise Pollution Control. Handbook of Environmental Engineering. Vol. 2. pp. 237–272. doi:10.1007/978-1-59259-779-6_7. ISBN 978-1-58829-359-6.*
51. **^** *"Emicode". Eurofins.com. Archived from the original on September 24, 2015. Retrieved March 2, 2012.*
52. **^** *"M1". Eurofins.com. Archived from the original on September 24, 2015. Retrieved March 2, 2012.*
53. **^** *"Blue Angel". Eurofins.com. Archived from the original on September 24, 2015. Retrieved March 2, 2012.*
54. **^** *"Indoor Air Comfort". Indoor Air Comfort. Archived from the original on February 1, 2011. Retrieved March 2, 2012.*
55. **^** *"CDPH Section 01350". Eurofins.com. Archived from the original on September 24, 2015. Retrieved March 2, 2012.*
56. ^ ***a b*** *"Smelly Moldy Houses". Archived from the original on December 15, 2021. Retrieved August 2, 2014.*
57. **^** *Meruva, N. K.; Penn, J. M.; Farthing, D. E. (November 2004). "Rapid identification of microbial VOCs from tobacco molds using closed-loop stripping and gas chromatography/time-of-flight mass spectrometry". J Ind Microbiol Biotechnol.* ***31*** *(10): 482–8. doi:10.1007/s10295-004-0175-0. PMID 15517467. S2CID 32543591.*
58. **^** *"Atmospheric carbon dioxide passes 400 ppm everywhere". Physics Today (6): 8170. 2016. Bibcode:2016PhT..2016f8170.. doi:10.1063/pt.5.029904.*
59. **^** *Xie Y, Li Y, Feng Y, Cheng W, Wang Y (April 2022). "Inhalable microplastics prevails in air: Exploring the size detection limit". Environ Int.* ***162****: 107151. Bibcode:2022EnInt.16207151X. doi:10.1016/j.envint.2022.107151. PMID 35228011.*

60. ^ *Liu C, Li J, Zhang Y, Wang L, Deng J, Gao Y, Yu L, Zhang J, Sun H (July 2019). "Widespread distribution of PET and PC microplastics in dust in urban China and their estimated human exposure". Environ Int.* ***128****: 116–124. Bibcode:2019EnInt.128..116L. doi:10.1016/j.envint.2019.04.024. PMID 31039519.*
61. ^ *Yuk, Hyeonseong; Jo, Ho Hyeon; Nam, Jihee; Kim, Young Uk; Kim, Sumin (2022). "Microplastic: A particulate matter(PM) generated by deterioration of building materials". Journal of Hazardous Materials.* ***437****. Elsevier BV: 129290. Bibcode:2022JHzM..43729290Y. doi:10.1016/j.jhazmat.2022.129290. ISSN 0304-3894. PMID 35753297.*
62. ^ *Eberhard, Tiffany; Casillas, Gaston; Zarus, Gregory M.; Barr, Dana Boyd (January 6, 2024). "Systematic review of microplastics and nanoplastics in indoor and outdoor air: identifying a framework and data needs for quantifying human inhalation exposures" (PDF). Journal of Exposure Science & Environmental Epidemiology.* ***34*** *(2). Springer Science and Business Media LLC: 185–196. doi: 10.1038/s41370-023-00634-x. ISSN 1559-0631. Retrieved December 19, 2024. " MPs have been found in water and soil, and recent research is exposing the vast amount of them in ambient and indoor air."*
63. ^ *Gasperi, Johnny; Wright, Stephanie L.; Dris, Rachid; Collard, France; Mandin, Corinne; Guerrouache, Mohamed; Langlois, Valérie; Kelly, Frank J.; Tassin, Bruno (2018). "Microplastics in air: Are we breathing it in?" (PDF). Current Opinion in Environmental Science & Health.* ***1****: 1–5. Bibcode:2018COESH...1....1G. doi:10.1016/j.coesh.2017.10.002. S2CID 133750509. Archived (PDF) from the original on March 6, 2020. Retrieved July 11, 2019.*
64. ^ *Prasittisopin, Lapyote; Ferdous, Wahid; Kamchoom, Viroon (2023). "Microplastics in construction and built environment". Developments in the Built Environment.* ***15****. Elsevier BV. doi:10.1016/j.dibe.2023.100188. ISSN 2666-1659.*
65. ^ *Galloway, Nanette LoBiondo (September 13, 2024). "Ventnor introduces ordinance to control microplastics contamination". DownBeach. Retrieved October 2, 2024.*
66. ^ *Weschler, Charles J. (December 2000). "Ozone in Indoor Environments: Concentration and Chemistry: Ozone in Indoor Environments". Indoor Air.* ***10*** *(4): 269–288. doi:10.1034/j.1600-0668.2000.010004269.x. PMID 11089331. Archived from the original on April 15, 2024. Retrieved April 11, 2024.*
67. ^ *Weschler, Charles J.; Nazaroff, William W (February 22, 2023). "Human skin oil: a major ozone reactant indoors". Environmental Science: Atmospheres.* ***3*** *(4): 640–661. doi:10.1039/D3EA00008G. ISSN 2634-3606. Archived from the original on April 15, 2024. Retrieved April 11, 2024.*
68. ^ *Kumar, Prashant; Kalaiarasan, Gopinath; Porter, Alexandra E.; Pinna, Alessandra; KÃƒÆ’Ã†â€™Ãƒâ€ Ã¢â‚¬â„¢ÃƒÆ’Ã¢â‚¬Â ÃƒÂ¢Ã¢â€šÂ¬Ã¢â€žÂ¢ÃƒÆ’Ã†â€™ÃƒÂ¢Ã¢â€ MichaÃƒÆ’Ã†â€™Ãƒâ€ Ã¢â‚¬â„¢ÃƒÆ’Ã¢â‚¬Â ÃƒÂ¢Ã¢â€šÂ¬Ã¢â€žÂ¢ÃƒÆ’Ã†â€™ÃƒÂ¢ M.; Demokritou, Philip; Chung, Kian Fan; Pain, Christopher; Arvind, D. K.; Arcucci, Rossella; Adcock, Ian M.; Dilliway, Claire (February 20, 2021). "An overview of methods of fine and ultrafine particle collection for physicochemical*

characterisation and toxicity assessments". Science of the Total Environment. ***756****: 143553. Bibcode:2021ScTEn.75643553K. doi:10.1016/j.scitotenv.2020.143553. hdl:10044/1/84518. PMID 33239200. S2CID 227176222.*

69. **^** *Apte, M. G.; Buchanan, I. S. H.; Mendell, M. J. (April 2008). "Outdoor ozone and building-related symptoms in the BASE study". Indoor Air.* ***18*** *(2): 156–170. Bibcode:2008InAir..18..156A. doi:10.1111/j.1600-0668.2008.00521.x. PMID 18333994.*
70. **^** *"Eight-hour Average Ozone Concentrations | Ground-level Ozone | New England | US EPA". United States Environmental Protection Agency. Archived from the original on December 15, 2021. Retrieved September 16, 2019.*
71. ^ ***a b c*** *Park, J. H.; Cox-Ganser, J. M. (2011). "Meta-Mold exposure and respiratory health in damp indoor environments". Frontiers in Bioscience.* ***3*** *(2): 757–771. doi:10.2741/e284. PMID 21196349.*
72. **^** *"CDC – Mold – General Information – Facts About Mold and Dampness". December 4, 2018. Archived from the original on December 16, 2019. Retrieved June 23, 2017.*
73. **^** *Singh, Dr Jagjit; Singh, Jagjit, eds. (1994). Building Mycology (1 ed.). Taylor & Francis. doi:10.4324/9780203974735. ISBN 978-1-135-82462-4.*
74. ^ ***a b*** *Clarke, J.A; Johnstone, C.M; Kelly, N.J; McLean, R.C; anderson, J.A; Rowan, N.J; Smith, J.E (January 20, 1999). "A technique for the prediction of the conditions leading to mould growth in buildings". Building and Environment.* ***34*** *(4): 515–521. Bibcode:1999BuEnv..34..515C. doi:10.1016/S0360-1323(98)00023-7. Archived from the original on October 26, 2022. Retrieved April 10, 2024.*
75. **^** *Vereecken, Evy; Roels, Staf (November 15, 2011). "Review of mould prediction models and their influence on mould risk evaluation". Building and Environment.* ***51*** *: 296–310. doi:10.1016/j.buildenv.2011.11.003. Archived from the original on March 2, 2024. Retrieved April 11, 2024.*
76. **^** *BS 5250:2021 - Management of moisture in buildings. Code of practice. British Standards Institution (BSI). October 31, 2021. ISBN 978-0-539-18975-9.*
77. **^** *Madgwick, Della; Wood, Hannah (August 8, 2016). "The problem of clothes drying in new homes in the UK". Structural Survey.* ***34*** *(4/5): 320–330. doi:10.1108/SS-10-2015-0048. ISSN 0263-080X. Archived from the original on May 7, 2021. Retrieved April 11, 2024.*
78. **^** *May, Neil; McGilligan, Charles; Ucci, Marcella (2017). "Health and Moisture in Buildings" (PDF). UK Centre for Moisture in Buildings. Archived (PDF) from the original on April 11, 2024. Retrieved April 11, 2024.*
79. **^** *"Understanding and addressing the health risks of damp and mould in the home". GOV.UK. September 7, 2023. Archived from the original on April 10, 2024. Retrieved April 11, 2024.*
80. **^** *Clark, Sierra N.; Lam, Holly C. Y.; Goode, Emma-Jane; Marczylo, Emma L.; Exley, Karen S.; Dimitroulopoulou, Sani (August 2, 2023). "The Burden of Respiratory Disease from Formaldehyde, Damp and Mould in English Housing". Environments.* ***10*** *(8): 136. doi:10.3390/environments10080136. ISSN 2076-3298.*

81. **^** Microbiology of the Indoor Environment Archived July 23, 2011, at the Wayback Machine, microbe.net
82. **^** http://www.info.gov.hk/info/sars/pdf/amoy_e.pdf
83. **^** https://www.info.gov.hk/info/sars/graphics/amoyannex.jpg
84. **^** *"Progress in Global Surveillance and Response Capacity 10 Years after Severe Acute Respiratory Syndrome". "environmental contamination with SARS CoV RNA was identified on the carpet in front of the index case-patient's room and 3 nearby rooms (and on their door frames but not inside the rooms) and in the air intake vents near the centrally located elevators ... secondary infections occurred not in 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."*
85. **^** *Azuma, Kenichi; Kagi, Naoki; Yanagi, U.; Osawa, Haruki (December 2018). "Effects of low-level inhalation exposure to carbon dioxide in indoor environments: A short review on human health and psychomotor performance". Environment International.* ***121*** *(Pt 1): 51–56. Bibcode:2018EnInt.121...51A. doi:10.1016/j.envint.2018.08.059. PMID 30172928.*
86. **^** *Du, Bowen; Tandoc, Michael (June 19, 2020). "Indoor CO2 concentrations and cognitive function: A critical review". International Journal of Indoor Environment and Health.* ***30*** *(6): 1067–1082. Bibcode:2020InAir..30.1067D. doi:10.1111/ina.12706. PMID 32557862. S2CID 219915861.*
87. **^** *Fan, Yuejie; Cao, Xiaodong; Zhang, Jie; Lai, Dayi; Pang, Liping (June 1, 2023). "Short-term exposure to indoor carbon dioxide and cognitive task performance: A systematic review and meta-analysis". Building and Environment.* ***237****: 110331. Bibcode:2023BuEnv.23710331F. doi:10.1016/j.buildenv.2023.110331.*
88. ^ ***a b*** *Lowther, Scott D.; Dimitroulopoulou, Sani; Foxall, Kerry; Shrubsole, Clive; Cheek, Emily; Gadeberg, Britta; Sepai, Ovnair (November 16, 2021). "Low Level Carbon Dioxide Indoors—A Pollution Indicator or a Pollutant? A Health-Based Perspective". Environments.* ***8*** *(11): 125. doi:10.3390/environments8110125. ISSN 2076-3298.*
89. **^** *Persily, Andrew (July 2022). "Development and application of an indoor carbon dioxide metric". Indoor Air.* ***32*** *(7): e13059. doi:10.1111/ina.13059. PMID 35904382.*
90. **^** *"Indoor Environmental Quality: HVAC Management | NIOSH | CDC". www.cdc.gov. February 25, 2022. Archived from the original on April 1, 2022. Retrieved April 1, 2022.*

91. **^** Indoor Environmental Quality: Building Ventilation Archived January 20, 2022, at the Wayback Machine. National Institute for Occupational Safety and Health. Accessed October 8, 2008.
92. **^** *"SAMHE - Schools' Air quality Monitoring for Health and Education". samhe.org.uk. Archived from the original on March 18, 2024. Retrieved March 18, 2024.*
93. **^** *"Document Display | NEPIS | US EPA". nepis.epa.gov. Archived from the original on November 16, 2023. Retrieved October 19, 2023.*
94. **^** Zeeb & Shannoun 2009, p. 3.
95. **^** C.Michael Hogan and Sjaak Slanina. 2010, *Air pollution*. Encyclopedia of Earth Archived October 12, 2006, at the Wayback Machine. eds. Sidney Draggan and Cutler Cleveland. National Council for Science and the Environment. Washington DC
96. **^** *"Radon Mitigation Methods". Radon Solution—Raising Radon Awareness. Archived from the original on December 15, 2008. Retrieved December 2, 2008.*
97. **^** Zeeb & Shannoun 2009, p. [*page needed*].
98. **^** *"Basic radon facts" (PDF). US Environmental Protection Agency. Archived (PDF) from the original on January 13, 2022. Retrieved September 18, 2018.* Image not found or type unknown Public Domain This article incorporates text from this source, which is in the public domain.
99. **^** *"Radon Action Level and Target Level". UKradon. Archived from the original on March 18, 2024. Retrieved March 18, 2024.*
100. **^** *"Radon Zone Map (with State Information)". U.S. Environmental Protection Agency. Archived from the original on April 1, 2023. Retrieved April 10, 2024.*
101. **^** *"UK maps of radon". UKradon. Archived from the original on March 7, 2024. Retrieved April 10, 2024.*
102. **^** *"Radon map of Australia". Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). Archived from the original on March 20, 2024. Retrieved April 10, 2024.*
103. **^** *"Climate Change 2021: The Physical Science Basis". Intergovernmental Panel on Climate Change. Archived (PDF) from the original on May 26, 2023. Retrieved April 15, 2024.*
104. **^** *Chen, Guochao; Qiu, Minghao; Wang, Peng; Zhang, Yuqiang; Shindell, Drew; Zhang, Hongliang (July 19, 2024). "Continuous wildfires threaten public and ecosystem health under climate change across continents". Frontiers of Environmental Science & Engineering.* ***18*** *(10). doi:10.1007/s11783-024-1890-6. ISSN 2095-2201.*
105. **^** *Gherasim, Alina; Lee, Alison G.; Bernstein, Jonathan A. (November 14, 2023). "Impact of Climate Change on Indoor Air Quality". Immunology and Allergy Clinics of North America.* ***44*** *(1): 55–73. doi:10.1016/j.iac.2023.09.001. PMID 37973260. Archived from the original on November 15, 2023. Retrieved April 15, 2024.*
106. **^** *Lacressonnière, Gwendoline; Watson, Laura; Gauss, Michael; Engardt, Magnuz; Andersson, Camilla; Beekmann, Matthias; Colette, Augustin; Foret, Gilles; Josse, Béatrice; Marécal, Virginie; Nyiri, Agnes; Siour, Guillaume; Sobolowski, Stefan; Vautard, Robert (February 1, 2017). "Particulate matter air pollution in Europe in a*

+2 °C warming world". Atmospheric Environment. ***154****: 129–140. Bibcode:2017AtmEn.154..129L. doi:10.1016/j.atmosenv.2017.01.037. Archived from the original on November 17, 2023. Retrieved April 15, 2024.*

107. **^** *Lee, J; Lewis, A; Monks, P; Jacob, M; Hamilton, J; Hopkins, J; Watson, N; Saxton, J; Ennis, C; Carpenter, L (September 26, 2006). "Ozone photochemistry and elevated isoprene during the UK heatwave of august 2003". Atmospheric Environment.* ***40*** *(39): 7598–7613. Bibcode:2006AtmEn..40.7598L. doi:10.1016/j.atmosenv.2006.06.057. Archived from the original on October 26, 2022. Retrieved April 15, 2024.*
108. **^** *Salthammer, Tunga; Schieweck, Alexandra; Gu, Jianwei; Ameri, Shaghayegh; Uhde, Erik (August 7, 2018). "Future trends in ambient air pollution and climate in Germany – Implications for the indoor environment". Building and Environment.* ***143****: 661–670. Bibcode:2018BuEnv.143..661S. doi:10.1016/j.buildenv.2018.07.050 .*
109. **^** *Zhong, L.; Lee, C.-S.; Haghighat, F. (December 1, 2016). "Indoor ozone and climate change". Sustainable Cities and Society.* ***28****: 466–472. doi:10.1016/j.scs.2016.08.020. Archived from the original on November 28, 2022. Retrieved April 15, 2024.*
110. **^** *Zhao, Jiangyue; Uhde, Erik; Salthammer, Tunga; Antretter, Florian; Shaw, David; Carslaw, Nicola; Schieweck, Alexandra (December 9, 2023). "Long-term prediction of the effects of climate change on indoor climate and air quality". Environmental Research.* ***243****: 117804. doi:10.1016/j.envres.2023.117804. PMID 38042519.*
111. **^** *Niculita-Hirzel, Hélène (March 16, 2022). "Latest Trends in Pollutant Accumulations at Threatening Levels in Energy-Efficient Residential Buildings with and without Mechanical Ventilation: A Review". International Journal of Environmental Research and Public Health.* ***19*** *(6): 3538. doi: 10.3390/ijerph19063538. ISSN 1660-4601. PMC 8951331. PMID 35329223.*
112. **^** *UK Health Security Agency (2024) [1 September 2012]. "Chapter 5: Impact of climate change policies on indoor environmental quality and health in UK housing". Health Effects of Climate Change (HECC) in the UK: 2023 report (published January 15, 2024).*
113. **^** *World Health Organization, ed. (2010). Who guidelines for indoor air quality: selected pollutants. Copenhagen: WHO. ISBN 978-92-890-0213-4. OCLC 696099951.*
114. **^** *"Air quality: UK guidelines for volatile organic compounds in indoor spaces". Public Health England. September 13, 2019. Retrieved April 17, 2024.*
115. **^** *"Home - IEQ Guidelines". ieqguidelines.org. Retrieved April 17, 2024.*
116. **^** *Toyinbo, Oluyemi; Hägerhed, Linda; Dimitroulopoulou, Sani; Dudzinska, Marzenna; Emmerich, Steven; Hemming, David; Park, Ju-Hyeong; Haverinen-Shaughnessy, Ulla; the Scientific Technical Committee 34 of the International Society of Indoor Air Quality, Climate (April 19, 2022). "Open database for international and national indoor environmental quality guidelines". Indoor Air.* ***32*** *(4): e13028. doi:10.1111/ina.13028. ISSN 0905-6947. PMC 11099937. PMID 35481936.*cite journal: CS1 maint: numeric names: authors list (link)

117. **^** *Dimitroulopoulou, Sani; DudziÃƒÆ’Ã†â€™Ãƒâ€ Ã¢â‚¬â„¢ÃƒÆ’Ã¢â‚¬Â ÃƒÂ¢Ã¢â€šÂ¬Ã¢â€žÂ¢ÃƒÆ’Ã†â€™ÃƒÂ¢Ã Marzenna R.; Gunnarsen, Lars; Hägerhed, Linda; Maula, Henna; Singh, Raja; Toyinbo, Oluyemi; Haverinen-Shaughnessy, Ulla (August 4, 2023). "Indoor air quality guidelines from across the world: An appraisal considering energy saving, health, productivity, and comfort". Environment International.* ***178****: 108127. Bibcode:2023EnInt.17808127D. doi:10.1016/j.envint.2023.108127. PMID 37544267.*
118. **^** *Pitarma, Rui; Marques, Gonçalo; Ferreira, Bárbara Roque (February 2017). "Monitoring Indoor Air Quality for Enhanced Occupational Health". Journal of Medical Systems.* ***41*** *(2): 23. doi:10.1007/s10916-016-0667-2. PMID 28000117. S2CID 7372403.*
119. **^** *Wyon, D. P. (August 2004). "The effects of indoor air quality on performance and productivity: The effects of IAQ on performance and productivity". Indoor Air.* ***14****: 92–101. doi:10.1111/j.1600-0668.2004.00278.x. PMID 15330777.*
120. **^** *Son, Young Joo; Pope, Zachary C.; Pantelic, Jovan (September 2023). "Perceived air quality and satisfaction during implementation of an automated indoor air quality monitoring and control system". Building and Environment.* ***243****: 110713. Bibcode:2023BuEnv.24310713S. doi:10.1016/j.buildenv.2023.110713.*
121. **^** *IAQM (2021). Indoor Air Quality Guidance: Assessment, Monitoring, Modelling and Mitigation (PDF) (Version 0.1 ed.). London: Institute of Air Quality Management.*
122. ^ ***a b*** *Institute for Occupational Safety and Health of the German Social Accident Insurance. "Indoor workplaces – Recommended procedure for the investigation of working environment". Archived from the original on November 3, 2021. Retrieved June 10, 2020.*
123. **^** *"Climate Change: Atmospheric Carbon Dioxide | NOAA Climate.gov". www.climate.gov. April 9, 2024. Retrieved May 6, 2024.*
124. **^** *"Ventilation to reduce the spread of respiratory infections, including COVID-19". GOV.UK. August 2, 2022. Archived from the original on January 18, 2024. Retrieved April 15, 2024.*
125. **^** *Dela Cruz, Majbrit; Christensen, Jan H.; Thomsen, Jane Dyrhauge; Müller, Renate (December 2014). "Can ornamental potted plants remove volatile organic compounds from indoor air? — a review". Environmental Science and Pollution Research.* ***21*** *(24): 13909–13928. Bibcode:2014ESPR...2113909D. doi:10.1007/s11356-014-3240-x. PMID 25056742. S2CID 207272189.*
126. **^** *Cummings, Bryan E.; Waring, Michael S. (March 2020). "Potted plants do not improve indoor air quality: a review and analysis of reported VOC removal efficiencies". Journal of Exposure Science & Environmental Epidemiology.* ***30*** *(2): 253–261. Bibcode:2020JESEE..30..253C. doi:10.1038/s41370-019-0175-9. PMID 31695112. S2CID 207911697.*
127. **^** *Wolverton, B. C.; Wolverton, J. D. (1996). "Interior plants: their influence on airborne microbes inside energy-efficient buildings". Journal of the Mississippi Academy of Sciences.* ***41*** *(2): 100–105.*

128. **^** *US EPA, OAR (July 16, 2013). "Mold". US EPA. Archived from the original on May 18, 2020. Retrieved September 16, 2019.*
129. **^** *Institute of Medicine (US) Committee on Damp Indoor Spaces and Health (2004). Damp Indoor Spaces and Health. National Academies Press. ISBN 978-0-309-09193-0. PMID 25009878. Archived from the original on January 19, 2023. Retrieved March 30, 2024.*[*page needed*]
130. **^** *"Indoor Environmental Quality". Washington, DC: US National Institute for Occupational Safety and Health. Archived from the original on December 3, 2013. Retrieved May 17, 2013.*
131. **^** *Lewis, Alastair C; Allan, James; Carslaw, David; Carruthers, David; Fuller, Gary; Harrison, Roy; Heal, Mathew; Nemitz, Eiko; Reeves, Claire (2022). Indoor Air Quality (PDF) (Report). Air Quality Expert Group. doi:10.5281/zenodo.6523605. Archived (PDF) from the original on June 5, 2023. Retrieved April 15, 2024.*
132. **^** *"Isiaq.Org". International Society of Indoor Air Quality and Climate. Archived from the original on January 21, 2022. Retrieved March 2, 2012.*

Sources

[edit]
Monographs

- *May, Jeffrey C.; Connie L. May; Ouellette, John J.; Reed, Charles E. (2004). The mold survival guide for your home and for your health. Baltimore: Johns Hopkins University Press. ISBN 978-0-8018-7938-8.*
- *May, Jeffrey C. (2001). My house is killing me! : the home guide for families with allergies and asthma. Baltimore: The Johns Hopkins University Press. ISBN 978-0-8018-6730-9.*
- *May, Jeffrey C. (2006). My office is killing me! : the sick building survival guide. Baltimore: The Johns Hopkins University Press. ISBN 978-0-8018-8342-2.*
- *Salthammer, T., ed. (1999). Organic Indoor Air Pollutants — Occurrence, Measurement, Evaluation. Wiley-VCH. ISBN 978-3-527-29622-4.*
- *Spengler, J.D.; Samet, J.M. (1991). Indoor air pollution: A health perspective. Baltimore: Johns Hopkins University Press. ISBN 978-0-8018-4125-5.*
- *Samet, J.M.; McCarthy, J.F. (2001). Indoor Air Quality Handbook. NY: McGraw–Hill. ISBN 978-0-07-445549-4.*
- *Tichenor, B. (1996). Characterizing Sources of Indoor Air Pollution and Related Sink Effects. ASTM STP 1287. West Conshohocken, PA: ASTM. ISBN 978-0-8031-2030-3.*
- *Zeeb, Hajo; Shannoun, Ferid, eds. (2009). WHO Handbook on Indoor Radon: A Public Health Perspective. World Health Organization. ISBN 978-92-4-154767-3. PMID 23762967. NBK143216. Archived from the original on March 30, 2024. Retrieved March 30, 2024.*

Articles, radio segments, web pages

- *Apte, M. G.; Buchanan, I. S. H.; Mendell, M. J. (April 2008). "Outdoor ozone and building-related symptoms in the BASE study". Indoor Air.* ***18*** *(2): 156–170.*

Bibcode:2008InAir..18..156A. doi:10.1111/j.1600-0668.2008.00521.x. PMID 18333994.
- Bad In-Flight Air Exacerbated by Passengers Archived December 15, 2021, at the Wayback Machine, Talk of the Nation, National Public Radio, September 21, 2007.
- Indoor Air Pollution index page, United States Environmental Protection Agency.
- *Steinemann, Anne (2017). "Ten questions concerning air fresheners and indoor built environments". Building and Environment.* ***111****: 279–284. Bibcode:2017BuEnv.111..279S. doi:10.1016/j.buildenv.2016.11.009. hdl: 11343/121890.*

Further reading

[edit]

- *Lin, Y.; Zou, J.; Yang, W.; Li, C. Q. (2018). "A Review of Recent Advances in Research on PM2.5 in China". International Journal of Environmental Research and Public Health.* ***15*** *(3): 438. doi:10.3390/ijerph15030438. PMC 5876983. PMID 29498704.*
- *Abdel Hameed, A. A.; Yasser, I. H.; Khoder, I. M. (2004). "Indoor air quality during renovation actions: a case study". Journal of Environmental Monitoring.* ***6*** *(9): 740–744. doi:10.1039/b402995j. PMID 15346177.*

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
Visual	◦ Air travel ◦ 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
- Peak water
- Pollution
- Privatization
- Quality
- Right
- Resources
    - improved
    - policy

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 ◦ Radium jaw ◦ Repetitive strain injury ◦ Silicosis ◦ Silo-filler's disease ◦ Sports injury ◦ Surfer's ear ◦ Tennis elbow ◦ Tinnitus ◦ Writer's cramp

Occupational hygiene		◦ Occupational hazard
		  ◦ Biological hazard
		  ◦ Chemical hazard
		  ◦ Physical hazard
		  ◦ Psychosocial hazard
		◦ Occupational stress
		◦ Hierarchy of hazard controls
		◦ Prevention through design
		◦ Exposure assessment
		◦ Occupational exposure limit
		◦ Occupational epidemiology
		◦ Workplace health surveillance

Professions		◦ Environmental health ◦ Industrial engineering ◦ 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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  - 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
- Passive house
- Passive ventilation
- Radiant heating and cooling
- Radiant cooling
- Radiant heating
- Radon mitigation
- Refrigeration
- Renewable heat
- Room air distribution
- Solar air heat
- Solar combisystem
- Solar cooling
- Solar heating

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

Components

- Grille

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

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Oxley Nature Center

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Photo

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OkieTundra

4.5 (84)

Photo

The Blue Dome

4.5 (60)

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Tulsa Zoo

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Bob Dylan Center

4.9 (245)

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Streetwalker Tours

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Driving Directions in Tulsa County

Driving Directions From ALDI to Durham Supply Inc

Driving Directions From Dollar General to Durham Supply Inc

Driving Directions From Best Western Airport to Durham Supply Inc

Driving Directions From Church on the Move Tulsa to Durham Supply Inc

Driving Directions From East Central High School to Durham Supply Inc

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95.8563627!2d36.1475704!1m5!1m1!1sChIJDzPLSIrytocRY_EaORpHGro!2m2!1d-95.8384781!2d36.1563128!3e2

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Driving Directions From Tulsa Zoo 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 Outsiders House Museum to Durham Supply Inc

Driving Directions From Route 66 Historical Village to Durham Supply Inc

Driving Directions From Streetwalker Tours to Durham Supply Inc

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Reviews for Durham Supply Inc

Durham Supply Inc

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Ethel Schiller

(5)

This place is really neat, if they don't have it they can order it from another of their stores and have it there overnight in most cases. Even hard to find items for a trailer! I definitely recommend this place to everyone! O and the prices is awesome too!

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.

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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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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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!

Confirming Compliance with HUD Requirements for Mobile Home Ducts**View GBP**

Check our other pages :

- **Understanding PPE Guidelines for Mobile Home Furnace Repair**
- **Checking Gas Line Integrity in Mobile Home Heating Systems**
- **Matching Compatibility of Controls and Existing Wiring**

Frequently Asked Questions

What specific HUD requirements must mobile home ducts meet for compliance?

Mobile home ducts must comply with HUDs Manufactured Home Construction and Safety Standards, which include specific criteria such as duct sizing based on the homes design, proper sealing to prevent air leakage, use of approved materials that can withstand the environment within a mobile home, and adequate insulation to maintain energy efficiency.

How can I verify if my mobile homes HVAC system meets HUD standards?

To verify compliance, you should check for certification labels or documents from the manufacturer indicating adherence to HUD standards. Additionally, an inspection by a qualified professional who is familiar with these regulations can ensure that all components of your HVAC system, including ducts, meet requirements.

Are there regular inspections required for maintaining compliance with HUD standards for mobile home ducts?

While there are no mandatory federal inspections after installation unless specified by local jurisdictions or housing authorities, it is advisable to conduct regular maintenance checks. Periodic inspections by a certified technician can help ensure ongoing compliance and optimal performance of your HVAC system.

Royal Supply Inc

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