

Mobile Homes



- **Considering Weight Distribution on Mobile Home Roofs**
Considering Weight Distribution on Mobile Home Roofs Analyzing Space Limitations for Duct Installation Minimizing Vibrations through Effective Mounting Checking for Clearances near Windows and Doors Verifying Electrical Capacity for New Units Inspecting Crawl Spaces before Major Installations Protecting Exterior Components from Windy Conditions Resolving Access Issues in Narrow Hallways Planning Around Existing Plumbing or Gas Lines Prioritizing Safety in Confined Work Areas Ensuring Adequate Ventilation for Heat Pumps Mitigating Moisture Risks in Humid Climates
- **Comparing Basic and Extended Coverage Options**
Comparing Basic and Extended Coverage Options Reviewing Part Replacement Clauses in Detail Understanding Labor Inclusions in Contracts Assessing Multi year Agreements for Homeowners Outlining Limitations of Warranty Claims Inspecting Renewal Terms for Ongoing Coverage Checking Deductible Requirements for Repairs Estimating Future Costs through Contract Analysis Tracking Service Visits Outlined in Agreements Selecting Clauses that Cover Seasonal Tuneups Transferring Warranty Benefits to New Owners Planning Budget Strategies for Contract Renewals
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Understanding contract analysis in the context of HVAC systems is crucial for accurately estimating future costs. In an industry where technology, energy efficiency, and regulatory compliance play pivotal roles, having a comprehensive grasp of contracts can significantly impact financial forecasting and project management.

HVAC systems are essential components in residential, commercial, and industrial buildings. They ensure comfort and air quality while consuming substantial energy resources. Regular maintenance can prolong the life of an HVAC system in a mobile home **mobile home hvac** wall. Given their importance and complexity, managing these systems involves long-term planning and significant investments. One of the key aspects of this planning is contract analysis-a tool that helps stakeholders anticipate expenses and align them with budgetary constraints.

Contract analysis involves scrutinizing agreements related to equipment purchase, installation services, maintenance plans, warranties, and energy consumption commitments. By meticulously examining these documents, businesses can identify cost drivers such as service fees, parts replacement schedules, or energy use penalties. Understanding these elements allows for better allocation of resources over time.

Moreover, technological advancements continue to reshape the HVAC landscape with innovations aimed at improving efficiency and reducing environmental impact. Contracts often outline terms for integrating new technologies or upgrading existing systems. Analyzing these clauses can reveal potential future costs associated with technology adoption or compliance with evolving regulations.

Additionally, maintenance contracts are a critical component of HVAC system management. They not only dictate regular servicing schedules but also detail emergency repair protocols and associated costs. A thorough evaluation of these contracts ensures that businesses are prepared for unexpected expenditures while maximizing system longevity through proactive care.

In conclusion, contract analysis in the context of HVAC systems provides invaluable insights into future cost estimation. It enables stakeholders to make informed decisions by understanding current obligations and anticipating future needs based on contractual provisions. As the industry evolves towards greater efficiency and sustainability, mastering contract analysis will remain a vital skill for managing both operational success and economic viability in the ever-changing realm of HVAC systems.

Impact of HVAC system installation on roof weight distribution —

- Overview of mobile home HVAC systems and their components
- Impact of HVAC system installation on roof weight distribution
- Considerations for maintaining structural integrity during HVAC installation
- Strategies for evenly distributing weight across the roof when adding or upgrading HVAC systems
- Potential risks of improper weight distribution on mobile home roofs and HVAC efficiency
- Guidelines for professional assessment and installation to ensure balanced weight distribution

Estimating future costs in any industry is a complex task, requiring a deep understanding of both current market conditions and the specific variables that can influence pricing. In the world of HVAC (Heating, Ventilation, and Air Conditioning) systems, this task becomes even more nuanced due to the intricate components involved and the myriad factors that can affect costs. By analyzing contracts thoroughly, businesses and consumers alike can gain valuable insights into how these costs might evolve over time.

At the heart of HVAC cost estimation are several key components: equipment prices, installation labor, maintenance needs, and energy consumption. Each of these elements plays a pivotal role in determining the overall expense associated with an HVAC system. Equipment prices are often influenced by technological advancements and supply chain fluctuations. For instance, as new energy-efficient technologies emerge, older models may become less expensive but also less desirable.

Labor costs for installation can vary significantly based on geographic location and demand for skilled technicians. In areas where there is a shortage of qualified laborers or during peak seasons, such as summer when cooling systems are in high demand, labor rates may climb steeply.

Maintenance requirements must also be factored into cost estimations. Regular servicing not only ensures optimal performance but also extends the lifespan of HVAC systems. Contract analysis should include clauses that outline maintenance schedules and responsibilities to predict these recurring expenses accurately.

Another critical variable is energy consumption. The efficiency of an HVAC system directly impacts utility bills; thus, contracts should specify expected efficiency ratings or include provisions for periodic assessments to ensure continued performance at promised levels.

Beyond these tangible components lie external variables like regulatory changes and environmental considerations which can heavily influence costs indirectly. New legislation mandating stricter emissions standards might necessitate retrofits or replacements sooner than anticipated.

Contract analysis serves as a crucial tool in estimating future HVAC costs by offering a detailed forecast based on historical data and trend analysis. It allows stakeholders to identify potential risk factors such as price escalators or clauses that could lead to unforeseen expenditures. Additionally, it aids in negotiating better terms by highlighting areas where savings could be realized without compromising on quality or performance.

In conclusion, while predicting future costs involves navigating through numerous uncertainties inherent in the HVAC industry, understanding key components and diligently analyzing contractual agreements provide a strategic advantage. They empower decision-makers with foresight into potential financial commitments while ensuring they remain well-prepared to adapt to evolving market dynamics efficiently.

Posted by on

Considerations for maintaining structural integrity during HVAC installation

Estimating future costs through contract analysis is a crucial skill in both the public and private sectors, where understanding potential financial commitments is key to effective budgeting and strategic planning. Contracts often contain a wealth of information that, when properly analyzed, can provide valuable insights into future expenditures. This essay explores several techniques for analyzing contracts to estimate these future costs effectively.

One fundamental technique in contract analysis is the identification and evaluation of cost drivers. Cost drivers are elements within a contract that significantly influence the total cost. These might include labor rates, material prices, equipment expenses, or overhead charges. By identifying these components early on, analysts can make more accurate projections about how fluctuations in these areas might impact overall costs.

Another critical technique is the use of trend analysis. Contracts often have historical data that can be invaluable for predicting future costs. By examining past expenditure patterns and adjusting for known changes, such as inflation or anticipated alterations in scope or demand, analysts can forecast future spending more accurately. Trend analysis helps in recognizing recurring cost patterns and potential anomalies that may require further investigation.

Scenario analysis is also a powerful tool in this domain. Given the inherent uncertainty in predicting future costs, creating multiple scenarios allows organizations to prepare for various possible outcomes. By developing best-case, worst-case, and most-likely scenarios based on different assumptions about key variables-such as market conditions or supplier performance-businesses can better manage risks associated with their contractual obligations.

Moreover, sensitivity analysis provides another layer of insight by evaluating how changes in specific assumptions affect overall cost estimates. This technique involves altering one variable at a time while keeping others constant to see its impact on projected costs. Sensitivity analysis helps determine which factors are most crucial to accurate forecasting and where there might be room for negotiation or adjustment within the contract terms.

Lastly, leveraging technology through specialized software tools has become increasingly important in modern contract analysis for estimating future costs. These tools can automate data collection from contracts and perform complex analyses much faster than traditional methods allow. They enable real-time updates and simulations based on new data inputs-ensuring estimates remain relevant as circumstances change.

In conclusion, analyzing contracts to estimate future costs requires a mix of qualitative judgment and quantitative techniques. By focusing on key cost drivers, employing trend and scenario analyses, conducting sensitivity assessments, and utilizing advanced technological tools, organizations can achieve more reliable forecasts-ultimately leading to better financial planning and decision-making processes. As businesses continue to operate in dynamic environments with fluctuating economic landscapes, mastering these techniques will remain an essential component of strategic management practices.





Strategies for evenly distributing weight across the roof when adding or upgrading HVAC systems

Analyzing past contracts and predicting future costs is a critical endeavor in the realm of mobile home HVAC systems. By delving into historical data, stakeholders can glean valuable insights into cost trends, identify potential pitfalls, and make informed decisions that benefit both consumers and manufacturers.

The foundation of any thorough cost prediction model lies in comprehensive case studies. These are detailed examinations of previous contracts that help illuminate patterns in pricing, installation complexities, and maintenance requirements. For instance, a case study might reveal how seasonal fluctuations in demand have historically impacted costs or how advancements in technology have reduced the price of certain components over time.

One illustrative case study could involve analyzing contracts from various regions to determine how geographical factors influence pricing. Mobile homes in colder climates may require more robust HVAC systems with higher upfront costs but potentially lower long-term maintenance expenses due to less frequent usage compared to those in milder climates. Such analyses help predict future costs by highlighting regional variations and their impact on overall expenditure.

Another pertinent aspect of contract analysis is understanding the interplay between supply chain dynamics and cost structures. The HVAC industry is heavily influenced by global supply chains; therefore, disruptions such as trade restrictions or raw material shortages can significantly affect prices. Historical contract data can shed light on how past supply chain issues were managed and what strategies proved most effective in mitigating cost increases.

Moreover, examining past contracts also provides insight into consumer behavior and policy changes that might affect future pricing structures. For example, shifts towards energy-efficient solutions driven by environmental policies could alter demand patterns for specific types of HVAC units, thereby affecting their market prices. Understanding these shifts through previous contract analyses allows businesses to anticipate changes and adjust their strategies accordingly.

Predicting future costs also involves considering technological advancements within the industry. Over recent years, there has been a significant push towards smart HVAC systems equipped with IoT capabilities for enhanced efficiency and control. By studying past adoption rates of new technologies as seen through contract agreements, analysts can project how quickly current innovations might be integrated into mainstream offerings-potentially driving

down costs as economies of scale are achieved.

In conclusion, estimating future costs through contract analysis is an intricate process that requires meticulous examination of past data. By conducting detailed case studies on historical contracts within the mobile home HVAC sector, stakeholders can uncover valuable insights into pricing trends influenced by geographic factors, supply chain dynamics, policy changes, consumer behavior shifts, and technological advancements. This knowledge equips decision-makers with the foresight needed to navigate the complexities of cost prediction effectively-ultimately ensuring better planning for both suppliers and consumers alike in this ever-evolving field.

Potential risks of improper weight distribution on mobile home roofs and HVAC efficiency

Estimating future costs through contract analysis is a critical yet challenging endeavor for businesses and organizations. It involves scrutinizing existing contracts to predict financial obligations, identify savings opportunities, and ensure fiscal responsibility. However, this process is fraught with several common challenges that can complicate accurate cost estimation.

One of the primary challenges in estimating costs through contract analysis is the complexity and variability of contract terms. Contracts often contain intricate language and provisions that can be difficult to interpret. This complexity increases when dealing with multiple contracts from different vendors or clients, each having unique terms, conditions, and pricing models. For instance, some contracts may include clauses for price adjustments based on market indices or inflation rates, while others might have volume-based discounts or penalties for non-compliance. Understanding these nuances requires a deep dive into each contract's specifics,

often necessitating expert legal or financial interpretation.

Another significant challenge is data management and accessibility. Contracts are sometimes stored in disparate systems or formats, making it difficult to consolidate information for analysis. This fragmentation can lead to incomplete data capture and inaccuracies in cost projections. Moreover, manual extraction of relevant information from lengthy documents is not only time-consuming but also prone to human error. Implementing robust data management systems that centralize contract information can mitigate these issues but often requires substantial investment in technology and training.

Additionally, changes over time pose a challenge to accurate cost estimation. Contracts are not static; they evolve due to amendments, renewals, or renegotiations influenced by changing business needs or external factors like regulatory shifts or economic fluctuations. Keeping track of these changes and their implications on future costs demands continuous monitoring and updating of records-a task that can strain resources if not properly managed.

Risk assessment is another crucial aspect where challenges arise in estimating future costs through contract analysis. Identifying potential risks such as supplier insolvency, geopolitical events affecting supply chains, or fluctuations in currency exchange rates requires foresight and strategic planning. Failure to account for these risks can result in unforeseen expenditures that skew initial estimates.

Lastly, aligning stakeholder expectations with realistic cost projections remains a persistent challenge. Different departments within an organization may have varied priorities-finance teams focusing on budget constraints while procurement emphasizes supplier performance metrics-and reconciling these perspectives into a cohesive estimate necessitates effective communication and collaboration.

To address these challenges effectively involves adopting a comprehensive approach combining advanced analytics tools with skilled personnel adept at navigating complex contractual landscapes. Leveraging technologies like artificial intelligence (AI) for automated document analysis can significantly enhance accuracy by swiftly identifying key terms and patterns across large volumes of contracts.

In conclusion, while estimating future costs through contract analysis presents undeniable challenges stemming from complex contractual terms, fragmented data systems, evolving agreements over time risk factors impacting financial forecasts stakeholders' differing priorities

overcoming them lies within employing strategic solutions encompassing technological advancements coupled with proficient human oversight. Ultimately mastering this intricate process enables organizations make informed decisions fostering financial stability growth amidst ever-changing business environments

Guidelines for professional assessment and installation to ensure balanced weight distribution

Estimating future costs is a critical component of effective financial management, particularly in the realm of contract analysis. Accurate cost estimation can mean the difference between a successful project and one that spirals into budgetary chaos. As such, organizations must employ strategic approaches to enhance the accuracy of their cost projections.

One fundamental strategy is grounding estimates in historical data. By analyzing past contracts and outcomes, businesses can identify patterns and trends that inform future predictions. This involves not only reviewing prior costs but also understanding the context behind those figures—such as economic conditions or specific challenges faced during project execution. Learning from history allows estimators to adjust for known variables and better anticipate potential fluctuations.

In addition to leveraging historical data, incorporating expert judgement is crucial. Professionals with extensive experience in similar projects bring invaluable insights that numbers alone might miss. Their intuition about market dynamics, potential risks, and resource requirements enriches the estimation process. However, it is important to balance expert opinion with empirical data to avoid over-reliance on subjective assessments.

Another effective strategy involves breaking down complex projects into smaller components or phases—a method known as "bottom-up" estimating. This approach encourages detailed analysis at each level of a project, thereby increasing overall accuracy when these micro-estimates are aggregated. By meticulously assessing each task's resources and timelines independently, organizations can pinpoint discrepancies early and adjust their strategies accordingly.

Moreover, embracing technology enhances precision in cost estimation. Sophisticated software tools now offer predictive analytics capabilities, automating data collection and enabling real-time adjustments based on current market conditions or supply chain disruptions. These technologies not only expedite the estimation process but also reduce human error by providing a consistent framework for calculations.

Communication plays an equally vital role in improving estimation accuracy. Open dialogue among stakeholders ensures all parties have access to relevant information and understand assumptions underlying cost projections. Collaborative discussions facilitate consensus-building around realistic timelines and budgets while allowing for contingency planning against unforeseen events.

Lastly, continuous review and refinement of estimation processes are essential for maintaining accuracy over time. Organizations should implement feedback loops where lessons learned from completed projects feed back into future estimates. This iterative approach fosters an environment of learning and adaptation, ensuring that estimations evolve alongside changing business landscapes.

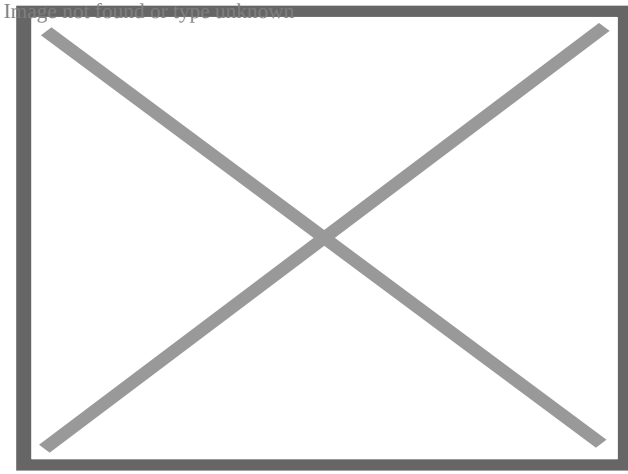
In conclusion, improving accuracy in cost estimation through contract analysis requires a multifaceted approach involving historical insight, expert judgement, detailed breakdowns, technological assistance, effective communication, and ongoing refinement. By adopting these strategies, organizations position themselves to more reliably forecast future costs—thereby enhancing decision-making capabilities and securing financial stability amidst uncertainty.

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

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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

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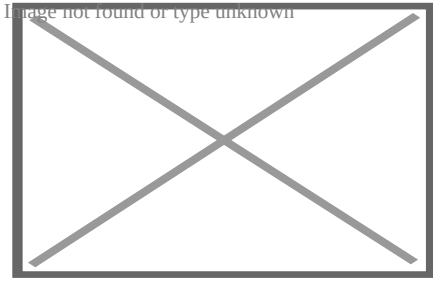
The original focus of this form of housing was its ability to relocate easily. Units were initially marketed primarily to people whose lifestyle required mobility. However, beginning in the 1950s, these homes began to be marketed primarily as an inexpensive form of housing designed to be set up and left 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.

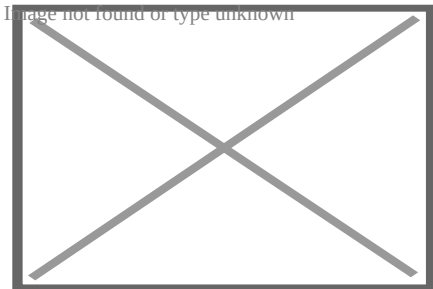
Modern manufactured homes

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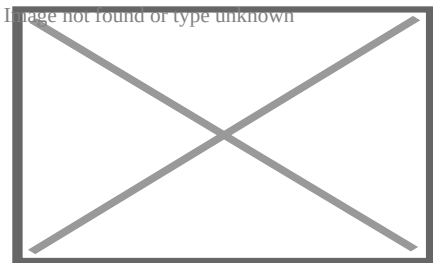


A manufactured house ready to be assembled in Grass Valley, California

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)

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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

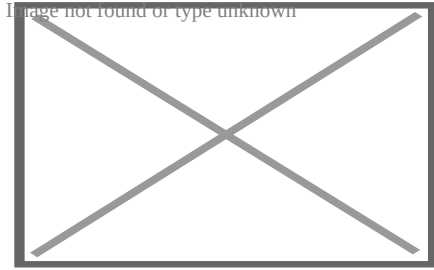
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House is ready for
delivery to site

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

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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

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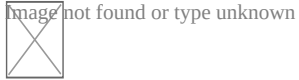
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- Prefabrication
- Prefabricated home
- Reefer container housing units
- British post-war temporary prefab houses
- HUD USER
- Regulatory Barriers Clearinghouse
- Lustron house
- Cardinal Industries, Inc.
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- All American Homes
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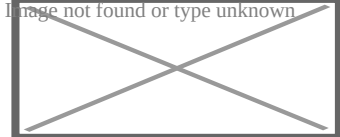
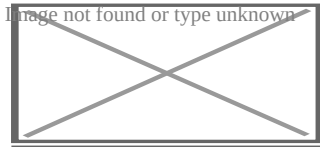
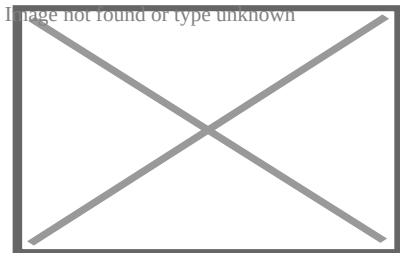
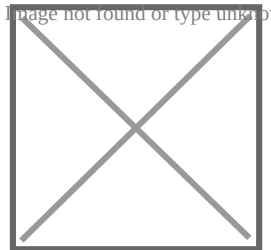
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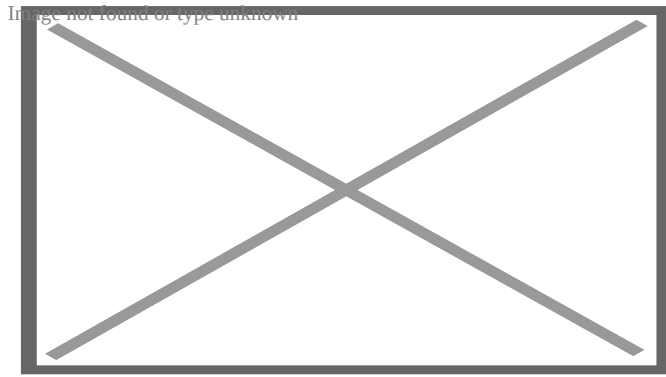


Wikimedia Commons has media related to ***Manufactured homes***.

About Air conditioning

This article is about cooling of air. For the Curved Air album, see Air Conditioning (album). For a similar device capable of both cooling and heating, see heat pump. "a/c" redirects here. For the abbreviation used in banking and book-keeping, see Account (disambiguation). For other uses, see AC.





There are various types of air conditioners. Popular examples include: Window-mounted air conditioner (Suriname, 1955); Ceiling-mounted cassette air conditioner (China, 2023); Wall-mounted air conditioner (Japan, 2020); Ceiling-mounted console (Also called ceiling suspended) air conditioner (China, 2023); and portable air conditioner (Vatican City, 2018).

Air conditioning, often abbreviated as **A/C** (US) or **air con** (UK),^[1] is the process of removing heat from an enclosed space to achieve a more comfortable interior temperature (sometimes referred to as 'comfort cooling') and in some cases also strictly controlling the humidity of internal air. Air conditioning can be achieved using a mechanical 'air conditioner' or by other methods, including passive cooling and ventilative cooling.^{[2][3]} Air conditioning is a member of a family of systems and techniques that provide heating, ventilation, and air conditioning (HVAC).^[4] Heat pumps are similar in many ways to air conditioners, but use a reversing valve to allow them both to heat and to cool an enclosed space.^[5]

Air conditioners, which typically use vapor-compression refrigeration, range in size from small units used in vehicles or single rooms to massive units that can cool large buildings.^[6] Air source heat pumps, which can be used for heating as well as cooling, are becoming increasingly common in cooler climates.

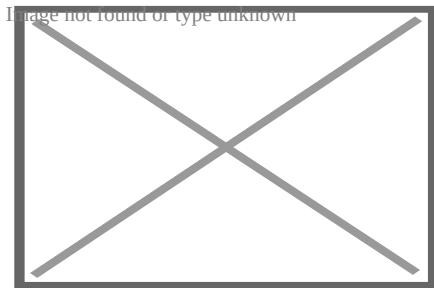
Air conditioners can reduce mortality rates due to higher temperature.^[7] According to the International Energy Agency (IEA) 1.6 billion air conditioning units were used globally in 2016.^[8] The United Nations called for the technology to be made more sustainable to mitigate climate change and for the use of alternatives, like passive cooling, evaporative cooling, selective shading, windcatchers, and better thermal insulation.

History

[edit]

Air conditioning dates back to prehistory.^[9] Double-walled living quarters, with a gap between the two walls to encourage air flow, were found in the ancient city of Hamoukar, in modern Syria.^[10] Ancient Egyptian buildings also used a wide variety of passive air-conditioning techniques.^[11] These became widespread from the Iberian Peninsula through North Africa, the Middle East, and Northern India.^[12]

Passive techniques remained widespread until the 20th century when they fell out of fashion and were replaced by powered air conditioning. Using information from engineering studies of traditional buildings, passive techniques are being revived and modified for 21st-century architectural designs.^[13]^[12]



An array of air conditioner condenser units outside a commercial office building

Air conditioners allow the building's indoor environment to remain relatively constant, largely independent of changes in external weather conditions and internal heat loads. They also enable deep plan buildings to be created and have allowed people to live comfortably in hotter parts of the world.^[14]

Development

[edit]

Preceding discoveries

[edit]

In 1558, Giambattista della Porta described a method of chilling ice to temperatures far below its freezing point by mixing it with potassium nitrate (then called "nitre") in his popular science book *Natural Magic*.^[15]^[16]^[17] In 1620, Cornelis Drebbel demonstrated "Turning Summer into Winter" for James I of England, chilling part of the Great Hall of Westminster Abbey with an apparatus of troughs and vats.^[18] Drebbel's contemporary Francis Bacon, like della Porta a believer in science communication, may not have been present at the demonstration, but in a book published later the same year, he described it as "experiment of artificial freezing" and said that "Nitre (or rather its spirit) is very cold, and hence nitre or salt when added to snow or ice intensifies the cold of the latter, the nitre

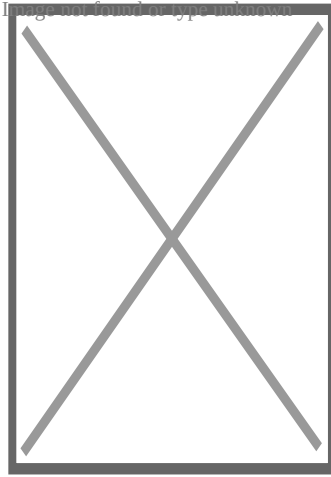
by adding to its cold, but the salt by supplying activity to the cold of the snow."^[15]

In 1758, Benjamin Franklin and John Hadley, a chemistry professor at the University of Cambridge, conducted experiments applying the principle of evaporation as a means to cool an object rapidly. Franklin and Hadley confirmed that the evaporation of highly volatile liquids (such as alcohol and ether) could be used to drive down the temperature of an object past the freezing point of water. They experimented with the bulb of a mercury-in-glass thermometer as their object. They used a bellows to speed up the evaporation. They lowered the temperature of the thermometer bulb down to -14°C (7°F) while the ambient temperature was 18°C (64°F). Franklin noted that soon after they passed the freezing point of water 0°C (32°F), a thin film of ice formed on the surface of the thermometer's bulb and that the ice mass was about 6 mm (1/4 in) thick when they stopped the experiment upon reaching -14°C (7°F). Franklin concluded: "From this experiment, one may see the possibility of freezing a man to death on a warm summer's day."^[19]

The 19th century included many developments in compression technology. In 1820, English scientist and inventor Michael Faraday discovered that compressing and liquefying ammonia could chill air when the liquefied ammonia was allowed to evaporate.^[20] In 1842, Florida physician John Gorrie used compressor technology to create ice, which he used to cool air for his patients in his hospital in Apalachicola, Florida. He hoped to eventually use his ice-making machine to regulate the temperature of buildings.^{[20][21]} He envisioned centralized air conditioning that could cool entire cities. Gorrie was granted a patent in 1851,^[22] but following the death of his main backer, he was not able to realize his invention.^[23] In 1851, James Harrison created the first mechanical ice-making machine in Geelong, Australia, and was granted a patent for an ether vapor-compression refrigeration system in 1855 that produced three tons of ice per day.^[24] In 1860, Harrison established a second ice company. He later entered the debate over competing against the American advantage of ice-refrigerated beef sales to the United Kingdom.^[24]

First devices

[edit]



Willis Carrier, who is credited with building the first modern electrical air conditioning unit

Electricity made the development of effective units possible. In 1901, American inventor Willis H. Carrier built what is considered the first modern electrical air conditioning unit.^[25]^[26]^[27]^[28] In 1902, he installed his first air-conditioning system, in the Sackett-Wilhelms Lithographing & Publishing Company in Brooklyn, New York.^[29] His invention controlled both the temperature and humidity, which helped maintain consistent paper dimensions and ink alignment at the printing plant. Later, together with six other employees, Carrier formed The Carrier Air Conditioning Company of America, a business that in 2020 employed 53,000 people and was valued at \$18.6 billion.^[30]^[31]

In 1906, Stuart W. Cramer of Charlotte, North Carolina, was exploring ways to add moisture to the air in his textile mill. Cramer coined the term "air conditioning" in a patent claim which he filed that year, where he suggested that air conditioning was analogous to "water conditioning", then a well-known process for making textiles easier to process.^[32] He combined moisture with ventilation to "condition" and change the air in the factories; thus, controlling the humidity that is necessary in textile plants. Willis Carrier adopted the term and incorporated it into the name of his company.^[33]

Domestic air conditioning soon took off. In 1914, the first domestic air conditioning was installed in Minneapolis in the home of Charles Gilbert Gates. It is, however, possible that the considerable device (c. 2.1 m × 1.8 m × 6.1 m; 7 ft × 6 ft × 20 ft) was never used, as the house remained uninhabited^[20] (Gates had already died in October 1913.)

In 1931, H.H. Schultz and J.Q. Sherman developed what would become the most common type of individual room air conditioner: one designed to sit on a window ledge. The units went on sale in 1932 at US\$10,000 to \$50,000 (the equivalent of \$200,000 to \$1,100,000 in 2023.)^[20] A year later, the first air conditioning systems for cars were offered for sale.^[34] Chrysler Motors introduced the first practical semi-portable air conditioning unit in 1935,^[35] and Packard became the first automobile manufacturer to offer an air conditioning unit in its cars in 1939.^[36]

Further development

[edit]

Innovations in the latter half of the 20th century allowed more ubiquitous air conditioner use. In 1945, Robert Sherman of Lynn, Massachusetts, invented a portable, in-window air conditioner that cooled, heated, humidified, dehumidified, and filtered the air.^[37] The first inverter air conditioners were released in 1980–1981.^{[38][39]}

In 1954, Ned Cole, a 1939 architecture graduate from the University of Texas at Austin, developed the first experimental "suburb" with inbuilt air conditioning in each house. 22 homes were developed on a flat, treeless track in northwest Austin, Texas, and the community was christened the 'Austin Air-Conditioned Village.' The residents were subjected to a year-long study of the effects of air conditioning led by the nation's premier air conditioning companies, builders, and social scientists. In addition, researchers from UT's Health Service and Psychology Department studied the effects on the "artificially cooled humans." One of the more amusing discoveries was that each family reported being troubled with scorpions, the leading theory being that scorpions sought cool, shady places. Other reported changes in lifestyle were that mothers baked more, families ate heavier foods, and they were more apt to choose hot drinks.^{[40][41]}

Air conditioner adoption tends to increase above around \$10,000 annual household income in warmer areas.^[42] Global GDP growth explains around 85% of increased air condition adoption by 2050, while the remaining 15% can be explained by climate change.^[42]

As of 2016 an estimated 1.6 billion air conditioning units were used worldwide, with over half of them in China and USA, and a total cooling capacity of 11,675 gigawatts.^{[8][43]} The International Energy Agency predicted in 2018 that the number of air conditioning units would grow to around 4 billion units by 2050 and that the total cooling capacity would grow to around 23,000 GW, with the biggest increases in India and China.^[8] Between 1995 and 2004, the proportion of urban households in China with air conditioners increased from 8% to 70%.^[44] As of 2015, nearly 100 million homes, or about 87% of US households, had air conditioning systems.^[45] In 2019, it was estimated that 90% of new single-family homes constructed in the US included air conditioning (ranging from 99% in the South to 62% in the West).^{[46][47]}

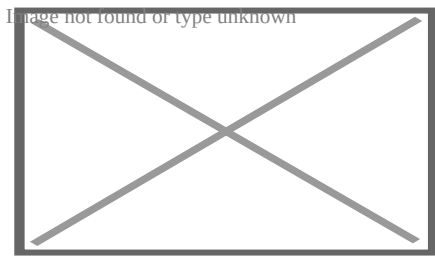
Operation

[edit]

Operating principles

[edit]

Main article: Vapor-compression refrigeration



A simple stylized diagram of the refrigeration cycle: 1) condensing coil, 2) expansion valve, 3) evaporator coil, 4) compressor

Cooling in traditional air conditioner systems is accomplished using the vapor-compression cycle, which uses a refrigerant's forced circulation and phase change between gas and liquid to transfer heat.^{[48][49]} The vapor-compression cycle can occur within a unitary, or packaged piece of equipment; or within a chiller that is connected to terminal cooling equipment (such as a fan coil unit in an air handler) on its evaporator side and heat rejection equipment such as a cooling tower on its condenser side. An air source heat pump shares many components with an air conditioning system, but includes a reversing valve, which allows the unit to be used to heat as well as cool a space.^[50]

Air conditioning equipment will reduce the absolute humidity of the air processed by the system if the surface of the evaporator coil is significantly cooler than the dew point of the surrounding air. An air conditioner designed for an occupied space will typically achieve a 30% to 60% relative humidity in the occupied space.^[51]

Most modern air-conditioning systems feature a dehumidification cycle during which the compressor runs. At the same time, the fan is slowed to reduce the evaporator temperature and condense more water. A dehumidifier uses the same refrigeration cycle but incorporates both the evaporator and the condenser into the same air path; the air first passes over the evaporator coil, where it is cooled^[52] and dehumidified before passing over the condenser coil, where it is warmed again before it is released back into the room.^[citation needed]

Free cooling can sometimes be selected when the external air is cooler than the internal air. Therefore, the compressor does not need to be used, resulting in high cooling efficiencies for these times. This may also be combined with seasonal thermal energy storage.^[53]

Heating

[edit]

Main article: Heat pump

Some air conditioning systems can reverse the refrigeration cycle and act as an air source heat pump, thus heating instead of cooling the indoor environment. They are also

commonly referred to as "reverse cycle air conditioners". The heat pump is significantly more energy-efficient than electric resistance heating, because it moves energy from air or groundwater to the heated space and the heat from purchased electrical energy. When the heat pump is in heating mode, the indoor evaporator coil switches roles and becomes the condenser coil, producing heat. The outdoor condenser unit also switches roles to serve as the evaporator and discharges cold air (colder than the ambient outdoor air).

Most air source heat pumps become less efficient in outdoor temperatures lower than 4 °C or 40 °F.^[54] This is partly because ice forms on the outdoor unit's heat exchanger coil, which blocks air flow over the coil. To compensate for this, the heat pump system must temporarily switch back into the regular air conditioning mode to switch the outdoor evaporator coil *back* to the condenser coil, to heat up and defrost. Therefore, some heat pump systems will have electric resistance heating in the indoor air path that is activated only in this mode to compensate for the temporary indoor air cooling, which would otherwise be uncomfortable in the winter.

Newer models have improved cold-weather performance, with efficient heating capacity down to −14 °F (−26 °C).^{[55][54][56]} However, there is always a chance that the humidity that condenses on the heat exchanger of the outdoor unit could freeze, even in models that have improved cold-weather performance, requiring a defrosting cycle to be performed.

The icing problem becomes much more severe with lower outdoor temperatures, so heat pumps are sometimes installed in tandem with a more conventional form of heating, such as an electrical heater, a natural gas, heating oil, or wood-burning fireplace or central heating, which is used instead of or in addition to the heat pump during harsher winter temperatures. In this case, the heat pump is used efficiently during milder temperatures, and the system is switched to the conventional heat source when the outdoor temperature is lower.

Performance

[edit]

Main articles: coefficient of performance, Seasonal energy efficiency ratio, and European seasonal energy efficiency ratio

The coefficient of performance (COP) of an air conditioning system is a ratio of useful heating or cooling provided to the work required.^{[57][58]} Higher COPs equate to lower operating costs. The COP usually exceeds 1; however, the exact value is highly dependent on operating conditions, especially absolute temperature and relative temperature between sink and system, and is often graphed or averaged against expected conditions.^[59] Air conditioner equipment power in the U.S. is often described in terms of "tons of refrigeration", with each approximately equal to the cooling power of one short ton (2,000 pounds (910 kg) of ice melting in a 24-hour period. The value is equal to 12,000

BTU_{IT} per hour, or 3,517 watts.^[60] Residential central air systems are usually from 1 to 5 tons (3.5 to 18 kW) in capacity.^[citation needed]

The efficiency of air conditioners is often rated by the seasonal energy efficiency ratio (SEER), which is defined by the Air Conditioning, Heating and Refrigeration Institute in its 2008 standard AHRI 210/240, *Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment*.^[61] A similar standard is the European seasonal energy efficiency ratio (ESEER).^[citation needed]

Efficiency is strongly affected by the humidity of the air to be cooled. Dehumidifying the air before attempting to cool it can reduce subsequent cooling costs by as much as 90 percent. Thus, reducing dehumidifying costs can materially affect overall air conditioning costs.^[62]

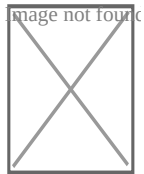
Control system

[edit]

Wireless remote control

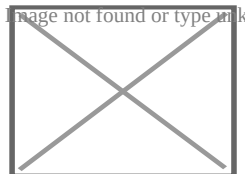
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Main articles: Remote control and Infrared blaster

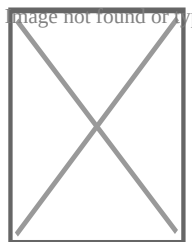


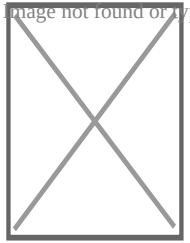
A

wireless
remote
controller



The infrared
transmitting
LED on the
remote





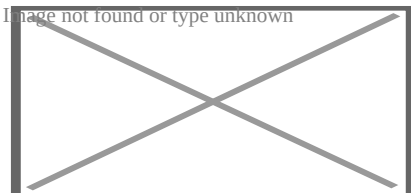
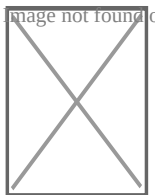
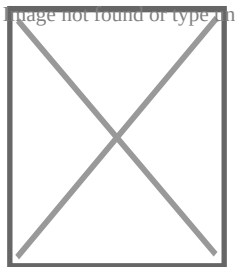
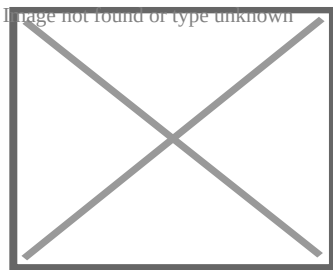
The infrared receiver on the air conditioner

This type of controller uses an infrared LED to relay commands from a remote control to the air conditioner. The output of the infrared LED (like that of any infrared remote) is invisible to the human eye because its wavelength is beyond the range of visible light (940 nm). This system is commonly used on mini-split air conditioners because it is simple and portable. Some window and ducted central air conditioners uses it as well.

Wired controller

[edit]

Main article: Thermostat



Several wired controllers (Indonesia, 2024)

A wired controller, also called a "wired thermostat," is a device that controls an air conditioner by switching heating or cooling on or off. It uses different sensors to measure temperatures and actuate control operations. Mechanical thermostats commonly use bimetallic strips, converting a temperature change into mechanical displacement, to actuate control of the air conditioner. Electronic thermostats, instead, use a thermistor or other semiconductor sensor, processing temperature change as electronic signals to control the air conditioner.

These controllers are usually used in hotel rooms because they are permanently installed into a wall and hard-wired directly into the air conditioner unit, eliminating the need for batteries.

Types

[edit]

Types	Typical Capacity*	Air supply	Mounting	Typical application
Mini-split	small – large	Direct	Wall	Residential
Window	very small – small	Direct	Window	Residential
Portable	very small – small	Direct / Ducted	Floor	Residential, remote areas
Ducted (individual)	small – very large	Ducted	Ceiling	Residential, commercial
Ducted (central)	medium – very large	Ducted	Ceiling	Residential, commercial
Ceiling suspended	medium – large	Direct	Ceiling	Commercial
Cassette	medium – large	Direct / Ducted	Ceiling	Commercial
Floor standing	medium – large	Direct / Ducted	Floor	Commercial
Packaged	very large	Direct / Ducted	Floor	Commercial
Packaged RTU (Rooftop Unit)	very large	Ducted	Rooftop	Commercial

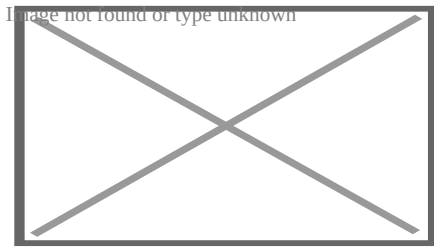
* where the typical capacity is in kilowatt as follows:

- very small: <1.5 kW
- small: 1.5–3.5 kW
- medium: 4.2–7.1 kW
- large: 7.2–14 kW

- very large: >14 kW

Mini-split and multi-split systems

[edit]



Evaporator, indoor unit, or terminal, side of a ductless split-type air conditioner

Ductless systems (often mini-split, though there are now ducted mini-split) typically supply conditioned and heated air to a single or a few rooms of a building, without ducts and in a decentralized manner.^[63] Multi-zone or multi-split systems are a common application of ductless systems and allow up to eight rooms (zones or locations) to be conditioned independently from each other, each with its indoor unit and simultaneously from a single outdoor unit.

The first mini-split system was sold in 1961 by Toshiba in Japan, and the first wall-mounted mini-split air conditioner was sold in 1968 in Japan by Mitsubishi Electric, where small home sizes motivated their development. The Mitsubishi model was the first air conditioner with a cross-flow fan.^{[64][65][66]} In 1969, the first mini-split air conditioner was sold in the US.^[67] Multi-zone ductless systems were invented by Daikin in 1973, and variable refrigerant flow systems (which can be thought of as larger multi-split systems) were also invented by Daikin in 1982. Both were first sold in Japan.^[68] Variable refrigerant flow systems when compared with central plant cooling from an air handler, eliminate the need for large cool air ducts, air handlers, and chillers; instead cool refrigerant is transported through much smaller pipes to the indoor units in the spaces to be conditioned, thus allowing for less space above dropped ceilings and a lower structural impact, while also allowing for more individual and independent temperature control of spaces. The outdoor and indoor units can be spread across the building.^[69] Variable refrigerant flow indoor units can also be turned off individually in unused spaces.^[citation needed] The lower start-up power of VRF's DC inverter compressors and their inherent DC power requirements also allow VRF solar-powered heat pumps to be run using DC-providing solar panels.

Ducted central systems

[edit]

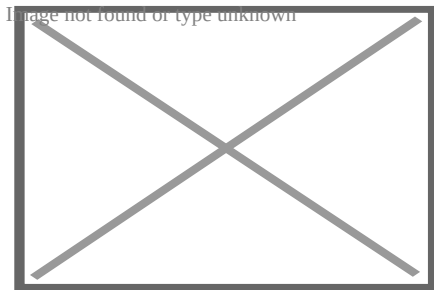
Split-system central air conditioners consist of two heat exchangers, an outside unit (the condenser) from which heat is rejected to the environment and an internal heat exchanger

(the evaporator, or Fan Coil Unit, FCU) with the piped refrigerant being circulated between the two. The FCU is then connected to the spaces to be cooled by ventilation ducts.^[70] Floor standing air conditioners are similar to this type of air conditioner but sit within spaces that need cooling.

Central plant cooling

[edit]

See also: Chiller



Industrial air conditioners on top of the shopping mall *Passage* in Linz, Austria

Large central cooling plants may use intermediate coolant such as chilled water pumped into air handlers or fan coil units near or in the spaces to be cooled which then duct or deliver cold air into the spaces to be conditioned, rather than ducting cold air directly to these spaces from the plant, which is not done due to the low density and heat capacity of air, which would require impractically large ducts. The chilled water is cooled by chillers in the plant, which uses a refrigeration cycle to cool water, often transferring its heat to the atmosphere even in liquid-cooled chillers through the use of cooling towers. Chillers may be air- or liquid-cooled.^[71]^[72]

Portable units

[edit]

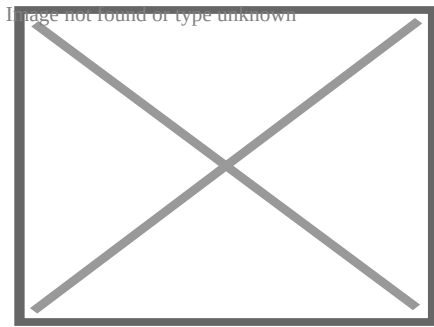
A portable system has an indoor unit on wheels connected to an outdoor unit via flexible pipes, similar to a permanently fixed installed unit (such as a ductless split air conditioner).

Hose systems, which can be *monoblock* or *air-to-air*, are vented to the outside via air ducts. The *monoblock* type collects the water in a bucket or tray and stops when full. The *air-to-air* type re-evaporates the water, discharges it through the ducted hose, and can run continuously. Many but not all portable units draw indoor air and expel it outdoors through a single duct, negatively impacting their overall cooling efficiency.

Many portable air conditioners come with heat as well as a dehumidification function.^[73]

Window unit and packaged terminal

[edit]



Through-the-wall PTAC units, University Motor Inn, Philadelphia

Main article: Packaged terminal air conditioner

The packaged terminal air conditioner (PTAC), through-the-wall, and window air conditioners are similar. These units are installed on a window frame or on a wall opening. The unit usually has an internal partition separating its indoor and outdoor sides, which contain the unit's condenser and evaporator, respectively. PTAC systems may be adapted to provide heating in cold weather, either directly by using an electric strip, gas, or other heaters, or by reversing the refrigerant flow to heat the interior and draw heat from the exterior air, converting the air conditioner into a heat pump. They may be installed in a wall opening with the help of a special sleeve on the wall and a custom grill that is flush with the wall and window air conditioners can also be installed in a window, but without a custom grill.^[74]

Packaged air conditioner

[edit]

Packaged air conditioners (also known as self-contained units)^{[75][76]} are central systems that integrate into a single housing all the components of a split central system, and deliver air, possibly through ducts, to the spaces to be cooled. Depending on their construction they may be outdoors or indoors, on roofs (rooftop units),^{[77][78]} draw the air to be conditioned from inside or outside a building and be water or air-cooled. Often, outdoor units are air-cooled while indoor units are liquid-cooled using a cooling tower.^{[70][79][80][81][82][83]}

Types of compressors

[edit]

Compressor types	Common applications	Typical capacity	Efficiency	Durability	Repairability
Reciprocating	Refrigerator, Walk-in freezer, portable air conditioners	small – large	very low (small capacity) medium (large capacity)	very low	medium
Rotary vane	Residential mini splits	small	low	low	easy
Scroll	Commercial and central systems, VRF	medium	medium	medium	easy
Rotary screw	Commercial chiller	medium – large	medium	medium	hard
Centrifugal	Commercial chiller	very large	medium	high	hard
Maglev Centrifugal	Commercial chiller	very large	high	very high	very hard

Reciprocating

[edit]

Main article: Reciprocating compressor

This compressor consists of a crankcase, crankshaft, piston rod, piston, piston ring, cylinder head and valves. ^[*citation needed*]

Scroll

[edit]

Main article: Scroll compressor

This compressor uses two interleaving scrolls to compress the refrigerant.^[84] it consists of one fixed and one orbiting scrolls. This type of compressor is more efficient because it has 70 percent less moving parts than a reciprocating compressor. ^[*citation needed*]

Screw

[edit]

Main article: Rotary-screw compressor

This compressor use two very closely meshing spiral rotors to compress the gas. The gas enters at the suction side and moves through the threads as the screws rotate. The

meshing rotors force the gas through the compressor, and the gas exits at the end of the screws. The working area is the inter-lobe volume between the male and female rotors. It is larger at the intake end, and decreases along the length of the rotors until the exhaust port. This change in volume is the compression. ^[citation needed]

Capacity modulation technologies

[edit]

There are several ways to modulate the cooling capacity in refrigeration or air conditioning and heating systems. The most common in air conditioning are: on-off cycling, hot gas bypass, use or not of liquid injection, manifold configurations of multiple compressors, mechanical modulation (also called digital), and inverter technology. ^[citation needed]

Hot gas bypass

[edit]

Hot gas bypass involves injecting a quantity of gas from discharge to the suction side. The compressor will keep operating at the same speed, but due to the bypass, the refrigerant mass flow circulating with the system is reduced, and thus the cooling capacity. This naturally causes the compressor to run uselessly during the periods when the bypass is operating. The turn down capacity varies between 0 and 100%.^[85]

Manifold configurations

[edit]

Several compressors can be installed in the system to provide the peak cooling capacity. Each compressor can run or not in order to stage the cooling capacity of the unit. The turn down capacity is either 0/33/66 or 100% for a trio configuration and either 0/50 or 100% for a tandem.^[citation needed]

Mechanically modulated compressor

[edit]

This internal mechanical capacity modulation is based on periodic compression process with a control valve, the two scroll set move apart stopping the compression for a given time period. This method varies refrigerant flow by changing the average time of compression, but not the actual speed of the motor. Despite an excellent turndown ratio – from 10 to 100% of the cooling capacity, mechanically modulated scrolls have high energy consumption as the motor continuously runs.^[citation needed]

Variable-speed compressor

[edit]

Main article: Inverter compressor

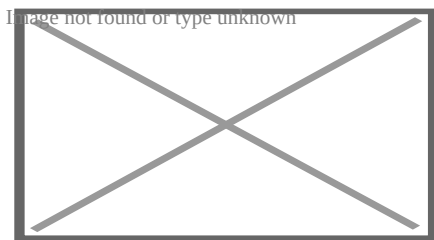
This system uses a variable-frequency drive (also called an Inverter) to control the speed of the compressor. The refrigerant flow rate is changed by the change in the speed of the compressor. The turn down ratio depends on the system configuration and manufacturer. It modulates from 15 or 25% up to 100% at full capacity with a single inverter from 12 to 100% with a hybrid tandem. This method is the most efficient way to modulate an air conditioner's capacity. It is up to 58% more efficient than a fixed speed system.^[*citation needed*]

Impact

[edit]

Health effects

[edit]



Rooftop condenser unit fitted on top of an Osaka Municipal Subway 10 series subway carriage. Air conditioning has become increasingly prevalent on public transport vehicles as a form of climate control, and to ensure passenger comfort and drivers' occupational safety and health.

In hot weather, air conditioning can prevent heat stroke, dehydration due to excessive sweating, electrolyte imbalance, kidney failure, and other issues due to hyperthermia.^[8]^[86] Heat waves are the most lethal type of weather phenomenon in the United States.^[87]^[88] A 2020 study found that areas with lower use of air conditioning correlated with higher rates of heat-related mortality and hospitalizations.^[89] The August 2003 France heatwave resulted in approximately 15,000 deaths, where 80% of the victims were over 75 years old. In response, the French government required all retirement homes to have at least one air-conditioned room at 25 °C (77 °F) per floor during heatwaves.^[8]

Air conditioning (including filtration, humidification, cooling and disinfection) can be used to provide a clean, safe, hypoallergenic atmosphere in hospital operating rooms and other environments where proper atmosphere is critical to patient safety and well-being. It is sometimes recommended for home use by people with allergies, especially mold.^[90]^[91] However, poorly maintained water cooling towers can promote the growth and spread of

microorganisms such as *Legionella pneumophila*, the infectious agent responsible for Legionnaires' disease. As long as the cooling tower is kept clean (usually by means of a chlorine treatment), these health hazards can be avoided or reduced. The state of New York has codified requirements for registration, maintenance, and testing of cooling towers to protect against Legionella.^[92]

Economic effects

[edit]

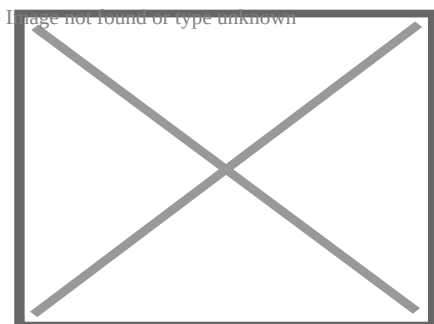
First designed to benefit targeted industries such as the press as well as large factories, the invention quickly spread to public agencies and administrations with studies with claims of increased productivity close to 24% in places equipped with air conditioning.^[93]

Air conditioning caused various shifts in demography, notably that of the United States starting from the 1970s. In the US, the birth rate was lower in the spring than during other seasons until the 1970s but this difference then declined since then.^[94] As of 2007, the Sun Belt contained 30% of the total US population while it was inhabited by 24% of Americans at the beginning of the 20th century.^[95] Moreover, the summer mortality rate in the US, which had been higher in regions subject to a heat wave during the summer, also evened out.^[7]

The spread of the use of air conditioning acts as a main driver for the growth of global demand of electricity.^[96] According to a 2018 report from the International Energy Agency (IEA), it was revealed that the energy consumption for cooling in the United States, involving 328 million Americans, surpasses the combined energy consumption of 4.4 billion people in Africa, Latin America, the Middle East, and Asia (excluding China).^[8] A 2020 survey found that an estimated 88% of all US households use AC, increasing to 93% when solely looking at homes built between 2010 and 2020.^[97]

Environmental effects

[edit]



Air conditioner farm in the facade of a building in Singapore

Space cooling including air conditioning accounted globally for 2021 terawatt-hours of energy usage in 2016 with around 99% in the form of electricity, according to a 2018 report on air-conditioning efficiency by the International Energy Agency.^[8] The report predicts an increase of electricity usage due to space cooling to around 6200 TWh by 2050,^{[8][98]} and that with the progress currently seen, greenhouse gas emissions attributable to space cooling will double: 1,135 million tons (2016) to 2,070 million tons.^[8] There is some push to increase the energy efficiency of air conditioners. United Nations Environment Programme (UNEP) and the IEA found that if air conditioners could be twice as effective as now, 460 billion tons of GHG could be cut over 40 years.^[99] The UNEP and IEA also recommended legislation to decrease the use of hydrofluorocarbons, better building insulation, and more sustainable temperature-controlled food supply chains going forward.^[99]

Refrigerants have also caused and continue to cause serious environmental issues, including ozone depletion and climate change, as several countries have not yet ratified the Kigali Amendment to reduce the consumption and production of hydrofluorocarbons.^[100] CFCs and HCFCs refrigerants such as R-12 and R-22, respectively, used within air conditioners have caused damage to the ozone layer,^[101] and hydrofluorocarbon refrigerants such as R-410A and R-404A, which were designed to replace CFCs and HCFCs, are instead exacerbating climate change.^[102] Both issues happen due to the venting of refrigerant to the atmosphere, such as during repairs. HFO refrigerants, used in some if not most new equipment, solve both issues with an ozone damage potential (ODP) of zero and a much lower global warming potential (GWP) in the single or double digits vs. the three or four digits of hydrofluorocarbons.^[103]

Hydrofluorocarbons would have raised global temperatures by around 0.3–0.5 °C (0.5–0.9 °F) by 2100 without the Kigali Amendment. With the Kigali Amendment, the increase of global temperatures by 2100 due to hydrofluorocarbons is predicted to be around 0.06 °C (0.1 °F).^[104]

Alternatives to continual air conditioning include passive cooling, passive solar cooling, natural ventilation, operating shades to reduce solar gain, using trees, architectural shades, windows (and using window coatings) to reduce solar gain.^[citation needed]

Social effects

[edit]

Socioeconomic groups with a household income below around \$10,000 tend to have a low air conditioning adoption,^[42] which worsens heat-related mortality.^[7] The lack of cooling can be hazardous, as areas with lower use of air conditioning correlate with higher rates of heat-related mortality and hospitalizations.^[89] Premature mortality in NYC is projected to grow between 47% and 95% in 30 years, with lower-income and vulnerable populations most at risk.^[89] Studies on the correlation between heat-related mortality and

hospitalizations and living in low socioeconomic locations can be traced in Phoenix, Arizona,^[105] Hong Kong,^[106] China,^[106] Japan,^[107] and Italy.^[108]^[109] Additionally, costs concerning health care can act as another barrier, as the lack of private health insurance during a 2009 heat wave in Australia, was associated with heat-related hospitalization.^[109]

Disparities in socioeconomic status and access to air conditioning are connected by some to institutionalized racism, which leads to the association of specific marginalized communities with lower economic status, poorer health, residing in hotter neighborhoods, engaging in physically demanding labor, and experiencing limited access to cooling technologies such as air conditioning.^[109] A study overlooking Chicago, Illinois, Detroit, and Michigan found that black households were half as likely to have central air conditioning units when compared to their white counterparts.^[110] Especially in cities, Redlining creates heat islands, increasing temperatures in certain parts of the city.^[109] This is due to materials heat-absorbing building materials and pavements and lack of vegetation and shade coverage.^[111] There have been initiatives that provide cooling solutions to low-income communities, such as public cooling spaces.^[8]^[111]

Other techniques

[edit]

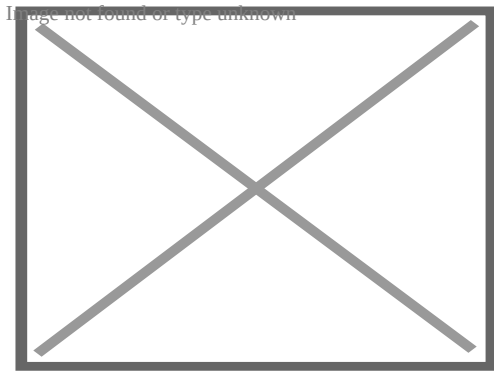
Buildings designed with passive air conditioning are generally less expensive to construct and maintain than buildings with conventional HVAC systems with lower energy demands.^[112] While tens of air changes per hour, and cooling of tens of degrees, can be achieved with passive methods, site-specific microclimate must be taken into account, complicating building design.^[12]

Many techniques can be used to increase comfort and reduce the temperature in buildings. These include evaporative cooling, selective shading, wind, thermal convection, and heat storage.^[113]

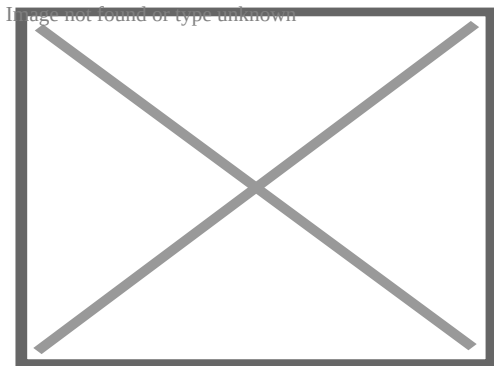
Passive ventilation

[edit]

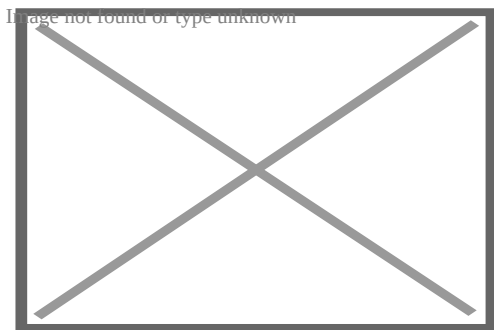
This section is an excerpt from Passive ventilation.[edit]



The ventilation system of a regular earthship



Dogtrot houses are designed to maximise natural ventilation.



A roof turbine ventilator, colloquially known as a 'Whirly Bird' is an application of wind driven ventilation.

Passive ventilation is the process of supplying air to and removing air from an indoor space without using mechanical systems. It refers to the flow of external air to an indoor space as a result of pressure differences arising from natural forces.

There are two types of natural ventilation occurring in buildings: *wind driven ventilation* and *buoyancy-driven ventilation*. Wind driven ventilation arises from the different pressures created by wind around a building or structure, and openings being formed on the perimeter which then permit flow through the building. Buoyancy-driven ventilation occurs as a result of the directional buoyancy force that results from temperature differences between the interior and exterior.^[114]

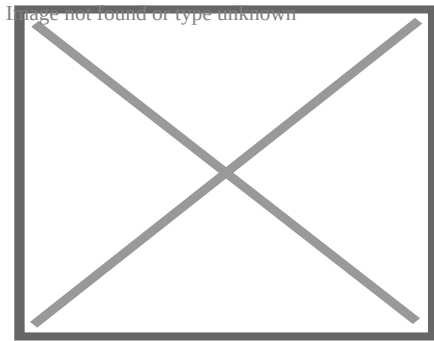
Since the internal heat gains which create temperature differences between the interior

and exterior are created by natural processes, including the heat from people, and wind effects are variable, naturally ventilated buildings are sometimes called "breathing buildings".

Passive cooling

[edit]

This section is an excerpt from Passive cooling.[edit]



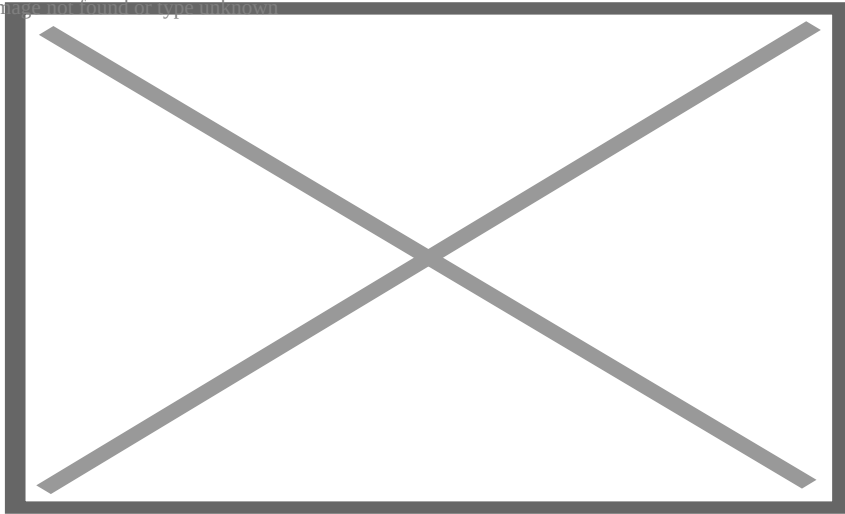
A traditional Iranian solar cooling design using a wind tower

Passive cooling is a building design approach that focuses on heat gain control and heat dissipation in a building in order to improve the indoor thermal comfort with low or no energy consumption.^{[115][116]} This approach works either by preventing heat from entering the interior (heat gain prevention) or by removing heat from the building (natural cooling).^[117]

Natural cooling utilizes on-site energy, available from the natural environment, combined with the architectural design of building components (e.g. building envelope), rather than mechanical systems to dissipate heat.^[118] Therefore, natural cooling depends not only on the architectural design of the building but on how the site's natural resources are used as heat sinks (i.e. everything that absorbs or dissipates heat). Examples of on-site heat sinks are the upper atmosphere (night sky), the outdoor air (wind), and the earth/soil.

Passive cooling is an important tool for design of buildings for climate change adaptation – reducing dependency on energy-intensive air conditioning in warming environments.^{[119][120]}

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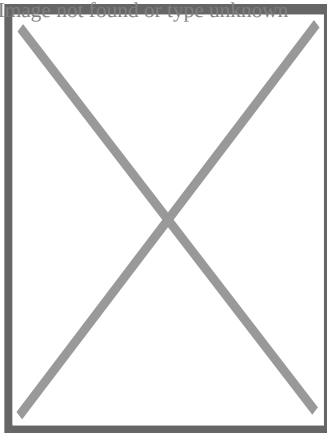


A pair of short windcatchers (*malqaf*) used in traditional architecture; wind is forced down on the windward side and leaves on the leeward side (*cross-ventilation*). In the absence of wind, the circulation can be driven with evaporative cooling in the inlet (which is also designed to catch dust). In the center, a *shuksheika* (roof lantern vent), used to shade the qa'a below while allowing hot air rise out of it (*stack effect*).^[11]

Daytime radiative cooling

[edit]

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Passive daytime radiative cooling (PDRC) surfaces are high in solar reflectance and heat emittance, cooling with zero energy use or pollution.^[121]

Passive daytime radiative cooling (PDRC) surfaces reflect incoming solar radiation and heat back into outer space through the infrared window for cooling during the daytime. Daytime radiative cooling became possible with the ability to suppress solar heating using photonic structures, which emerged through a study by Raman et al. (2014).^[122] PDRCs can come in a variety of forms, including paint coatings and films, that are designed to be high in solar reflectance and thermal emittance.^{[121][123]}

PDRC applications on building roofs and envelopes have demonstrated significant decreases in energy consumption and costs.^[123] In suburban single-family residential areas, PDRC application on roofs can potentially lower energy costs by 26% to 46%.^[124] PDRCs are predicted to show a market size of ~\$27 billion for indoor space cooling by 2025 and have undergone a surge in research and development since the 2010s.^[125]^[126]

Fans

[edit]

Main article: Ceiling fan

Hand fans have existed since prehistory. Large human-powered fans built into buildings include the punkah.

The 2nd-century Chinese inventor Ding Huan of the Han dynasty invented a rotary fan for air conditioning, with seven wheels 3 m (10 ft) in diameter and manually powered by prisoners.^[127]

:*Āf Ē'Ā†â€™Āfâ€šĀ,ĀċĀfĒ'Ā,ĀċĀfĀċĀċâ€šĀ-Ā...ĀĭĀfâ€šĀ,Ā-ĀfĒ'Āċâ,-ĀĭĀfâ€šĀ,Ā 99,ĀfĀ*

In 747, Emperor Xuanzong (r. 712–762) of the Tang dynasty (618–907) had the Cool Hall (*Liang Dian*

ĀfĒ'Ā†â€™Āfâ€šĀ,ĀĭĀfĒ'Āċâ,-ĀĭĀfâ€šĀ,ĀĭĀfĒ'Āċâ,-ĀĭĀfâ€šĀ,Ā¼ĀfĒ'Ā†â€™Āfâ€šĀ,ĀĭĀ

) built in the imperial palace, which the *Tang Yulin* describes as having water-powered fan wheels for air conditioning as well as rising jet streams of water from fountains. During the subsequent Song dynasty (960–1279), written sources mentioned the air conditioning rotary fan as even more widely used.^[127]

:*ĀfĒ'Ā†â€™Āfâ€šĀ,ĀċĀfĒ'Ā,ĀċĀfĀċĀċâ€šĀ-Ā...ĀĭĀfâ€šĀ,Ā-ĀfĒ'Āċâ,-ĀĭĀfâ€šĀ,Ā 134,ĀfĀ*

Thermal buffering

[edit]

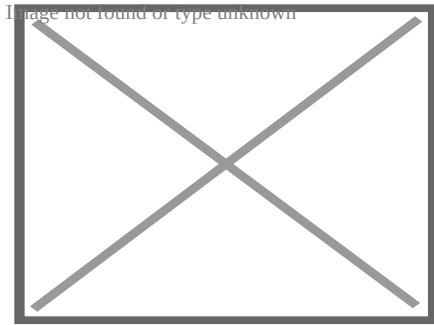
In areas that are cold at night or in winter, heat storage is used. Heat may be stored in earth or masonry; air is drawn past the masonry to heat or cool it.^[13]

In areas that are below freezing at night in winter, snow and ice can be collected and stored in ice houses for later use in cooling.^[13] This technique is over 3,700 years old in the Middle East.^[128] Harvesting outdoor ice during winter and transporting and storing for use in summer was practiced by wealthy Europeans in the early 1600s,^[15] and became popular in Europe and the Americas towards the end of the 1600s.^[129] This practice was replaced by mechanical compression-cycle icemakers.

Evaporative cooling

[edit]

Main article: Evaporative cooler



An evaporative cooler

In dry, hot climates, the evaporative cooling effect may be used by placing water at the air intake, such that the draft draws air over water and then into the house. For this reason, it is sometimes said that the fountain, in the architecture of hot, arid climates, is like the fireplace in the architecture of cold climates.^[11] Evaporative cooling also makes the air more humid, which can be beneficial in a dry desert climate.^[130]

Evaporative coolers tend to feel as if they are not working during times of high humidity, when there is not much dry air with which the coolers can work to make the air as cool as possible for dwelling occupants. Unlike other types of air conditioners, evaporative coolers rely on the outside air to be channeled through cooler pads that cool the air before it reaches the inside of a house through its air duct system; this cooled outside air must be allowed to push the warmer air within the house out through an exhaust opening such as an open door or window.^[131]

See also

[edit]

- Air filter
- Air purifier
- Cleanroom
- Crankcase heater
- Energy recovery ventilation
- Indoor air quality
- Particulates

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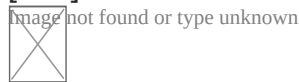
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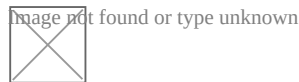
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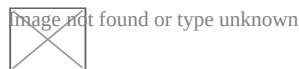
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- o U.S. patent 808,897 Carrier's original patent
- o U.S. patent 1,172,429
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Heating, ventilation, and air conditioning

**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
- Thermal insulation

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

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

**Professions,
trades,
and services**

- Duct cleaning
- Duct leakage testing
- Environmental engineering
- Hydronic balancing
- Kitchen exhaust cleaning
- Mechanical engineering
- Mechanical, electrical, and plumbing
- Mold growth, assessment, and remediation
- Refrigerant reclamation
- Testing, adjusting, balancing

**Industry
organizations**

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

Health and safety

See also

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Home appliances

- Air conditioner
- Air fryer
- Air ioniser
- Air purifier
- Barbecue grill
- Blender
 - Immersion blender
- Bread machine
- Bug zapper
- Coffee percolator
- Clothes dryer
 - combo
- Clothes iron
- Coffeemaker
- Dehumidifier
- Dishwasher
 - drying cabinet
- Domestic robot
 - comparison
- Deep fryer
- Electric blanket
- Electric drill
- Electric kettle
- Electric knife
- Electric water boiler
- Electric heater
- Electric shaver
- Electric toothbrush
- Epilator
- Espresso machine
- Evaporative cooler
- Food processor
- Fan
 - attic
 - bladeless
 - ceiling
 - Fan heater
 - window
- Freezer
- Garbage disposer
- Hair dryer
- Hair iron
- Humidifier
- Icemaker
- Ice cream maker
- Induction cooker
- Instant hot water dispenser
- Juicer
- Kitchen hood
- Kitchen stove

Types

See also

- Appliance plug
- Appliance recycling

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Roofs

Roof shapes

- Arched roof
- Barrel roof
- Board roof
- Bochká roof
- Bow roof
- Butterfly roof
- Clerestory
- Conical roof
- Dome
- Flat roof
- Gable roof
- Gablet roof
- Gambrel roof
- Half-hipped roof
- Hip roof
- Onion dome
- Mansard roof
- Pavilion roof
- Rhombic roof
- Ridged roof
- Saddle roof
- Sawtooth roof
- Shed roof
- Tented roof

Cross-gabled roof

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Roof elements

- Air conditioning unit
- Attic
- Catslide
- Chimney
- Collar beam
- Dormer
- Eaves
- Flashing
- Gable
- Green roof
- Gutter
- Hanging beam
- Joist
- Lightning rod
- Loft
- Purlin
- Rafter
- Ridge vent
- Roof batten
- Roof garden
- Roofline
- Roof ridge
- Roof sheeting
- Roof tiles
- Roof truss
- Roof window
- Skylight
- Soffit
- Solar panels
- Spire
- Weathervane
- Wind brace

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Electronics

Branches

- Analogue electronics
- Digital electronics
- Electronic engineering
- Instrumentation
- Microelectronics
- Optoelectronics
- Power electronics
- Printed electronics
- Semiconductor
- Schematic capture
- Thermal management
- 2020s in computing
- Atomtronics
- Bioelectronics
- List of emerging electronics
- Failure of electronic components

Advanced topics

- Flexible electronics
- Low-power electronics
- Molecular electronics
- Nanoelectronics
- Organic electronics
- Photonics
- Piezotronics
- Quantum electronics
- Spintronics

**Electronic
equipment**

- Air conditioner
- Central heating
- Clothes dryer
- Computer/Notebook
- Camera
- Dishwasher
- Freezer
- Home robot
- Home cinema
- Home theater PC
- Information technology
- Cooker
- Microwave oven
- Mobile phone
- Networking hardware
- Portable media player
- Radio
- Refrigerator
- Robotic vacuum cleaner
- Tablet
- Telephone
- Television
- Water heater
- Video game console
- Washing machine

Applications

- Audio equipment
- Automotive electronics
- Avionics
- Control system
- Data acquisition
- e-book
- e-health
- Electromagnetic warfare
- Electronics industry
- Embedded system
- Home appliance
- Home automation
- Integrated circuit
- Home appliance
 - Consumer electronics
 - Major appliance
 - Small appliance
- Marine electronics
- Microwave technology
- Military electronics
- Multimedia
- Nuclear electronics
- Open-source hardware
- Radar and Radio navigation
- Radio electronics
- Terahertz technology
- Wired and Wireless Communications

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About Royal Supply South

Things To Do in Arapahoe County

Photo

History Colorado Center

4.6 (2666)

Photo

Image not found or type unknown

Aurora History Museum

4.6 (251)

Photo

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Cherry Creek Valley Ecological Park

4.7 (484)

Photo

Wings Over the Rockies Air & Space Museum

4.7 (5324)

Photo

Image not found or type unknown

Four Mile Historic Park

4.6 (882)

Photo

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Meow Wolf Denver | Convergence Station

4.5 (14709)

Driving Directions in Arapahoe County

Driving Directions From Denver to Royal Supply South

Driving Directions From William Richheimer, MD to Royal Supply South

Driving Directions From Costco Wholesale to Royal Supply South

<https://www.google.com/maps/dir/Regal+River+Point/Royal+Supply+South/@39.65262105,008644,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJJ40tUAqAbIcRVEizYRM3e105.008644!2d39.652626!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e0>

<https://www.google.com/maps/dir/William+Richheimer%2C+MD/Royal+Supply+South/@39.651013,2747,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ45q8GHV-blcRLAgDq5g8-Vc!2m2!1d-105.0132747!2d39.6510094!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e2>

<https://www.google.com/maps/dir/Walgreens/Royal+Supply+South/@39.6246603,-105.0200245,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ8zuXzzqAbIcRPsc0NxgB105.0200245!2d39.6246603!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e1>

https://www.google.com/maps/dir/Lowe%27s+Home+Improvement/Royal+Supply+South/@39.651013,3478,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJMbvTxDmAbIcRm_hEdvP105.013478!2d39.62581!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e3

<https://www.google.com/maps/dir/Mullen+High+School/Royal+Supply+South/@39.651013,362791,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJUXQGSwCAa4cRd9cGgp105.0362791!2d39.6513096!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e0>

<https://www.google.com/maps/dir/Tandy+Leather+South+Denver+-+151/Royal+Supply+South/@39.6520857,-105.005976,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJt2nr7QqAbIcRqgEXMaZao105.005976!2d39.6520857!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e0>

105.005976!2d39.6520857!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e2

Driving Directions From The Aurora Highlands North Sculpture to Royal Supply South

Driving Directions From Morrison Nature Center to Royal Supply South

Driving Directions From Clock Tower Tours to Royal Supply South

Driving Directions From Aurora History Museum to Royal Supply South

Driving Directions From Cherry Creek State Park to Royal Supply South

Driving Directions From Aurora Reservoir to Royal Supply South

<https://www.google.com/maps/dir/Denver+Museum+of+Nature+%26+Science/Royal+Supply+South/@39.7475261,104.9428078,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-104.9428078!2d39.7475261!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e0>

<https://www.google.com/maps/dir/Colorado+Freedom+Memorial/Royal+Supply+South/@39.7283941,104.7811557,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-104.7811557!2d39.7283941!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e2>

<https://www.google.com/maps/dir/Morrison+Nature+Center/Royal+Supply+South/@39.7537565,104.8009141,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-104.8009141!2d39.7537565!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e1>

<https://www.google.com/maps/dir/Cherry+Creek+Valley+Ecological+Park/Royal+Supply+South/@39.5822885,104.8038771,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-104.8038771!2d39.5822885!1m5!1m1!1sChIJ06br1RqAbIcRAjyWXdlXZaw!2m2!1d-105.0233105!2d39.6435918!3e2>

105.0233105!2d39.6435918!3e3

Reviews for Royal Supply South

Estimating Future Costs through Contract Analysis [View GBP](#)

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Google Business Profile

Company Website : <https://royal-durhamsupply.com/locations/wichita-kansas/>

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