

- **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- **Identifying Warning Signs of Outdated Components**
Identifying Warning Signs of Outdated Components Converting Older Units to High Efficiency Models Examining Duct Layout for Better Distribution Adjusting Equipment Size to Fit Modern Needs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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Mobile homes, like any other living spaces, require efficient HVAC (Heating, Ventilation, and Air Conditioning) systems to ensure comfort throughout the year. However, many mobile homes rely on outdated components in their HVAC systems, which can lead to inefficiency, increased energy costs, and even safety hazards. Identifying these warning signs of outdated components is crucial for maintaining a comfortable and safe living environment.

Smart thermostats offer convenient temperature control for mobile homes **hvac system for mobile home** ultraviolet radiation.

One of the most common outdated components in mobile home HVAC systems is the ductwork. Over time, ducts can become leaky or clogged with debris due to age and lack of maintenance. This results in reduced airflow and uneven heating or cooling throughout the home. A telltale sign of duct problems is inconsistent temperatures from room to room or an increase in dust accumulation within the house. If you notice these issues, it might be time to inspect your ductwork for leaks or blockages.

Another component that often becomes obsolete is the thermostat. Older thermostats may not have modern features such as programmable settings or smart connectivity, which can help optimize energy use. An outdated thermostat may also struggle to maintain accurate temperature readings, leading to frequent cycling of the HVAC system and increased wear and tear on its components. If your thermostat seems unresponsive or if you're still using a manual model without digital capabilities, upgrading could significantly improve your system's efficiency.

The furnace is another critical component that can show signs of aging. An older furnace might emit strange noises during operation-such as banging or rattling-which could indicate worn-out parts like belts or motors. Additionally, rust or soot around the furnace area suggests potential combustion issues that need immediate attention for both efficiency and safety reasons.

Air conditioning units in mobile homes are also susceptible to becoming outdated over time. A major warning sign here includes reduced cooling effectiveness despite regular maintenance efforts like cleaning filters and coils. This could indicate that critical components such as compressors are wearing out due to age. High humidity levels within the home even when the AC is running might also suggest inefficiency stemming from an old system struggling to keep up with demands.

Finally, noticing higher than usual energy bills without any changes in usage patterns can serve as a red flag indicating outdated HVAC components. As these systems age, they tend to consume more power while delivering less effective heating or cooling—a clear indicator that certain elements within the system are no longer functioning optimally.

In conclusion, recognizing warning signs of outdated components in mobile home HVAC systems is essential for ensuring comfort and safety while minimizing energy costs. Regular inspections by qualified professionals can help identify these issues early on before they escalate into more serious problems requiring costly repairs or replacements. By being proactive about maintenance and upgrades where necessary—whether it's replacing old thermostats with modern versions or sealing leaky ducts—homeowners can enjoy more efficient climate control tailored perfectly for their needs.

In the fast-paced world of technology, keeping systems up-to-date is crucial for maintaining optimal performance and ensuring reliability. However, identifying when components become outdated can be challenging. Recognizing signs of inefficiency and performance issues is essential in preventing broader system failures and maintaining a competitive edge.

One of the first indicators that components may be outdated is a noticeable decline in system performance. Slower processing speeds, increased response times, and frequent lags are often symptomatic of underlying hardware or software inefficiencies. These issues can result from technological advancements that render older components less capable of meeting current demands or from accumulated wear and tear over time.

Another warning sign is an increase in system crashes or unexpected shutdowns. This erratic behavior often points to compatibility issues between older components and newer software updates or applications. As software evolves, it typically requires more resources and support for features not available in older hardware configurations. When these needs are unmet, stability suffers.

Moreover, escalating maintenance costs can signal that it's time to evaluate component efficacy. If repairs become frequent or expensive due to sourcing hard-to-find parts for obsolete hardware, this might indicate that upgrading would be more cost-effective than continuous patchwork fixes.

Security vulnerabilities also serve as critical red flags. Outdated components are often unsupported by manufacturers with security patches, leaving systems exposed to cyber threats. In an era where data breaches can have devastating consequences, ignoring these risks could lead to severe financial losses and damage an organization's reputation.

Energy inefficiency adds another layer of concern tied to outdated technology. Older equipment tends to consume more power than modern alternatives optimized for energy conservation. This not only raises operational costs but also contradicts efforts towards sustainability-an increasingly important consideration for businesses globally.

Lastly, user feedback provides valuable insights into potential problems stemming from outdated components. Complaints about slow applications or connectivity issues should not be dismissed lightly; they reflect real-world experiences that highlight areas needing attention.

In conclusion, staying vigilant about the signs of inefficiency and performance issues can help identify outdated components before they cause significant disruptions. By monitoring declines in performance, increasing maintenance demands, security vulnerabilities, energy inefficiencies, and listening to user feedback, organizations can proactively address these challenges. Updating systems not only enhances operational efficiency but also safeguards against potential security threats while aligning with cost-saving strategies and environmental goals.

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Essential Safety Gear and Equipment for Technicians

In the rapidly evolving landscape of technology, efficiency and performance are paramount. The digital devices and systems that power our world today are designed to operate with a fine balance between output and energy consumption. However, as these components age or become outdated, this balance can be disrupted, leading to increased energy consumption—a critical warning sign that should not be overlooked.

Increased energy consumption often serves as an early indicator of underlying issues within technological components. Whether it's a computer system, industrial machinery, or household appliances, all complex systems rely on a multitude of components working in harmony. Over time, wear and tear can degrade their efficiency. For example, in computing devices, outdated processors may struggle to handle modern software demands efficiently. This struggle results in more power being drawn to compensate for the lag, which is reflected in higher electricity bills and heat output.

From an environmental perspective, excessive energy use due to outdated components contributes to unnecessary carbon emissions. In a world increasingly conscious of climate change and environmental sustainability, ignoring the signs of increased energy consumption is both economically and ecologically irresponsible. Companies striving for sustainable operations must prioritize regular assessments of their equipment to ensure they are not inadvertently inflating their carbon footprint due to outdated technology.

Moreover, increased energy usage not only impacts the environment but also financial bottom lines. Businesses often experience significant cost savings by upgrading old systems with more efficient ones rather than maintaining power-hungry legacy technologies. These upgrades are investments that pay off over time through reduced utility costs and improved operational efficiency.

Identifying increased energy consumption as a warning sign requires vigilance and proactive monitoring. Implementing energy audits can help organizations pinpoint which components are drawing more power than necessary. Sophisticated monitoring tools can track real-time energy usage patterns and flag anomalies indicative of failing or obsolete hardware.

In conclusion, while technological advancements have made devices more efficient than ever before, the journey doesn't end at installation. Continuous observation of energy consumption patterns is crucial for maintaining optimal performance levels and ensuring sustainability goals are met. Increased energy usage should never be dismissed as merely an operational quirk; instead, it should serve as a catalyst for action-prompting timely upgrades or replacements that keep systems running smoothly while safeguarding both financial health and environmental integrity. Embracing this mindset will not only extend the lifespan of valuable technology investments but also contribute positively to broader societal efforts toward responsible resource management.



Proper Procedures for Handling Refrigerants and Chemicals

In today's fast-paced world, the seamless operation of machinery and technology is critical to both our personal and professional lives. Whether it's the car we drive to work, the computer we use for remote meetings, or the appliances that keep our homes running smoothly, ensuring these components function optimally is paramount. However, nothing lasts forever, and over time, even the most reliable equipment can begin to show signs of wear and tear. Recognizing these warning signs early through frequent repairs and maintenance alerts can save us from unexpected failures and costly replacements.

One of the first indicators that a component may be outdated is an increase in the frequency of repairs. When a piece of machinery or technology requires constant attention just to maintain its basic functionality, it might be a sign that it's nearing the end of its lifecycle. This uptick in maintenance requirements often points to underlying issues related to age or obsolescence. For example, if your office printer frequently jams despite regular servicing, it could indicate that some of its parts are worn out or incompatible with newer software systems.

Another warning sign is decreased efficiency. Outdated components often struggle to perform at their original capacity due to technological advancements that have surpassed them. This inefficiency can manifest as slower processing times on computers, increased energy consumption in household appliances, or reduced fuel economy in vehicles. These symptoms not only impact productivity but also lead to higher operational costs over time.

Noise levels are also a crucial indicator of potential issues with components. Machines typically operate within certain noise thresholds when functioning correctly; any unusual sounds like grinding, knocking, or clicking should not be ignored. These noises can signify mechanical degradation or alignment problems suggesting that parts may be reaching their functional limit.

Additionally, compatibility issues should raise alarms about outdated components. As software updates roll out and new technologies emerge, older systems may struggle to keep up with current standards. This incompatibility might cause frequent system crashes or errors during everyday tasks—a clear signal that it's time for an upgrade.

Finally, visual cues such as rusting metal parts or cracked casings are tangible evidence that a component has seen better days. Regular inspections revealing such deterioration highlight the need for immediate action before minor issues escalate into major failures.

To effectively manage these risks associated with outdated components requires a proactive approach: implementing regular maintenance schedules supported by alert systems designed specifically for identifying early warning signs of failure. By doing so, businesses and individuals alike can extend the lifespan of their equipment while minimizing disruptions caused by unexpected breakdowns.

In conclusion, recognizing frequent repairs and maintenance alerts as indicators of outdated components allows us to address potential problems before they become significant setbacks. Embracing this vigilant mindset not only preserves functionality but also ensures safety and cost-effectiveness in our increasingly tech-reliant lives—a practice well worth adopting in any modern setting.

Electrical Safety Protocols for Mobile Home HVAC Work

In the realm of mechanical systems, whether domestic appliances, vehicles, or industrial machinery, age is a silent factor that gradually erodes efficiency and reliability. As these systems age, they often begin to show subtle signs that can easily be overlooked by an untrained eye or ear. Among these signs are unusual noises and odors—often the first indicators of outdated components struggling to perform.

Unusual noises emanating from a system can range from persistent rattles and hums to high-pitched squeals or grinding sounds. These auditory clues are not merely nuisances but are symptomatic of deeper mechanical issues. For instance, a grinding noise in an automobile might suggest worn-out brake pads or failing bearings. Similarly, in household appliances like washing machines or refrigerators, strange noises may indicate motor wear or imbalance in moving parts. Such sounds often signify increased friction due to lack of lubrication or misalignment—a telltale sign that the component is nearing the end of its operational life.

Odors provide another dimension to diagnosing aging systems. A burnt smell from electrical equipment hints at overheating components, possibly due to faulty wiring or failing insulation.

In cars, a sweet scent could be indicative of a coolant leak, while musty odors might suggest mold growth within air conditioning units due to clogged filters and old components unable to maintain proper airflow.

These sensory signals should not be ignored as they serve as early warning signs pointing towards potential failures if left unchecked. Addressing them promptly can prevent minor issues from escalating into major malfunctions requiring costly repairs or replacements.

The presence of unusual noises and odors highlights the importance of regular maintenance and inspection regimes for any mechanical system. By being attentive to these warning signs, users can extend the lifespan of their equipment while ensuring safety and efficiency remain uncompromised.

Ultimately, understanding these indicators requires an appreciation for how mechanical components interact and degrade over time. It demands vigilance and sometimes invokes nostalgia as one reflects on the seamless operation experienced during earlier years when all parts were new and unworn. By heeding these warnings with timely interventions, we honor both technological craftsmanship and our own commitment to preserving smooth functionality amidst inevitable wear and tear brought about by time's relentless march forward.

Best Practices for Ensuring Structural Integrity During Installation and Maintenance

The quality of the air we breathe indoors plays a crucial role in maintaining our overall health and well-being. While many factors contribute to indoor air quality, one often overlooked aspect is the impact of outdated components within our living and working spaces. As buildings age, so do their components, including HVAC systems, filters, and insulation

materials. Understanding the warning signs of these outdated components can help us take timely actions to ensure that the air we breathe remains clean and healthy.

One of the most visible indicators of outdated components affecting indoor air quality is a noticeable decline in ventilation efficiency. Over time, HVAC systems can become clogged with dust and debris, significantly reducing their ability to circulate fresh air throughout a building. Inadequate ventilation not only leads to stuffy environments but also allows pollutants such as volatile organic compounds (VOCs) and allergens to accumulate. Occupants may begin experiencing symptoms like headaches, fatigue, or respiratory issues without realizing that an inefficient HVAC system could be at fault.

Another warning sign is an increase in energy bills without any substantial change in usage patterns. Outdated or poorly maintained heating and cooling systems often require more energy to function effectively due to wear and tear on their components. This inefficiency not only impacts financial resources but also contributes indirectly to poor indoor air quality as systems struggle to maintain appropriate humidity levels and filter out contaminants.

Old insulation materials are another culprit when assessing the impact of outdated components on indoor air quality. Insulation that has degraded over time might allow moisture ingress or harbor mold growth-both conditions that compromise air quality by introducing harmful spores into the environment. Furthermore, older buildings may still contain asbestos-based materials if they have not been updated; disturbance during renovations or repairs can release dangerous fibers into the air.

Additionally, frequent maintenance or repair issues signal that certain building elements may no longer be performing optimally. Persistent leaks from plumbing systems or aging roofs can introduce excess moisture into interiors-a breeding ground for mold and mildew which negatively affects both structural integrity and air purity.

In conclusion, recognizing warning signs such as decreased ventilation efficiency, unexplained increases in energy costs, deteriorating insulation effectiveness, and frequent maintenance needs are vital steps towards safeguarding indoor air quality against outdated components' detrimental effects. By remaining vigilant about these indicators-and taking proactive measures like regular inspections-property owners can ensure healthier living environments while also potentially extending their building's lifespan through timely upgrades or repairs where necessary. Investing attention now saves much larger costs later-not just financially but importantly regarding human health too!

Upgrading or replacing outdated HVAC components is a vital task to ensure energy efficiency, comfort, and safety in your home or workplace. Identifying the warning signs of outdated components can save you from unexpected breakdowns and costly repairs. This essay explores common indicators that suggest your HVAC system may be due for an upgrade or replacement.

One of the most telling signs that your HVAC components are outdated is a noticeable decline in performance. If you find that your system struggles to maintain a consistent temperature, it could be an indication that some parts are not functioning as efficiently as they should. An aging system often requires longer cycles to achieve desired temperatures, which not only impacts comfort but also results in higher energy bills.

Another red flag is frequent repairs. While occasional maintenance is normal, repeated service calls and part replacements may indicate that the system's components are nearing the end of their lifespan. In such cases, investing in newer technology might be more cost-effective than continuously patching up an old system.

Unusual noises stemming from the HVAC unit can also signal underlying issues. Rattling, banging, or squealing sounds often point to worn-out parts or mechanical failures within the system. These noises should not be ignored as they can worsen over time and lead to more significant problems if left unaddressed.

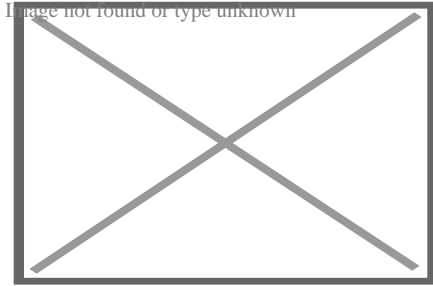
Increasing energy costs without a corresponding increase in usage is another sign that your HVAC components may be outdated. Older systems tend to lose efficiency over time, consuming more energy for less output. Upgrading to modern, energy-efficient models can significantly reduce utility bills and have a positive environmental impact.

Additionally, poor air quality inside your space could indicate that your HVAC system isn't operating effectively. Outdated filters and ductwork might fail to remove contaminants adequately, leading to dust accumulation and potential health risks for occupants.

In conclusion, recognizing these warning signs-declining performance, frequent repairs, unusual noises, rising energy costs, and poor air quality-can help determine when it's time to upgrade or replace outdated HVAC components. Addressing these issues promptly will enhance comfort levels while ensuring efficient operation of your heating and cooling systems for years to come. Embracing modern technology not only offers improved functionality but also contributes positively towards sustainability efforts by reducing overall energy consumption.



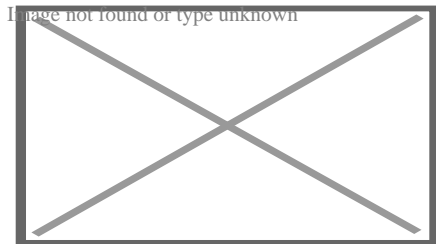
About Indoor air quality



An air filter being cleaned

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Part of a series on



Air pollution from a factory



- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
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- Global dimming
- Global distillation
- Indoor air quality
- Non-exhaust emissions
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○  Environment portal

○  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]

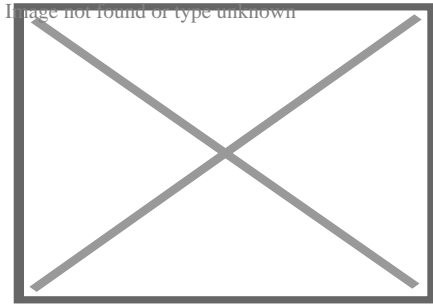
For health reasons it is crucial to breathe clean air, free from chemicals and toxicants as much as possible. It is estimated that humans spend approximately 90% of their lifetime indoors[⁸] and that indoor air pollution in some places can be much worse than that of the ambient air.[⁹][¹⁰]

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

Image not found or type unknown

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 monoxide, 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 (resuspended dust).^[36] Particulate matter can also be produced through cooking activities. Frying produces higher concentrations than boiling or grilling and cooking meat produces higher concentrations than cooking vegetables.^[37] Preparing a Thanksgiving dinner can produce very high concentrations of particulate matter, exceeding 300 $\mu\text{g}/\text{m}^3$.^[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 (O₃) is produced by certain high-voltage electric devices (such as air ionizers), and as a by-product of other types of pollution. It appears in lower

concentrations indoors than outdoors, usually at 0.2-0.7 of the outdoor concentration.^[66] Typically, most ozone is lost to surface reactions indoors, rather than to reactions in air, due to the large surface to volume ratios found indoors.^[67]

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

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

Biological agents

[edit]

Mold and other allergens

[edit]

Main articles: Indoor mold and Mold health issues

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

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

Mold growth can be inhibited by keeping surfaces at conditions that are further from condensation, with relative humidity levels below 75%. This usually translates to a relative humidity of indoor air below 60%, in agreement with the guidelines for thermal comfort that recommend a relative humidity between 40 and 60 %. Moisture buildup in

buildings may arise from water penetrating areas of the building envelope or fabric, from plumbing leaks, rainwater or groundwater penetration, or from condensation due to improper ventilation, insufficient heating or poor thermal quality of the building envelope.^[76] Even something as simple as drying clothes indoors on radiators can increase the risk of mold growth, if the humidity produced is not able to escape the building via ventilation.^[77]

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

Legionella

[edit]



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

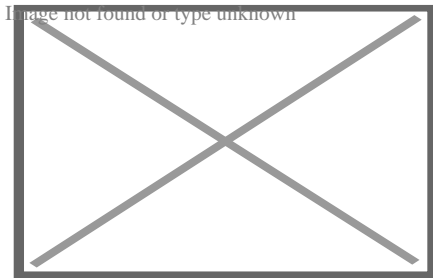
Legionella testing typically involves collecting water samples and surface swabs from evaporative cooling basins, shower heads, faucets/taps, and other locations where warm water collects. The samples are then cultured and colony forming units (cfu) of *Legionella* are quantified as cfu/liter.

Legionella is a parasite of protozoans such as amoeba, and thus requires conditions suitable for both organisms. The bacterium forms a biofilm which is resistant to chemical and antimicrobial treatments, including chlorine. Remediation for *Legionella* outbreaks in commercial buildings vary, but often include very hot water flushes (160 °F (71 °C)),

sterilisation of standing water in evaporative cooling basins, replacement of shower heads, and, in some cases, flushes of heavy metal salts. Preventive measures include adjusting normal hot water levels to allow for 120 °F (49 °C) at the tap, evaluating facility design layout, removing faucet aerators, and periodic testing in suspect areas.

Other bacteria

[edit]



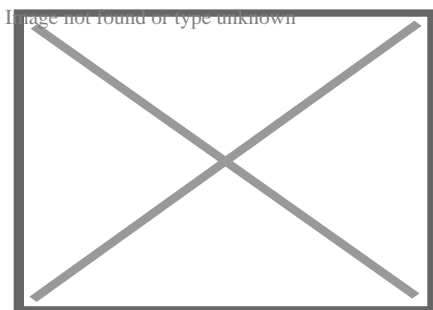
Airborne bacteria

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

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

Virus

[edit]



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

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

Carbon dioxide

[edit]

Humans are the main indoor source of carbon dioxide (CO₂) in most buildings. Indoor CO₂ levels are an indicator of the adequacy of outdoor air ventilation relative to indoor occupant density and metabolic activity.

Indoor CO₂ levels above 500 ppm can lead to higher blood pressure and heart rate, and increased peripheral blood circulation.^[85] With CO₂ 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 CO₂ at lower concentrations is conflicting and it is difficult to link CO₂ 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 CO₂, the total indoor CO₂ 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 CO₂ levels below 1000 ppm represent good IAQ, between 1000 and 1500 ppm represent moderate IAQ and greater than 1500 ppm represent poor IAQ.^[88]

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

Radon

[edit]

Main article: Radon

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

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

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

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

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

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

IAQ and climate change

[edit]

See also: Effects of climate change on human health

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

and models have attempted to predict how the forecasted IPCC scenarios will vary indoor air quality and indoor comfort parameters such as humidity and temperature.^[110]

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

Indoor air quality standards and monitoring

[edit]

Quality guidelines and standards

[edit]

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

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

Real-time monitoring

[edit]


Since indoor air pollutants can adversely affect human health, it is important to have real-time indoor air quality assessment/monitoring system that can help not only in the improvement of indoor air quality but also help in detection of leaks, spills in a work environment and boost energy efficiency of buildings by providing real-time feedback to the heating, ventilation, and air conditioning (HVAC) system(s).^[118] Additionally, there

have been enough studies that highlight the correlation between poor indoor air quality and loss of performance and productivity of workers in an office setting.^[119]

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

Improvement measures

[edit]

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


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

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

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

Source control


[edit]

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HVAC design

[edit]

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

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Environmentally sustainable design concepts include aspects of commercial and residential heating, ventilation and air-conditioning (HVAC) technologies. Among several considerations, one of the topics attended to is the issue of indoor air quality throughout

the design and construction stages of a building's life.^[citation needed]

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

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

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

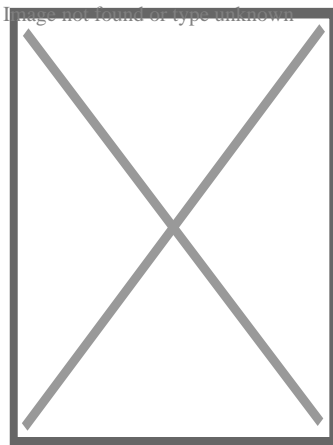
The "dew point temperature" is an absolute measure of the moisture in air. Some facilities are being designed with dew points in the lower 50s °F, and some in the upper and lower 40s °F.^[citation needed] Some facilities are being designed using desiccant wheels with gas-fired heaters to dry out the 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

[edit]



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

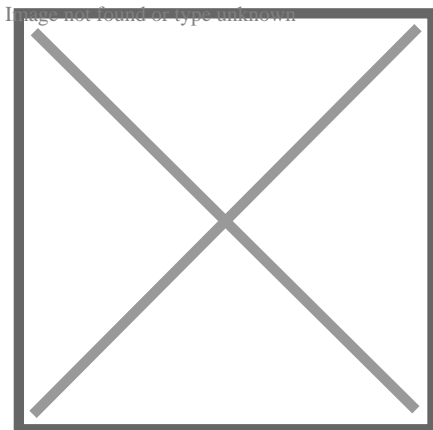
Houseplants together with the medium in which they are grown can reduce components of indoor air pollution, particularly volatile organic compounds (VOC) such as benzene, toluene, and xylene. Plants remove CO₂ and release oxygen and water, although the quantitative impact for house plants is small. The 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/m² 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

[edit]



EPA graphic about asthma triggers

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

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

air quality.^[130]

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

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

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

See also

[edit]

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

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[edit]

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External links

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- 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

Digital

Electromagnetic

Natural

Noise

Radiation

- Biological hazard
- Genetic pollution
- Introduced species
 - Invasive species
- Information pollution
- Light
 - Ecological light pollution
 - Overillumination
- Radio spectrum pollution
- Ozone
- Radium and radon in the environment
- Volcanic ash
- Wildfire
- Transportation
 - Land
 - Water
 - Air
 - Rail
 - Sustainable transport
- Urban
- Sonar
 - Marine mammals and sonar
- Industrial
- Military
- Abstract
- Noise control
- 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
- Satellite
- Air travel
- Clutter (advertising)
- Traffic signs
- Overhead power lines
- Vandalism

Space

Visual







War

- Chemical warfare
- Herbicidal warfare (Agent Orange)
- Nuclear holocaust (Nuclear fallout - nuclear famine - nuclear winter)
- Scorched earth
- Unexploded ordnance
- War and environmental law
- Agricultural wastewater
- Biological pollution
- Diseases
- Eutrophication
- Firewater
- Freshwater
- Groundwater
- Hypoxia
- Industrial wastewater
- Marine
 - debris
- Monitoring
- Nonpoint source pollution

Water

- 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
- Pollutants
 - Heavy metals
 - Paint
- Brain health and pollution

Topics

Misc	<ul style="list-style-type: none"> Area source Debris Dust Garbology Legacy pollution Midden Point source Waste 	
	Responses	<ul style="list-style-type: none"> Cleaner production Industrial ecology Pollution haven hypothesis Pollutant release and transfer register Polluter pays principle Pollution control Waste minimisation Zero waste
	Lists	<ul style="list-style-type: none"> Diseases Law by country Most polluted cities Least polluted cities by PM_{2.5} Most polluted countries Most polluted rivers Treaties
 Categories (by country)  Commons  WikiProject Environment  WikiProject Ecology		
 Environment portal  Ecology portal		

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Natural resources

Air	Pollution / quality	<ul style="list-style-type: none"> Ambient standards (US) Index Indoor Law <ul style="list-style-type: none"> Clean Air Act (US) Ozone depletion
	Emissions	<ul style="list-style-type: none"> 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

Aspects

- Watershed
- Desalination
- Floods
- Law
- Leaching
- Sanitation
 - improved
- Scarcity
- Security
- Supply
- Efficiency
- Conflict
- Conservation
- Peak water
- Pollution
- Privatization
- Quality
- Right
- Resources
 - improved
 - policy

- 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

Related

- Resource
 - Common-pool
 - Conflict (perpetuation)
 - Curse
 - Depletion
 - Extraction
 - Nationalism
 - Renewable / Non-renewable
- Politics
 - Oil war
 - Petrostate
 - Resource war

○  **Category** Image not found or type unknown

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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 hazard
 - Biological hazard
 - Chemical hazard
 - Physical hazard
 - Psychosocial hazard
- Occupational hygiene**
 - Occupational stress
 - Hierarchy of hazard controls
 - Prevention through design
 - Exposure assessment
 - Occupational exposure limit
 - Occupational epidemiology
 - Workplace health surveillance
 - Environmental health
 - Industrial engineering
- Professions**
 - Occupational health nursing
 - Occupational health psychology
 - Occupational medicine
 - Occupational therapist
 - Safety engineering
- International**
 - European Agency for Safety and Health at Work
 - International Labour Organization
 - World Health Organization
 - Canadian Centre for Occupational Health and Safety (Canada)
 - Istituto nazionale per l'assicurazione contro gli infortuni sul lavoro (Italy)
- Agencies and organizations**
 - National**
 - 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
- Immediately dangerous to life or health
- Diving regulations
- Occupational Safety and Health Act (United States)

Legislation

- Potty parity (United States)
- Right to sit (United States)
- Workers' right to access the toilet

- 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

See also

-  **Category**
 - Occupational diseases
 - Journals
 - Organizations

-  **Commons**

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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
- Grille

Components

**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
- 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

**Professions,
trades,
and services**

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)
- ASHRAE Handbook
- Building science
- Fireproofing

See also

- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

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International

- FAST
- United States

National

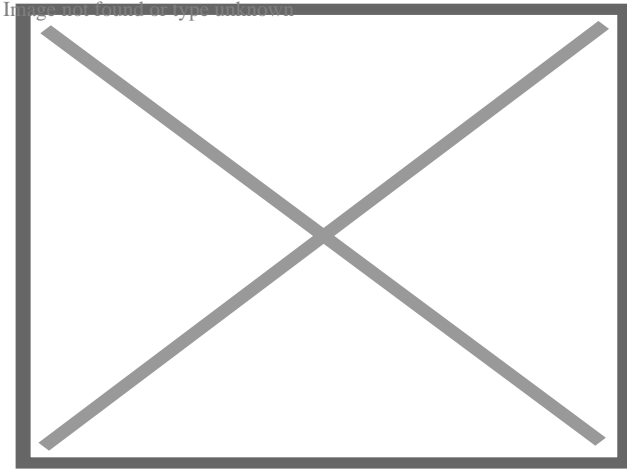
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About Manufactured housing



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A modern "triple wide" home

Manufactured housing (commonly known as mobile homes in the United States) is a type of prefabricated housing that is largely assembled in factories and then transported to sites of use. The definition of the term in the United States is regulated by federal law (Code of Federal Regulations, 24 CFR 3280): "Manufactured homes are built as dwelling units of at least 320 square feet (30 m²) in size with a permanent chassis to assure the initial and continued transportability of the home."^[1] The requirement to have a wheeled chassis permanently attached differentiates "manufactured housing" from other types of prefabricated homes, such as modular homes.

United States

[edit]

Definition

[edit]

According to the Manufactured Housing Institute's National Communities Council (MHINCC), *manufactured homes*^[2]

are homes built entirely in the factory under a federal building code administered by the U.S. Department of Housing and Urban Development (HUD). The Federal Manufactured Home Construction and Safety Standards (commonly known as the HUD Code) went into effect June 15, 1976. Manufactured homes may be single- or multi-section and are transported to the site and installed.

The MHINCC distinguishes among several types of *factory-built housing*: manufactured homes, modular homes, panelized homes, pre-cut homes, and mobile homes.

From the same source, *mobile home* "is the term used for manufactured homes produced prior to June 15, 1976, when the HUD Code went into effect."^[2] Despite the formal definition, *mobile home* and *trailer* are still common terms in the United States for this type of housing.

History

[edit]

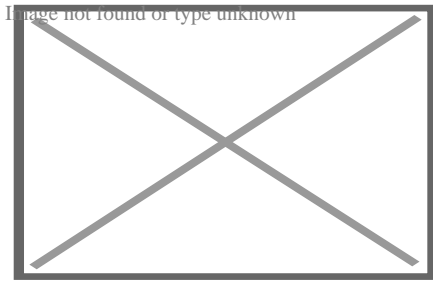
The original focus of this form of housing was its ability to relocate easily. Units were initially marketed primarily to people whose lifestyle required mobility. However, beginning in the 1950s, these homes began to be marketed primarily as an inexpensive form of housing designed to be set up and left in a location for long periods of time, or even permanently installed with a masonry foundation. Previously, units had been eight feet or less in width, but in 1956, the 10-foot (3.0 m) wide home was introduced. This helped solidify the line between mobile and house/travel trailers, since the smaller units could be moved simply with an automobile, but the larger, wider units required the services of a professional trucking company. In the 1960s and '70s, the homes became even longer and wider, making the mobility of the units more difficult. Today, when a factory-built home is moved to a location, it is usually kept there permanently. The mobility of the units has decreased considerably.

The factory-built homes of the past developed a negative stereotype because of their lower cost and the tendency for their value to depreciate more quickly than site-built homes. The tendency of these homes to rapidly depreciate in resale value made using them as collateral for loans far riskier than traditional home loans. Loan terms were usually limited to less than the 30-year term typical of the general home-loan market, and interest rates were considerably higher. In other words, these home loans resembled motor vehicle loans far more than traditional home mortgages. They have been consistently linked to lower-income families, which has led to prejudice and zoning restrictions, which include limitations on the number and density of homes permitted on any given site, minimum size requirements, limitations on exterior colors and finishes, and foundation mandates.

Many jurisdictions do not allow the placement of any additional factory-built homes, while others have strongly limited or forbidden all single-wide models, which tend to depreciate more rapidly than modern double-wide models. The derogatory concept of a "trailer park" is typically older single-wide homes occupying small, rented lots and remaining on wheels, even if the home stays in place for decades.

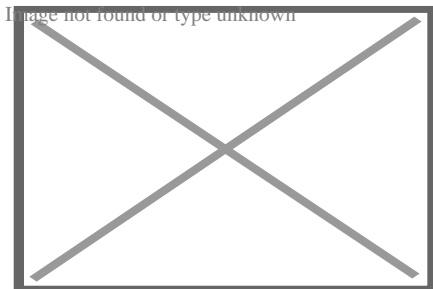
Modern manufactured homes

[edit]

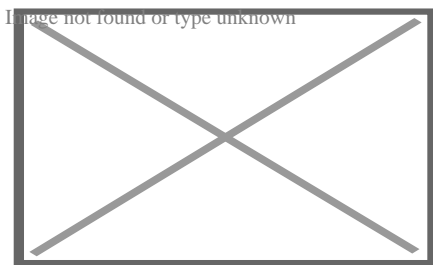


A manufactured house ready to be assembled in Grass Valley, California

Modern homes, especially modular homes, belie this image and can be identical in appearance to site-built homes. Newer homes, particularly double-wides, tend to be built to much higher standards than their predecessors. This has led to a reduction in the rate of value depreciation of many used units.



A manufactured house just before construction of its garage



Stick built garage being added to a new manufactured house

Although great strides have been made in terms of quality, manufactured homes do still struggle with construction problems. Author Wes Johnson has pointed out that the HUD code which governs manufactured homes desperately needs to be updated, quality control at manufacturing facilities are often lax, and set-up issues often compromise even a well-made manufactured home. Johnson states buyers need to be exceptionally cautious if they are entertaining the idea of purchasing any manufactured home by carefully checking it for defects before signing the contract and supervising the set-up process closely. These homes in the modern age are built to be beautiful and last longer than the typical old trailers.^[citation needed]

When FEMA studied the destruction wrought by Hurricane Andrew in Dade County Florida, they concluded that modular and masonry homes fared best compared to other construction.^[3]

High-performance manufactured housing

[edit]

While manufactured homes are considered to be affordable housing, older models can be some of the most expensive in the nation to heat due to energy inefficiency.^[4] *High-performance manufactured housing* uses less energy and therefore increases life-cycle affordability by decreasing operating costs. High-performance housing is not only energy efficient, but also attractive, functional, water-efficient, resilient to wind, seismic forces, and moisture penetration, and has healthy indoor environmental quality. Achieving high-performance involves integrated, whole building design, involving many components, not one single technology. High-performance manufactured housing should also include energy efficient appliances, such as Energy Star qualified appliances.^[4] Energy Star requires ample insulation: 2x6 walls: R21, roof: R40, floor: R33.

Difference from modular homes

[edit]

Both types of homes - manufactured and modular - are commonly referred to as factory-built housing, but they are not identical. Modular homes are built to International Residential Code (IRC) code. Modular homes can be transported on flatbed trucks rather than being towed, and can lack axles and an automotive-type frame. However, some modular houses are towed behind a semi-truck or toter on a frame similar to that of a trailer. The house 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 house. Once the house has reached its location, the axles and the tongue of the frame are then removed, and the house is set on a concrete foundation by a large crane. Some modern modular homes, once fully assembled, are indistinguishable from site-built homes. In addition, modular homes:

- must conform to the same local, state and regional building codes as homes built on-site;
- are treated the same by banks as homes built on-site. They are easily refinanced, for example;
- must be structurally approved by inspectors;
- can be of any size, although the block sections from which they are assembled are uniformly sized;^[5]^[6]

Difference from IRC codes homes (site built)

[edit]

Manufactured homes have several standard requirements that are more stringent than International Residential Code homes.

Fire Protection

A National Fire Protection Association (NFPA) study from July 2011 shows that occurrence of fires is lower in manufactured housing and the injury rate is lower in manufactured housing. The justification behind the superior fire safety is due to the following higher standard requirements:

- The HUD standard requires a flame spread of 25 or less in water heater and furnace compartments.
- The HUD standard requires a flame spread of 50 or less on the wall behind the range.
- The HUD standard requires a flame spread of 75 or less on the ceilings.
- The HUD standard requires a flame spread of 25 or less to protect the bottoms and side of kitchen cabinets around the range.
- The HUD standard requires additional protection of cabinets above the range.
- The HUD standard requires trim larger than 6" to meet flame spread requirements.
- The HUD standard requires smoke detectors in the general living area.
- The HUD standard requires 2 exterior doors.
- The HUD standard requires bedroom doors to be within 35 feet of an exterior door.

Bay Area

[edit]

The San Francisco Bay Area, located in Northern California, is known for its high real estate prices, making manufactured housing an increasingly popular alternative to traditional real estate.^[7] It is mainly the value of the land that makes real estate in this area so expensive. As of May 2011, the median price of a home in Santa Clara was \$498,000,^[8] while the most expensive manufactured home with all the premium features was only \$249,000.^[9] This drastic price difference is due to the fact that manufactured homes are typically placed in communities where individuals do not own the land, but instead pay a monthly site fee. This enables a consumer, who could otherwise not afford to live in the Bay Area, the opportunity to own a new home in this location. There are various communities of manufactured homes in the Bay Area, the largest being Casa de Amigos, located in Sunnyvale, California.

Bulk material storage

○

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Bulk material storage

Construction starts with the frame

○

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**Construction starts with
the frame**

Interior wall assemblies are attached

○

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**Interior wall assemblies
are attached**

Exterior wall assemblies are set in place

○

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**Exterior wall assemblies
are set in place**

Roof assembly is set atop the house

○

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**Roof assembly is set
atop the house**

Drywall completed

○

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Drywall completed

House is ready for delivery to site

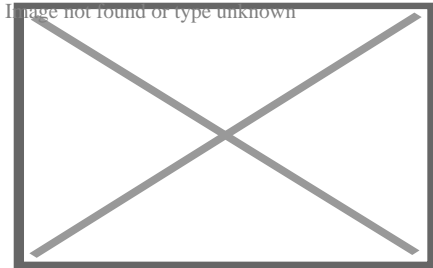
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House is ready for
delivery to site

Australia

[edit]



An Australian modern prefabricated house

In Australia these homes are commonly known as **transportable homes**, **relocatable homes** or **prefabricated homes** (not to be confused with the American meaning of the term). They are not as common as in the US, but the industry is expected to grow as this method of construction becomes more accepted.

Manufactured home parks refer to housing estates where the house owner rents the land instead of owning it. This is quite common in Queensland in both the form of tourist parks and over fifty estates. The term transportable homes tends to be used to refer to houses that are built on land that is owned by the house owner.^[*citation needed*]

Typically the homes are built in regional areas where the cost of organizing tradespeople and materials is higher than in the cities. In particular prefabricated homes have been popular in mining towns or other towns experiencing demand for new housing in excess of what can be handled by local builders. This method of construction is governed by state construction legislation and is subject to local council approval and homeowners' warranty or home warranty insurance.

Construction process

[edit]


A manufactured home is built entirely inside a huge, climate-controlled factory by a team of craftsmen. The first step in the process is the flooring, which is built in sections, each attached to a permanent chassis with its own wheels and secured for transport upon the home's completion. Depending on the size of the house and the floorplan's layout, there may be two, three or even four sections. The flooring sections have heating, electrical and plumbing connections pre-installed before they are finished with laminate, tile or hardwood. Next, the walls are constructed on a flat level surface with insulation and interior Sheetrock before being lifted by crane into position and secured to the floor sections. The interior ceilings and roof struts are next, vapor sealed and secured to each

section's wall frame before being shingled. Then, the exterior siding is added, along with the installation of doors and windows. Finally, interior finishing, such as sealing the drywall, is completed, along with fixture installation and finishing the electrical and plumbing connections. The exposed portions of each section, where they will eventually be joined together, are wrapped in plastic to protect them for transport.

With all the building site prep work completed, the building will be delivered by trucks towing the individual sections on their permanent chassis. The sections will be joined together securely, and all final plumbing and electrical connections are made before a decorative skirt or facade is applied to the bottom exterior of the house, hiding the chassis and finishing off the look of the home.

See also

[edit]

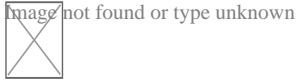
-  not found or type unknown Housing portal
- Modular home
- Prefabrication
- Prefabricated home
- Reefer container housing units
- British post-war temporary prefab houses
- HUD USER
- Regulatory Barriers Clearinghouse
- Lustron house
- Cardinal Industries, Inc.
- Dymaxion house
- Excel Homes
- All American Homes
- All Parks Alliance for Change

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[edit]

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- [^] **a b** "What is a Manufactured Home?" Manufactured Housing Institute's National Communities Council, accessed 6 July 2011 Archived 23 March 2012 at the Wayback Machine
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Wikimedia Commons has media related to ***Manufactured homes***.

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Things To Do in Tulsa County

Photo

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Guthrie Green

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Photo

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The Outsiders House Museum

4.7 (885)

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The Tulsa Arts District

4.7 (22)

Photo

Blue Whale of Catoosa

4.5 (3899)

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Tulsa Botanic Garden

4.7 (1397)

Photo

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Woodward Park and Gardens

4.7 (2580)

Driving Directions in Tulsa County

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Driving Directions From Tulsa VA Behavioral Medicine Clinic to Durham Supply Inc

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Driving Directions From Tulsa Air and Space Museum & Planetarium to Durham Supply Inc

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Driving Directions From Bob Dylan Center to Durham Supply Inc

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Reviews for Durham Supply Inc

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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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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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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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!

Identifying Warning Signs of Outdated Components [View GBP](#)

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- [Reviewing Key Safety Measures for Mobile Home HVAC Work](#)
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Frequently Asked Questions

What are the common warning signs that indicate my mobile home HVAC system might have outdated components?

Look for signs such as reduced airflow, unusual noises (like rattling or squeaking), frequent cycling on and off, inconsistent temperatures across rooms, and higher than usual energy bills. These symptoms can suggest parts of your HVAC system may be outdated or malfunctioning.

How can I determine if my mobile homes HVAC components are no longer efficient?

Check the age of your system; if it's over 10-15 years old, it may be time to consider updating. Additionally, compare its performance with newer models in terms of SEER (Seasonal Energy Efficiency Ratio) ratings. Inefficiency is also evident if repairs become

frequent or costly compared to investing in a new unit.

What steps should I take if I suspect my mobile home HVAC system has outdated components?

Start by scheduling a professional inspection to assess the condition of the entire system. A technician can identify specific outdated parts and recommend replacements or upgrades. Regular maintenance like cleaning filters and ducts can also help improve efficiency temporarily while you plan for updates.

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

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