Mobile Homes

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  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
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When embarking on a renovation or construction project, the excitement of transforming a space often takes center stage. However, beneath the surface lies an intricate network of plumbing and gas lines that demands careful consideration. Energy-efficient HVAC systems reduce utility costs for mobile home owners **Mobile Home Furnace Installation** allergen. Overlooking these critical elements can lead to unforeseen complications, increased costs, and potential safety hazards. Therefore, understanding the importance of planning around existing plumbing and gas lines is not only prudent but essential for a successful project.

To begin with, existing plumbing and gas lines serve as the lifeline of any building. They ensure that water and energy flow seamlessly to support daily activities. When planning renovations or new constructions, it is crucial to respect these established pathways to maintain their integrity and functionality. Any disruption or damage can result in costly repairs or replacements, which could otherwise be avoided with careful planning.

Moreover, integrating existing systems into new designs requires a nuanced approach that balances creativity with practicality. Architects and designers must work closely with engineers and contractors to assess the current layout of pipes and gas lines. This collaboration ensures that any proposed changes do not interfere with or compromise these systems. By doing so, they can create innovative solutions that enhance the space without sacrificing utility or efficiency.

Safety is another paramount concern when dealing with plumbing and gas lines. Gas leaks pose serious risks including fires or explosions if accidentally punctured during construction. Similarly, improperly handled water lines can lead to flooding or water damage. Thus, thorough inspections by qualified professionals are imperative before initiating any work near these installations.

Additionally, considering existing infrastructure often leads to more sustainable practices by reducing waste associated with unnecessary demolitions or relocations of piping systems. It encourages adaptive reuse strategies where possible-preserving resources while achieving aesthetic goals.

Finally yet importantly is compliance: adhering strictly not just for safety reasons but also because local building codes mandate specific standards regarding how close one may build relative towards such utilities-failure here could result in legal repercussions alongside financial penalties too!

In conclusion then - when you take time upfront recognizing significance surrounding pre-existing pipelines within context broader architectural endeavors-you safeguard both structural integrity long-term value proposition contained therein!

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**

When embarking on a renovation or construction project, one of the most crucial steps is assessing the current layout of plumbing and gas lines. This initial evaluation is not only essential for ensuring safety but also for optimizing the design and functionality of the space. Understanding the existing infrastructure can significantly influence planning decisions, helping to avoid costly mistakes and unnecessary complications down the road.

The first step in this assessment process involves a thorough inspection. It is essential to locate all existing plumbing and gas lines, often hidden behind walls or beneath floors. This task may require consulting blueprints if available or employing advanced tools like pipe locators to map out these critical systems accurately. A detailed understanding of their paths allows for smarter planning, ensuring that new installations do not interfere with these established routes.

Once the layout is clearly understood, it becomes possible to evaluate its condition. Checking for any signs of wear and tear, leaks, or outdated materials that might not comply with current codes should be prioritized. Older pipes may need replacement due to corrosion or inefficiency, while newer ones might only require minor adjustments for integration into the new design. This phase ensures that any changes made will be built upon a solid foundation that meets modern standards.

Next comes the challenge of integrating new designs with existing systems. This step demands both creativity and practicality from those involved in planning. For example, when designing a new kitchen or bathroom layout, considerations must include where fixtures like sinks and stoves will align with existing water and gas supplies. Thoughtful planning can minimize rerouting needs, saving both time and money while maintaining aesthetic appeal.

Furthermore, collaboration with professionals such as plumbers or contractors during this stage can provide invaluable insights into what is feasible within the given constraints. Their expertise can guide decision-making processes regarding whether to adapt designs around current layouts or undertake more extensive renovations that involve moving major pipelines.

Safety remains paramount throughout this entire process. Any modifications involving gas lines must adhere strictly to safety regulations due to their potential hazards if mishandled. Similarly, ensuring proper drainage systems are maintained prevents future problems such as blockages or backflows, which could cause significant damage.

In conclusion, assessing the current layout of plumbing and gas lines is an indispensable part of planning around existing infrastructures in any building project. By thoroughly inspecting these systems' paths and conditions before commencing work, individuals can make informed decisions that integrate seamlessly with their desired outcomes while prioritizing efficiency and safety at every turn. Through careful consideration and expert guidance where necessary, successful projects emerge-ones that respect both functional imperatives and creative aspirations alike.

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Considerations for maintaining structural integrity during HVAC installation

Modifying existing systems for HVAC installation presents a myriad of challenges, especially when it involves planning around existing plumbing or gas lines. These challenges necessitate careful consideration and strategic planning to ensure successful integration without compromising the functionality of either the HVAC system or the pre-existing structures.

One of the primary challenges in this scenario is navigating spatial constraints. Buildings, particularly older ones, often have complex layouts where plumbing and gas lines are intricately woven into walls, floors, and ceilings. This complexity can limit available space for new HVAC components such as ducts and vents. Consequently, professionals must conduct thorough assessments to map out these existing systems accurately before any modifications begin. Such assessments help in devising strategies that avoid interference with these critical lines while still achieving optimal placement for HVAC components.

Another significant challenge is the potential risk of damaging existing plumbing or gas lines during installation. Even minor errors can lead to major disruptions, such as leaks or bursts which could cause water damage or pose safety hazards due to gas leaks. Therefore, precision is paramount during installation processes. Skilled technicians often employ advanced technologies such as sensors and imaging tools to detect and monitor plumbing and gas pipelines' exact locations, minimizing the risk of accidental damage.

Furthermore, compliance with building codes and regulations adds another layer of complexity. Different regions have specific codes governing how close HVAC installations can be situated relative to plumbing and gas lines. Adhering to these regulations ensures not only legal compliance but also enhances safety standards within the building environment. Navigating these regulatory requirements demands a comprehensive understanding from all involved personnel.

Cost implications cannot be overlooked when modifying existing systems for HVAC installation around plumbing or gas lines. The financial burden can be substantial due to potential needs for rerouting pipes or reinforcing structural elements to accommodate new equipment safely. Budgeting must account for possible contingencies arising from unexpected complications discovered during modification work.

Moreover, effective communication among stakeholders is crucial throughout this process-ranging from architects and engineers who design solutions compatible with both old and new systems, to contractors executing those plans on-site under potentially challenging conditions.

In conclusion, modifying existing systems for HVAC installations near pre-existing plumbing or gas lines is fraught with challenges that demand meticulous planning and execution. By addressing spatial constraints wisely; employing technology judiciously; ensuring strict adherence to safety regulations; managing costs effectively; and fostering strong communication among project team members-all these efforts contribute towards overcoming obstacles inherent in integrating modern HVAC solutions into established infrastructure seamlessly yet safely.

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

When planning HVAC installations around existing plumbing or gas lines, the complexity of the task requires a strategic approach that ensures efficiency, safety, and compliance with regulatory standards. As these systems often coexist within the same infrastructure, understanding how to navigate around pre-existing elements is crucial for a successful installation. Here's an exploration of key strategies that can be employed in such scenarios.

First and foremost, conducting a thorough site assessment is essential. This involves detailed scrutiny of the building's current layout, including an accurate mapping of all plumbing and gas lines. By understanding their precise locations, you can identify potential conflicts and plan accordingly. The use of modern technology such as 3D scanning can aid in creating detailed models that provide valuable insights into spatial dynamics.

Collaboration with other professionals is another critical strategy. Engaging with plumbers or gas line experts during the planning phase allows for knowledge sharing and problem-solving that considers all aspects of the building's infrastructure. These collaborations often reveal practical solutions that may not have been apparent initially.

Moreover, flexibility in design plays a significant role in maneuvering around existing systems. Customizing ductwork or opting for flexible piping solutions can allow installations to adjust more easily to existing conditions without compromising performance or safety standards. In some cases, innovative product choices-such as ductless mini-split systems-might be suitable alternatives when traditional ductwork presents too many challenges.

Additionally, adherence to local codes and regulations is non-negotiable when dealing with HVAC installations near plumbing or gas lines. Ensuring compliance from the outset prevents future legal complications and guarantees that all work meets established safety criteria. Regular consultation with local authorities during the planning process helps keep projects aligned with these mandatory requirements.

Incorporating sustainability considerations into your strategy is also beneficial, especially when working within confined spaces dictated by existing lines. Opting for energy-efficient systems reduces operational costs over time and aligns with growing environmental consciousness among consumers and regulators alike.

Finally, contingency planning should not be overlooked. Unexpected issues are not uncommon when integrating new systems into older infrastructures; therefore, having backup plans ensures minimal disruption to project timelines and budgets should unforeseen obstacles arise.

In conclusion, strategically planning HVAC installations around existing plumbing or gas lines demands an integrated approach combining detailed assessments, professional collaboration, design flexibility, regulatory compliance, sustainability considerations, and robust contingency plans. By employing these strategies thoughtfully, installers can achieve seamless integration of modern HVAC solutions within complex infrastructural landscapes while ensuring optimal functionality and long-term reliability.

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

When undertaking any construction or renovation project, it is crucial to prioritize safety considerations and compliance with regulations, especially when planning around existing plumbing or gas lines. This focus not only ensures the protection of workers and residents but also guarantees that the project adheres to legal standards, preventing future complications or liabilities.

One of the primary safety considerations when dealing with existing plumbing or gas lines is understanding their exact location and condition. Before any work begins, a thorough inspection should be conducted to map out these utilities accurately. Advanced tools like pipe locators and ground-penetrating radar can aid in this process, minimizing the risk of accidental damage. Such precautions help prevent dangerous situations like gas leaks or water damage, which could lead to costly repairs or even pose health hazards.

Moreover, workers should be adequately trained in handling these utilities. For instance, they need to be aware of how to shut off valves quickly in case of an emergency. Training sessions focused on recognizing signs of leaks or damage are essential for maintaining a safe working environment. Additionally, equipping workers with proper personal protective equipment (PPE) further enhances safety during the project.

Compliance with regulations is another critical aspect that cannot be overlooked. Various codes govern how construction projects interact with existing utility lines, often varying by jurisdiction. These regulations are designed not only for the immediate safety of those involved in a project but also for long-term community welfare. Ensuring that all permits are obtained before beginning work is vital; failing to do so can result in hefty fines and delays.

Collaborating with local utility companies can provide invaluable assistance in adhering to these regulations. These organizations often have detailed records of utility line placements and may offer guidance on best practices for working near them. In some cases, having a representative from the utility company present during key phases of the project might be required to ensure compliance.

Furthermore, advancements in technology have introduced new materials and methods that enhance both safety and regulatory adherence when planning around plumbing or gas lines. For example, trenchless technology allows for repairs and installations without significant disruption to existing systems, reducing both risk and environmental impact.

In conclusion, safely navigating construction projects around existing plumbing or gas lines involves meticulous planning and adherence to established regulations. By prioritizing thorough inspections, worker training, collaboration with utility providers, and leveraging modern technologies, developers can ensure projects are completed safely while upholding legal responsibilities. Such diligence not only protects individuals involved but also contributes positively to broader community safety and infrastructure integrity.

Guidelines for professional assessment and installation to ensure balanced weight

distribution

When undertaking a renovation or construction project, the planning phase is crucial, especially when dealing with existing plumbing or gas lines. The complexity of these systems demands careful consideration of cost implications and budgeting for modifications to ensure the project is both financially feasible and technically sound.

Existing plumbing and gas lines can significantly impact the overall budget of a renovation project. These systems are often hidden behind walls or beneath floors, making any modification potentially invasive and costly. The first step in budgeting for such modifications is conducting a thorough assessment of the current infrastructure. This involves consulting with experienced professionals who can provide detailed insights into the condition, layout, and compliance issues related to existing systems.

Cost implications for modifying plumbing or gas lines can vary widely depending on several factors. For instance, relocating a gas line might require specialized labor due to safety concerns and regulatory requirements, which can increase costs significantly. Similarly, rerouting plumbing might involve extensive demolition and reconstruction efforts that further inflate expenses. Understanding these potential costs upfront allows homeowners and project managers to allocate funds more accurately within their budgets.

Another important aspect of budgeting around existing plumbing or gas lines is considering contingency plans for unexpected expenses. Renovation projects are notorious for unforeseen challenges; old pipes may be found to be corroded beyond repair, or outdated materials may not meet current safety standards. Setting aside a portion of the budget as a contingency fund helps mitigate financial strain when such surprises inevitably occur.

Moreover, choosing between repairing existing systems versus completely replacing them also impacts budgeting decisions. While initial assessments may suggest that repairs are sufficient, long-term considerations should be factored in as well-newer installations might offer greater efficiency and reliability, potentially resulting in savings over time despite higher upfront costs.

In addition to direct modification expenses, indirect costs should also be considered in the budget plan. These include permits required by local authorities for any changes made to plumbing or gas lines, as well as potential temporary relocation expenses if water or heating services need to be interrupted during construction.

Ultimately, effective cost management in projects involving existing plumbing or gas lines relies on meticulous planning and informed decision-making. By thoroughly understanding the scope of necessary modifications and their associated costs-and by preparing for unforeseen developments-homeowners can better control their budgets while ensuring that renovations proceed smoothly and safely.

In summary, addressing the cost implications and budgeting for modifications around existing plumbing or gas lines requires careful evaluation of current systems, strategic allocation of funds-including contingencies-and an informed approach to deciding between repair versus replacement options. Through this comprehensive planning process, stakeholders can achieve successful project outcomes without compromising financial stability.

When planning a renovation or any new construction project, one of the most critical aspects to consider is the existing plumbing or gas lines. These systems are essential for the functionality and safety of any building, and working around them requires careful planning and coordination with professionals. Here are some tips for ensuring a seamless integration while preserving the integrity of these vital systems.

First and foremost, it is crucial to engage with experienced, licensed professionals from the outset of your project. Plumbers and gas fitters possess specialized knowledge that is indispensable when dealing with existing lines. They can provide insights into potential challenges you might face and suggest viable solutions that adhere to building codes and safety regulations. Additionally, their expertise will help prevent costly mistakes that could arise from improper handling or rerouting of these utilities.

Communication is key when working with professionals in this field. Clearly articulate your goals and vision for the project, ensuring they fully understand what you hope to achieve. This open dialogue allows them to offer advice on how best to accommodate existing plumbing or gas lines within your design plans. It also fosters a collaborative environment where both parties can contribute ideas and solutions.

One practical tip is to request a detailed assessment of the current plumbing or gas line layout before commencing any work. This assessment should include an inspection report outlining the condition and configuration of existing systems. With this information at hand, both you and your team can make informed decisions about how to proceed without compromising safety or functionality.

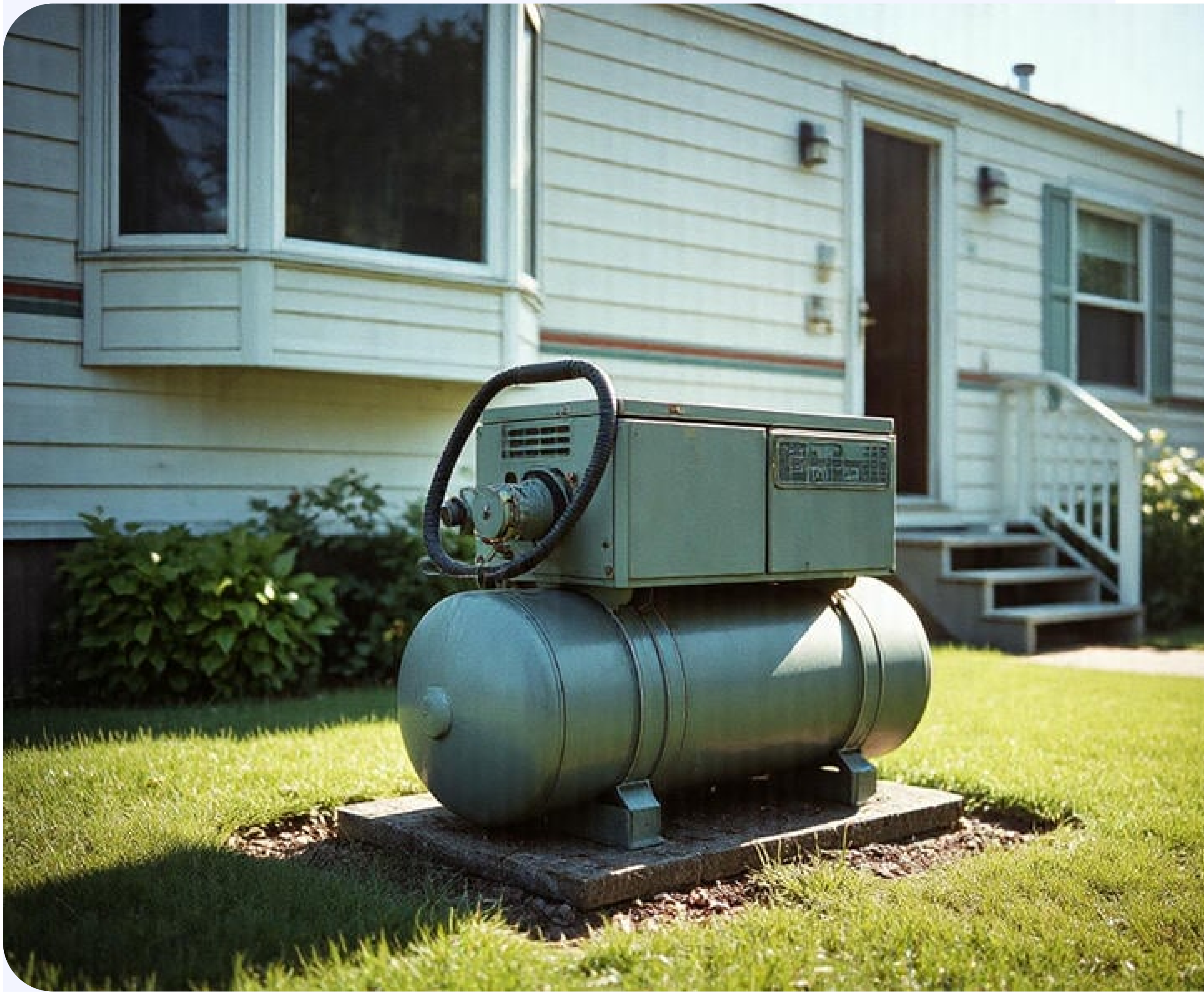
Flexibility in design plans may be necessary when working around existing infrastructure. Be prepared to adjust layouts if certain aspects prove unfeasible due to fixed utility placements. While this might seem like an inconvenience initially, maintaining flexibility ensures that you can still achieve your desired outcome without encountering significant delays or added expenses.

Incorporating modern technology into your planning process can also be beneficial. For example, utilizing 3D modeling software allows you to visualize proposed changes within the context of existing plumbing or gas lines more accurately than traditional blueprints might allow. This approach helps identify potential issues early on, providing an opportunity to address them proactively rather than reactively.

Throughout the project, prioritize safety above all else. Ensure that all work complies with local regulations regarding plumbing and gas installations; non-compliance not only poses serious risks but could also lead to legal ramifications down the line.

Finally, establish a strong relationship with your chosen professionals by showing appreciation for their expertise throughout each stage of development-from initial consultation through final installation checks-and remain open-minded towards their recommendations even if they require slight modifications from original plans.

By following these guidelines-engaging qualified experts early on; communicating clearly; conducting thorough assessments; remaining adaptable during design phases; leveraging technological tools effectively; prioritizing safety standards consistently-you'll pave way toward seamless integration between new construction elements while respecting pre-existing infrastructures' complexities intricacies alike!



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.

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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]

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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

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Preceding discoveries

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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]

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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

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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

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Operating principles

[edit]
Main article: Vapor-compression refrigeration

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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*

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

[edit]
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

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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]

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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

Image not found or type unknown

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]

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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]

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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]

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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.

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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]

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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]
:ÃƒÆ’Ã†â€™Ãƒâ€šÃ‚Â¢ÃƒÆ’Ã‚Â¢ÃƒÂ¢Ã¢â€šÂ¬Ã…Â¡Ãƒâ€šÃ‚Â¬ÃƒÆ’Ã¢â‚¬Â¦Ãƒâ€šÃ‚Â 99,Ãƒ
In 747, Emperor Xuanzong (r. 712–762) of the Tang dynasty (618–907) had the Cool Hall (*Liang Dian*

ÃƒÆ’Ã†â€™Ãƒâ€šÃ‚Â¦ÃƒÆ’Ã¢â‚¬Å¡Ãƒâ€šÃ‚Â¶ÃƒÆ’Ã¢â‚¬Å¡Ãƒâ€šÃ‚Â¼ÃƒÆ’Ã†â€™Ãƒâ€šÃ‚Â¦
) 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]
:ÃƒÆ’Ã†â€™Ãƒâ€šÃ‚Â¢ÃƒÆ’Ã‚Â¢Ãƒ‚Â¢Ã¢â€šÂ¬Ã…Â¡Ãƒâ€šÃ‚Â¬ÃƒÆ’Ã¢â‚¬Â¦Ãƒâ€šÃ‚Â 134,Ã

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

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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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Look up ***Cassette air conditioner*** in Wiktionary, the free dictionary.

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Wikiversity has learning resources about ***Refrigeration and air conditioning***

  - U.S. patent 808,897 Carrier's original patent
  - U.S. patent 1,172,429
  - U.S. patent 2,363,294
  - *Scientific American*, "Artificial Cold", 28 August 1880, p. 138
  - *Scientific American*, "The Presidential Cold Air Machine", 6 August 1881, p. 84

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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

Components

- ○ 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

Measurement and control

- Air flow meter
- Aquastat
- BACnet
- Blower door
- Building automation
- Carbon dioxide sensor
- Clean air delivery rate (CADR)
- Control valve
- Gas detector
- Home energy monitor
- Humidistat
- HVAC control system
- Infrared thermometer
- Intelligent buildings
- LonWorks
- Minimum efficiency reporting value (MERV)
- Normal temperature and pressure (NTP)
- OpenTherm
- Programmable communicating thermostat
- Programmable thermostat
- Psychrometrics
- Room temperature
- Smart thermostat
- Standard temperature and pressure (STP)
- Thermographic camera
- Thermostat
- Thermostatic radiator valve

Professions, trades, and services

- Architectural acoustics
- Architectural engineering
- Architectural technologist
- Building services engineering
- Building information modeling (BIM)
- Deep energy retrofit
- Duct cleaning
- Duct leakage testing
- Environmental engineering
- Hydronic balancing
- Kitchen exhaust cleaning
- Mechanical engineering
- Mechanical, electrical, and plumbing
- Mold growth, assessment, and remediation
- Refrigerant reclamation
- Testing, adjusting, balancing

Industry organizations

- AHRI
- AMCA
- ASHRAE
- ASTM International
- BRE
- BSRIA
- CIBSE
- Institute of Refrigeration
- IIR
- LEED
- SMACNA
- UMC

Health and safety

- Indoor air quality (IAQ)
- Passive smoking
- Sick building syndrome (SBS)
- Volatile organic compound (VOC)

See also

- ASHRAE Handbook
- Building science
- Fireproofing
- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

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Home appliances

Types

- 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

See also

- Appliance plug
- Appliance recycling

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Roofs

Roof shapes

- Arched roof
- Barrel roof
- Board roof
- Bochka 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
Advanced topics	○ 2020s in computing ○ Atomtronics ○ Bioelectronics ○ List of emerging electronics ○ Failure of electronic components ○ 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

Authority control databases: National

- Germany
- Czech Republic

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About Royal Supply South

Things To Do in Arapahoe County

Photo

Plains Conservation Center (Visitor Center)

4.6 (393)

Photo

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Clock Tower Tours

4.1 (7)

Photo

Image not found or type unknown

Morrison Nature Center

4.7 (128)

Photo

Meow Wolf Denver | Convergence Station

4.5 (14709)

Photo

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History Colorado Center

4.6 (2666)

Photo

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Four Mile Historic Park

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Driving Directions in Arapahoe County

Driving Directions From Littleton to Royal Supply South

Driving Directions From William Richheimer, MD to Royal Supply South

Driving Directions From King Soopers to Royal Supply South

Driving Directions From Costco Vision Center to Royal Supply South

Driving Directions From VRCC Veterinary Specialty and Emergency Hospital to Royal Supply South

Driving Directions From Arapahoe County Assessor to Royal Supply South

https://www.google.com/maps/dir/The+Home+Depot/Royal+Supply+South/@39.6230
105.0244932,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJuUU_myWAbIcRHSU8v
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Driving Directions From Plains Conservation Center (Visitor Center) to Royal Supply South

Driving Directions From Morrison Nature Center to Royal Supply South

Driving Directions From Cherry Creek State Park to Royal Supply South

Driving Directions From Molly Brown House Museum to Royal Supply South

Driving Directions From Aurora Reservoir to Royal Supply South

Driving Directions From Molly Brown House Museum to Royal Supply South

https://www.google.com/maps/dir/Plains+Conservation+Center+%28Visitor+Center%
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Reviews for Royal Supply South

Planning Around Existing Plumbing or Gas Lines**View GBP**

Check our other pages :

- **Understanding Labor Inclusions in Contracts**
- **Transferring Warranty Benefits to New Owners**
- **Mitigating Moisture Risks in Humid Climates**
- **Minimizing Vibrations through Effective Mounting**
- **Estimating Future Costs through Contract Analysis**

Frequently Asked Questions

How can I determine the location of existing plumbing and gas lines before installing an HVAC system in my mobile home?

To locate existing plumbing and gas lines, you can consult your mobile homes building plans if available, use a stud finder with an AC wire warning feature, or hire a professional to conduct an inspection. This ensures accurate mapping and prevents accidental damage during installation.

What should I consider when planning the placement of HVAC components near plumbing or gas lines?

When planning the placement, ensure there is sufficient clearance from plumbing and gas lines to prevent interference and allow for maintenance access. Avoid placing heavy components directly above these utilities to reduce stress on them.

Are there specific codes or regulations I need to follow regarding proximity to plumbing and gas lines in a mobile home HVAC setup?

Yes, local building codes often specify minimum clearance requirements between HVAC systems and utility lines. Consult local regulations or hire a licensed contractor familiar with these codes to ensure compliance and safety.

How do I safely install ductwork without disrupting existing piping or causing leaks?

Plan duct routes carefully by identifying all piping beforehand, using flexible ducts where necessary, and securing them properly. Avoid cutting into structural elements that may support pipes. Its advisable to work with professionals who have experience with mobile home installations.

Royal Supply Inc

Phone : +16362969959

City : Wichita

State : KS

Zip : 67216

Address : Unknown Address

Google Business Profile

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