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Simplifying Approval Steps for Mobile Home HVAC Financing

Overview of HVAC needs specific to mobile homes

In today's fast-paced world, where efficiency and convenience are paramount, streamlining approval processes has become an essential aspect of facilitating various services, including mobile home ownership. One area where this is particularly critical is in securing financing for HVAC systems in mobile homes. The importance of simplifying approval steps for mobile home HVAC financing cannot be overstated, as it directly impacts homeowners' comfort, financial well-being, and overall quality of life.

Mobile homes offer a unique living solution for many individuals and families, providing affordable housing options that are both flexible and accessible. However, like any other dwelling, mobile homes require efficient heating, ventilation, and air conditioning (HVAC) systems to ensure a comfortable living environment. Thermostat settings should be adjusted to match seasonal needs in mobile homes **replacing hvac system in mobile home** allergen. Unfortunately, the process of obtaining necessary financing for these systems can often be bogged down by complex approval procedures that deter homeowners from upgrading or installing essential HVAC equipment.

Simplifying these approval processes brings several key benefits. First and foremost, it significantly reduces the time required to secure financing. Traditional approval procedures often involve multiple layers of paperwork and bureaucratic hurdles that can delay projects unnecessarily. By streamlining these steps, lenders can expedite the process, enabling homeowners to quickly access the funds they need to enhance their living conditions.

Moreover, simplified approval processes reduce the stress and uncertainty associated with applying for financing. Homeowners may feel overwhelmed by complicated requirements or discouraged by lengthy waiting periods. By making the process more straightforward and transparent, lenders can eliminate barriers that prevent individuals from pursuing necessary

upgrades to their HVAC systems. This not only improves customer satisfaction but also fosters trust between lenders and borrowers.

Another crucial aspect is financial accessibility. Streamlined approval processes often involve more flexible criteria that take into account the unique circumstances of mobile home owners. Many residents of mobile homes may have non-traditional income sources or credit profiles that do not fit conventional lending models. Simplifying approvals allows lenders to consider alternative factors when assessing eligibility for financing, thereby opening doors for a broader range of applicants.

Furthermore, improving access to HVAC financing through streamlined approvals contributes positively to environmental sustainability efforts. Modern HVAC systems are generally more energy-efficient than older models; thus facilitating upgrades helps reduce energy consumption and lower carbon footprints within communities. Encouraging the adoption of efficient technologies aligns with broader goals towards greener living spaces while simultaneously lowering utility costs for homeowners.

In conclusion, streamlining approval processes for mobile home HVAC financing holds immense importance in enhancing both individual lives and community well-being at large. By removing unnecessary obstacles in accessing funding solutions tailored specifically towards this demographic's needs - such as accelerated timelines coupled with inclusive evaluation criteria - all parties involved stand poised on solid ground: offering better services faster while fostering equity across diverse populations residing within these vibrant neighborhoods nationwide!

Securing HVAC financing for mobile homes often presents a unique set of challenges, but simplifying the approval steps can help make the process more accessible and less stressful for homeowners. Mobile homes, due to their distinct characteristics, frequently face obstacles that are not common with traditional housing when it comes to securing financing for essential upgrades like HVAC systems.

One of the primary challenges is the perception of risk by lenders. Mobile homes are often seen as depreciating assets compared to site-built homes, which typically appreciate over time. This perception can make lenders hesitant to approve financing without stringent conditions or higher interest rates. As a result, homeowners may find themselves jumping through numerous hoops just to secure necessary funding.

Another obstacle is related to the title status of mobile homes. Unlike traditional homes, which are considered real property once they are permanently affixed to land owned by the homeowner, many mobile homes are classified as personal property unless they meet specific criteria. This classification can complicate the financing process because loans for personal property generally come with different terms and conditions than those for real estate.

Creditworthiness also plays a significant role in securing HVAC financing for mobile home owners. Many residents of mobile home communities may have limited credit histories or lower credit scores, factors that can impede their ability to obtain favorable loan terms or even qualify for financing at all. Lenders often require detailed financial documentation and evidence of income stability, which can be challenging for individuals with non-traditional employment or fluctuating incomes.

To address these obstacles and simplify the approval steps, several strategies can be implemented. Firstly, fostering partnerships between financial institutions and mobile home manufacturers could lead to tailored loan products specifically designed for this market segment. These products would take into consideration the unique nature of mobile homes and provide more flexible terms that reflect their value accurately.

Educational initiatives aimed at both lenders and borrowers could also play a crucial role in easing the financing process. Lenders need better awareness about the evolving quality standards of modern manufactured homes, while borrowers should be informed about maintaining good credit health and understanding financial obligations associated with loans.

Streamlining documentation processes is another vital step towards simplification. By adopting technology-driven solutions like digital applications and automated verification systems, lenders could reduce paperwork burdens on applicants while speeding up decision-making times.

Lastly, advocacy efforts focused on regulatory changes at state or federal levels might help reclassify certain types of mobile homes as real property under specific conditions-thereby aligning them closer with traditional housing finance options.

In conclusion, though there are considerable barriers in securing HVAC financing for mobile homes due largely in part because they differ from conventional houses financially speaking-streamlined approval processes tailored specifically towards overcoming these hurdles hold promise in making access easier without compromising on fairness or feasibility either side

involved will benefit greatly from such measures being taken seriously now rather than later down line when things become even harder navigate successfully overall!

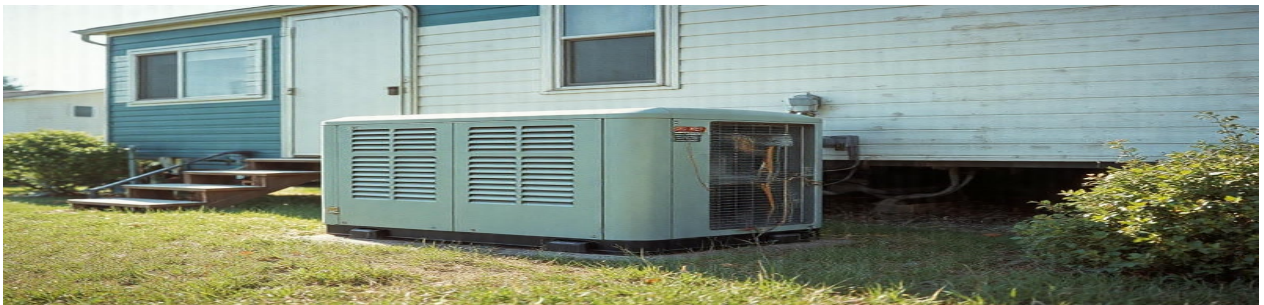
Affordable Payment Plans for Upgrading Mobile Home AC Systems



Choosing the right payment plan for upgrading your mobile home AC system is a crucial decision that can significantly impact your financial stability and comfort at home.. With numerous options available, it's essential to consider several factors to ensure you select a plan that aligns with your needs and budget. Firstly, assess your financial situation.

Posted by on 2024-12-30

Aligning Equipment Compatibility with Financing Options in Mobile Homes



In the dynamic world of mobile homes, aligning equipment compatibility with financing options is a crucial element that can significantly impact the success of any project.. The process involves ensuring that the equipment used in mobile home construction or renovation is not only technically suitable but also financially feasible.

Posted by on 2024-12-30

Understanding Financing Options for Mobile Home HVAC

Simplifying the approval steps in HVAC financing for mobile homes is a vital endeavor that can significantly enhance accessibility and efficiency for homeowners seeking to improve their living conditions. Mobile homes, often referred to as manufactured homes, have unique characteristics that can sometimes complicate traditional financing routes. Hence, adopting strategies tailored to these specific needs can streamline the process, making it less daunting for applicants.

One of the primary strategies involves enhancing transparency throughout the application process. By demystifying the steps involved, lenders can empower applicants with clear information about what is required at each stage. For instance, providing a detailed checklist of necessary documentation upfront can help applicants prepare adequately before submitting their applications. This proactive approach reduces back-and-forth communication, which often delays approval.

Another effective strategy is leveraging technology to automate and expedite certain aspects of the approval process. Digital platforms can facilitate quicker data verification and credit assessments by integrating directly with financial institutions and credit bureaus. Online portals where applicants can upload documents and track their application status in real-time offer convenience and peace of mind, reducing anxiety associated with waiting periods.

Furthermore, tailored loan products specifically designed for mobile home HVAC financing could be developed by financial institutions. These products would take into consideration factors such as shorter loan terms or modified interest rates that align better with the typical financial profiles of mobile home owners. By aligning product offerings more closely with customer needs, lenders not only simplify approvals but also increase their market appeal.

Collaboration between HVAC companies and financiers also plays a crucial role in simplifying approvals. Companies offering bundled services-whereby the cost of new systems includes installation and financing options-can remove some hurdles from consumers' paths by providing an all-inclusive package deal. Such partnerships ensure that homeowners receive comprehensive support from assessment through to installation without encountering multiple approval processes.

Education is another powerful tool in simplifying these steps. Providing workshops or online resources that educate mobile home owners on energy efficiency benefits and potential savings from modern HVAC systems can motivate them to pursue upgrades actively. This knowledge empowers consumers to make informed decisions that align with both their environmental values and financial capabilities.

Ultimately, simplicity in financing approvals hinges on creating a seamless experience for applicants while maintaining robust risk assessment standards for lenders. As we advance technologically and embrace more customer-centric approaches, these strategies will not only benefit individual homeowners but also contribute positively towards broader goals such as energy efficiency and sustainability within residential communities nationwide.

In conclusion, streamlining HVAC financing approvals for mobile homes involves a synergy of transparency, technological integration, tailored financial products, strategic partnerships, and education initiatives. Each strategy plays a pivotal role in ensuring that every step-from initial inquiry to final approval-is as straightforward as possible for all parties involved. Through these efforts, we pave the way for improved living environments while fostering inclusive financial practices within this important housing sector.



Explanation of common financing packages available

In today's rapidly evolving digital landscape, technology plays a pivotal role in enhancing efficiency and transparency across various sectors. One area where this impact is profoundly felt is in simplifying approval steps for mobile home HVAC (Heating, Ventilation, and Air Conditioning) financing. By leveraging technological advancements, stakeholders can

streamline processes, reduce administrative burdens, and build trust through greater transparency.

At the heart of these improvements lies the ability of technology to automate complex workflows. In traditional settings, obtaining financing for mobile home HVAC systems often involved cumbersome paperwork and lengthy approval times. Prospective borrowers had to navigate through multiple layers of bureaucracy, which not only slowed down the process but also increased the potential for errors and miscommunication. However, with the advent of advanced software solutions and digital platforms, these barriers are being dismantled. Automation tools can now efficiently handle data entry tasks, verify information against databases in real-time, and flag issues that require human intervention—all while maintaining high levels of accuracy.

Moreover, technology enhances transparency by enabling clear communication channels between all parties involved. Digital platforms can provide applicants with instant updates on their application status, reducing uncertainty and anxiety associated with waiting periods. Borrowers can track progress from submission to approval without having to make frequent inquiries or follow-ups with financial institutions. This immediate access to information not only empowers customers but also fosters trust as they feel more informed throughout the process.

Furthermore, data analytics capabilities embedded within modern technological frameworks offer profound insights that drive decision-making processes for lenders. By analyzing historical data patterns and credit scores using machine learning algorithms, institutions can assess risk more accurately than ever before. This precision allows lenders to offer personalized financing solutions tailored to individual needs while minimizing defaults—benefiting both parties in the long run.

In addition to efficiency gains and enhanced transparency for consumers seeking HVAC financing options for their mobile homes; technology also provides significant advantages on the regulatory front by ensuring compliance with industry standards seamlessly integrated into automated systems such as e-signatures or secure document storage facilities—thereby safeguarding sensitive customer information against potential breaches or misuse without adding extra layers onto already complex procedures traditionally associated around legal adherence requirements faced historically prior implementation new tech interventions now available today!

In conclusion: The integration intelligent technologies revolutionizes how we approach approving finance applications specifically targeting those looking fund upgrades related heating cooling equipment inside properties classified under category "mobile homes." It

ushers era wherein bureaucratic red tape becomes relic past replaced efficient transparent alternatives designed meet needs modern consumer base accustomed speed convenience offered digital age innovations made possible recent years alone!

Key factors to consider when choosing a financing option

The journey of financing a mobile home's HVAC system can often be a labyrinthine process, fraught with hurdles that both homeowners and lenders must navigate. However, the emergence of simplified approval steps has ushered in a new era, dramatically transforming this landscape. The impact on both homeowners and lenders is profound, bringing about a wave of benefits that enhance accessibility and efficiency.

For homeowners, simplified approval processes for mobile home HVAC financing mean less time spent entangled in bureaucratic red tape. Traditionally, obtaining financing involved exhaustive paperwork and stringent requirements that could deter even the most determined applicants. Simplified approval changes this narrative by streamlining documentation and reducing complexity. This expedited process not only saves time but also alleviates stress, making it easier for homeowners to secure necessary financing to improve their living conditions.

Furthermore, these improvements can lead to financial relief as more competitive rates become accessible through quicker approvals. Homeowners are empowered to make timely decisions regarding their HVAC needs without the looming fear of missing out on favorable terms due to delays in loan processing. This agility enables them to respond effectively to immediate issues such as replacing failing units or upgrading systems for energy efficiency.

On the flip side, lenders benefit significantly from streamlined approval processes as well. By minimizing administrative burdens associated with complex loan procedures, they are able to allocate resources more efficiently and serve a broader clientele base. Simplified processes reduce overhead costs related to lengthy application reviews and extensive document

management, thereby improving overall operational efficiency.

Additionally, this simplification fosters stronger relationships between lenders and borrowers through increased transparency and communication during the application process. Lenders who adopt these practices often gain competitive advantage by attracting more customers eager for quick solutions—a win-win situation that enhances customer satisfaction while boosting business growth.

In conclusion, simplifying approval steps for mobile home HVAC financing marks a pivotal shift towards greater inclusivity and efficiency within the lending landscape. For homeowners, it translates into reduced barriers when accessing essential financing options; meanwhile, lenders enjoy streamlined operations and expanded market reach. As this trend continues to gain momentum, the positive impacts on both sides promise a future where financial accessibility is not just an aspiration but an achievable reality for all involved parties.

Personal Loans for HVAC Systems

Simplifying approval steps for mobile home HVAC financing can be a game-changer for many homeowners. By streamlining the process, we not only expedite the delivery of essential heating and cooling systems but also enhance customer satisfaction and accessibility. To illustrate this, let's explore some case studies and examples of successful implementation in this area.

One significant example comes from a financial services company that recognized the complexities involved in traditional financing processes. Initially, customers faced lengthy paperwork, unclear eligibility criteria, and prolonged waiting periods for approvals. To address these issues, the company introduced a digitized platform that allowed applicants to submit all necessary documentation online. This platform employed algorithms to assess credit scores instantly and provided pre-approval decisions within minutes rather than days or weeks.

This change led to a remarkable improvement in customer experience. The time required for loan approval decreased by 60%, enabling more mobile home residents to access HVAC systems promptly during extreme weather conditions. Furthermore, the company reported a 30% increase in loan applications due to the simplified process, driving business growth while ensuring customers received timely assistance.

Another case study involves an HVAC manufacturer partnering with a finance company to offer tailored financing solutions directly at the point of sale. By training their sales team to assist with immediate financing options, they effectively removed barriers between potential buyers and necessary upgrades. Customers were able to secure loans without leaving their homes or dealing with multiple entities—a crucial advantage for remote or rural mobile home communities where access to financial institutions might be limited.

This initiative saw an uptick in sales conversions as it bridged gaps between product need and affordability. Mobile homeowners benefitted from immediate installations post-approval—sometimes on the same day—helping them maintain comfortable living environments without undue stress or delays.

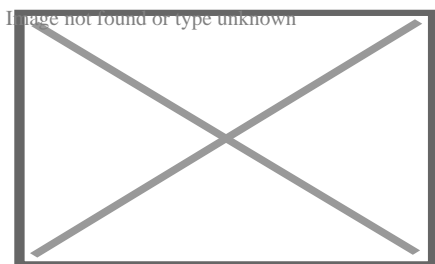
Lastly, consider the role of community outreach programs designed specifically for mobile home parks. One pilot program involved collaboration between local banks and non-profit organizations focused on improving living standards within these communities. By organizing workshops that educated residents about available financing options and simplifying documentation requirements through guided assistance sessions, they empowered individuals who otherwise might have felt overwhelmed by financial jargon or processes.

The result was a more informed public that could make educated decisions regarding their home improvements. This approach not only increased participation rates in HVAC upgrades but also fostered stronger community ties as neighbors shared experiences and supported one another through collective learning opportunities.

In conclusion, simplifying approval steps for mobile home HVAC financing is not just about reducing bureaucracy—it's about fostering inclusivity and empowerment among homeowners. These case studies demonstrate how innovative solutions can cut through red tape while simultaneously enhancing service delivery efficiency and customer satisfaction levels across diverse demographics. Through digital platforms, strategic partnerships at points-of-sale, and targeted educational initiatives within communities themselves; businesses can unlock new avenues for growth while making tangible positive impacts on people's lives every day.

About Thermal comfort

This article is about comfort zones in building construction. For other uses, see Comfort zone (disambiguation).



A thermal image of human

Thermal comfort is the condition of mind that expresses subjective satisfaction with the thermal environment.^[1] The human body can be viewed as a heat engine where food is the input energy. The human body will release excess heat into the environment, so the body can continue to operate. The heat transfer is proportional to temperature difference. In cold environments, the body loses more heat to the environment and in hot environments the body does not release enough heat. Both the hot and cold scenarios lead to discomfort.^[2] Maintaining this standard of thermal comfort for occupants of buildings or other enclosures is one of the important goals of HVAC (heating, ventilation, and air conditioning) design engineers.

Thermal neutrality is maintained when the heat generated by human metabolism is allowed to dissipate, thus maintaining thermal equilibrium with the surroundings. The main factors that influence thermal neutrality are those that determine heat gain and loss, namely metabolic rate, clothing insulation, air temperature, mean radiant temperature, air speed and relative humidity. Psychological parameters, such as individual expectations, and physiological parameters also affect thermal neutrality.^[3] Neutral temperature is the temperature that can lead to thermal neutrality and it may vary greatly between individuals and depending on factors such as activity level, clothing, and humidity. People are highly sensitive to even small differences in environmental temperature. At 24 °C, a difference of 0.38 °C can be detected between the temperature of two rooms.^[4]

The Predicted Mean Vote (PMV) model stands among the most recognized thermal comfort models. It was developed using principles of heat balance and experimental data collected in a controlled climate chamber under steady state conditions.^[5] The adaptive model, on the other hand, was developed based on hundreds of field studies with the idea that occupants dynamically interact with their environment. Occupants control their thermal environment by means of clothing, operable windows, fans, personal heaters, and sun shades.^{[3][6]} The PMV model can be applied to air-

conditioned buildings, while the adaptive model can be applied only to buildings where no mechanical systems have been installed.^[1] There is no consensus about which comfort model should be applied for buildings that are partially air-conditioned spatially or temporally.

Thermal comfort calculations in accordance with the ANSI/ASHRAE Standard 55,^[1] the ISO 7730 Standard^[7] and the EN 16798-1 Standard^[8] can be freely performed with either the CBE Thermal Comfort Tool for ASHRAE 55,^[9] with the Python package pythermalcomfort^[10] or with the R package `comf`.

Significance

[edit]

Satisfaction with the thermal environment is important because thermal conditions are potentially life-threatening for humans if the core body temperature reaches conditions of hyperthermia, above 37.5–38.3 °C (99.5–100.9 °F),^{[11][12]} or hypothermia, below 35.0 °C (95.0 °F).^[13] Buildings modify the conditions of the external environment and reduce the effort that the human body needs to do in order to stay stable at a normal human body temperature, important for the correct functioning of human physiological processes.

The Roman writer Vitruvius actually linked this purpose to the birth of architecture.^[14] David Linden also suggests that the reason why we associate tropical beaches with paradise is because in those environments is where human bodies need to do less metabolic effort to maintain their core temperature.^[15] Temperature not only supports human life; coolness and warmth have also become in different cultures a symbol of protection, community and even the sacred.^[16]

In building science studies, thermal comfort has been related to productivity and health. Office workers who are satisfied with their thermal environment are more productive.^{[17][18]} The combination of high temperature and high relative humidity reduces thermal comfort and indoor air quality.^[19]

Although a single static temperature can be comfortable, people are attracted by thermal changes, such as campfires and cool pools. Thermal pleasure is caused by varying thermal sensations from a state of unpleasantness to a state of pleasantness, and the scientific term for it is positive thermal alliesthesia.^[20] From a state of thermal neutrality or comfort any change will be perceived as unpleasant.^[21] This challenges the assumption that mechanically controlled buildings should deliver uniform temperatures and comfort, if it is at the cost of excluding thermal pleasure.^[22]

Influencing factors

[edit]

Since there are large variations from person to person in terms of physiological and psychological satisfaction, it is hard to find an optimal temperature for everyone in a given space. Laboratory and field data have been collected to define conditions that will be found comfortable for a specified percentage of occupants.^[1]

There are numerous factors that directly affect thermal comfort that can be grouped in two categories:

1. **Personal factors** – characteristics of the occupants such as metabolic rate and clothing level
2. **Environmental factors** – which are conditions of the thermal environment, specifically air temperature, mean radiant temperature, air speed and humidity

Even if all these factors may vary with time, standards usually refer to a steady state to study thermal comfort, just allowing limited temperature variations.

Personal factors

[edit]

Metabolic rate

[edit]

Main article: Metabolic rate

People have different metabolic rates that can fluctuate due to activity level and environmental conditions.^{[23][24][25]} ASHRAE 55-2017 defines metabolic rate as the rate of transformation of chemical energy into heat and mechanical work by metabolic activities of an individual, per unit of skin surface area.^[1]

$\dot{Q}_m = \dot{Q}_m \cdot A_{sk}$

Metabolic rate is expressed in units of met, equal to 58.2 W/m² (18.4 Btu/h·ft²). One met is equal to the energy produced per unit surface area of an average person seated at rest.

ASHRAE 55 provides a table of metabolic rates for a variety of activities. Some common values are 0.7 met for sleeping, 1.0 met for a seated and quiet position, 1.2–1.4 met for light activities standing, 2.0 met or more for activities that involve movement, walking, lifting heavy loads or operating machinery. For intermittent activity,

the standard states that it is permissible to use a time-weighted average metabolic rate if individuals are performing activities that vary over a period of one hour or less. For longer periods, different metabolic rates must be considered.[¹]

According to ASHRAE Handbook of Fundamentals, estimating metabolic rates is complex, and for levels above 2 or 3 met – especially if there are various ways of performing such activities – the accuracy is low. Therefore, the standard is not applicable for activities with an average level higher than 2 met. Met values can also be determined more accurately than the tabulated ones, using an empirical equation that takes into account the rate of respiratory oxygen consumption and carbon dioxide production. Another physiological yet less accurate method is related to the heart rate, since there is a relationship between the latter and oxygen consumption.[²⁶]

The Compendium of Physical Activities is used by physicians to record physical activities. It has a different definition of met that is the ratio of the metabolic rate of the activity in question to a resting metabolic rate.[²⁷] As the formulation of the concept is different from the one that ASHRAE uses, these met values cannot be used directly in PMV calculations, but it opens up a new way of quantifying physical activities.

Food and drink habits may have an influence on metabolic rates, which indirectly influences thermal preferences. These effects may change depending on food and drink intake.[²⁸]

Body shape is another factor that affects metabolic rate and hence thermal comfort. Heat dissipation depends on body surface area. The surface area of an average person is 1.8 m² (19 ft²).[¹] A tall and skinny person has a larger surface-to-volume ratio, can dissipate heat more easily, and can tolerate higher temperatures more than a person with a rounded body shape.[²⁸]

Clothing insulation

[edit]

Main article: Clothing insulation

The amount of thermal insulation worn by a person has a substantial impact on thermal comfort, because it influences the heat loss and consequently the thermal balance. Layers of insulating clothing prevent heat loss and can either help keep a person warm or lead to overheating. Generally, the thicker the garment is, the greater insulating ability it has. Depending on the type of material the clothing is made out of, air movement and relative humidity can decrease the insulating ability of the material.[²⁹][³⁰]

1 clo is equal to $0.155 \text{ m}^2 \cdot \text{K/W}$ ($0.88 \text{ }^\circ\text{F} \cdot \text{ft}^2 \cdot \text{h/Btu}$). This corresponds to trousers, a long sleeved shirt, and a jacket. Clothing insulation values for other common ensembles or single garments can be found in ASHRAE 55.^[1]

Skin wetness

[edit]

Skin wetness is defined as "the proportion of the total skin surface area of the body covered with sweat".^[31] The wetness of skin in different areas also affects perceived thermal comfort. Humidity can increase wetness in different areas of the body, leading to a perception of discomfort. This is usually localized in different parts of the body, and local thermal comfort limits for skin wetness differ by locations of the body.^[32] The extremities are much more sensitive to thermal discomfort from wetness than the trunk of the body. Although local thermal discomfort can be caused by wetness, the thermal comfort of the whole body will not be affected by the wetness of certain parts.

Environmental factors

[edit]

Air temperature

[edit]

Main article: Dry-bulb temperature

The air temperature is the average temperature of the air surrounding the occupant, with respect to location and time. According to ASHRAE 55 standard, the spatial average takes into account the ankle, waist and head levels, which vary for seated or standing occupants. The temporal average is based on three-minute intervals with at least 18 equally spaced points in time. Air temperature is measured with a dry-bulb thermometer and for this reason it is also known as dry-bulb temperature.

Mean radiant temperature

[edit]

Main article: Mean radiant temperature

The radiant temperature is related to the amount of radiant heat transferred from a surface, and it depends on the material's ability to absorb or emit heat, or its emissivity.

The mean radiant temperature depends on the temperatures and emissivities of the surrounding surfaces as well as the view factor, or the amount of the surface that is “seen” by the object. So the mean radiant temperature experienced by a person in a room with the sunlight streaming in varies based on how much of their body is in the sun.

Air speed

[edit]

Air speed is defined as the rate of air movement at a point, without regard to direction. According to ANSI/ASHRAE Standard 55, it is the average speed of the air surrounding a representative occupant, with respect to location and time. The spatial average is for three heights as defined for average air temperature. For an occupant moving in a space the sensors shall follow the movements of the occupant. The air speed is averaged over an interval not less than one and not greater than three minutes. Variations that occur over a period greater than three minutes shall be treated as multiple different air speeds.^[33]

Relative humidity

[edit]

Main article: Relative humidity

Relative humidity (RH) is the ratio of the amount of water vapor in the air to the amount of water vapor that the air could hold at the specific temperature and pressure. While the human body has thermoreceptors in the skin that enable perception of temperature, relative humidity is detected indirectly. Sweating is an effective heat loss mechanism that relies on evaporation from the skin. However at high RH, the air has close to the maximum water vapor that it can hold, so evaporation, and therefore heat loss, is decreased. On the other hand, very dry environments (RH < 20–30%) are also uncomfortable because of their effect on the mucous membranes. The recommended level of indoor humidity is in the range of 30–60% in air conditioned buildings,^[34]^[35] but new standards such as the adaptive model allow lower and higher humidity, depending on the other factors involved in thermal comfort.

Recently, the effects of low relative humidity and high air velocity were tested on humans after bathing. Researchers found that low relative humidity engendered thermal discomfort as well as the sensation of dryness and itching. It is recommended to keep relative humidity levels higher in a bathroom than other rooms in the house for optimal conditions.^[36]

Various types of apparent temperature have been developed to combine air temperature and air humidity. For higher temperatures, there are quantitative scales, such as the heat index. For lower temperatures, a related interplay was identified only qualitatively:

- High humidity and low temperatures cause the air to feel chilly.^[37]
- Cold air with high relative humidity "feels" colder than dry air of the same temperature because high humidity in cold weather increases the conduction of heat from the body.^[38]

There has been controversy over why damp cold air feels colder than dry cold air. Some believe it is because when the humidity is high, our skin and clothing become moist and are better conductors of heat, so there is more cooling by conduction.^[39]

The influence of humidity can be exacerbated with the combined use of fans (forced convection cooling).^[40]

Natural ventilation

[edit]

Main article: Natural ventilation

Many buildings use an HVAC unit to control their thermal environment. Other buildings are naturally ventilated (or would have cross ventilation) and do not rely on mechanical systems to provide thermal comfort. Depending on the climate, this can drastically reduce energy consumption. It is sometimes seen as a risk, though, since indoor temperatures can be too extreme if the building is poorly designed. Properly designed, naturally ventilated buildings keep indoor conditions within the range where opening windows and using fans in the summer, and wearing extra clothing in the winter, can keep people thermally comfortable.^[41]

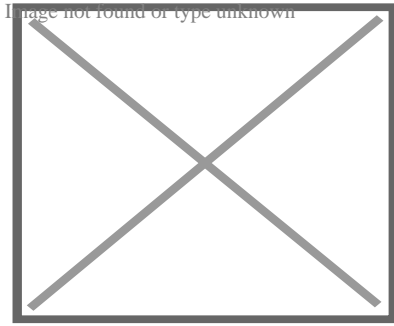
Models and indices

[edit]

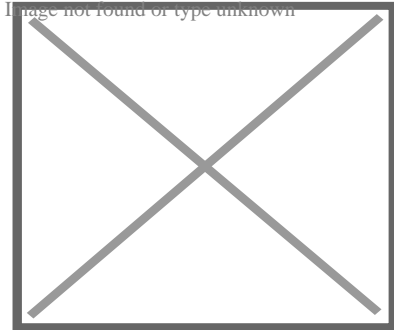
There are several different models or indices that can be used to assess thermal comfort conditions indoors as described below.

PMV/PPD method

[edit]



Psychrometric Chart



Temperature-relative
humidity chart
Two alternative
representations of thermal
comfort for the PMV/PPD
method

The PMV/PPD model was developed by P.O. Fanger using heat-balance equations and empirical studies about skin temperature to define comfort. Standard thermal comfort surveys ask subjects about their thermal sensation on a seven-point scale from cold (-3) to hot (+3). Fanger's equations are used to calculate the predicted mean vote (PMV) of a group of subjects for a particular combination of air temperature, mean radiant temperature, relative humidity, air speed, metabolic rate, and clothing insulation.^[5] PMV equal to zero is representing thermal neutrality, and the comfort zone is defined by the combinations of the six parameters for which the PMV is within the recommended limits ($-0.5 < \text{PMV} < +0.5$).^[1] Although predicting the thermal sensation of a population is an important step in determining what conditions are comfortable, it is more useful to consider whether or not people will be satisfied. Fanger developed another equation to relate the PMV to the Predicted Percentage of Dissatisfied (PPD). This relation was based on studies that surveyed subjects in a chamber where the indoor conditions could be precisely controlled.^[5]

The PMV/PPD model is applied globally but does not directly take into account the adaptation mechanisms and outdoor thermal conditions.^{[3][42][43]}

ASHRAE Standard 55-2017 uses the PMV model to set the requirements for indoor thermal conditions. It requires that at least 80% of the occupants be satisfied.[¹]

The CBE Thermal Comfort Tool for ASHRAE 55[⁹] allows users to input the six comfort parameters to determine whether a certain combination complies with ASHRAE 55. The results are displayed on a psychrometric or a temperature-relative humidity chart and indicate the ranges of temperature and relative humidity that will be comfortable with the given the values input for the remaining four parameters.[⁴⁴]

The PMV/PPD model has a low prediction accuracy.[⁴⁵] Using the world largest thermal comfort field survey database,[⁴⁶] the accuracy of PMV in predicting occupant's thermal sensation was only 34%, meaning that the thermal sensation is correctly predicted one out of three times. The PPD was overestimating subject's thermal unacceptability outside the thermal neutrality ranges ($-1 < PMV < 1$). The PMV/PPD accuracy varies strongly between ventilation strategies, building types and climates.[⁴⁵]

Elevated air speed method

[edit]

ASHRAE 55 2013 accounts for air speeds above 0.2 metres per second (0.66 ft/s) separately than the baseline model. Because air movement can provide direct cooling to people, particularly if they are not wearing much clothing, higher temperatures can be more comfortable than the PMV model predicts. Air speeds up to 0.8 m/s (2.6 ft/s) are allowed without local control, and 1.2 m/s is possible with local control. This elevated air movement increases the maximum temperature for an office space in the summer to 30 °C from 27.5 °C (86.0–81.5 °F).[¹]

Virtual Energy for Thermal Comfort

[edit]

"Virtual Energy for Thermal Comfort" is the amount of energy that will be required to make a non-air-conditioned building relatively as comfortable as one with air-conditioning. This is based on the assumption that the home will eventually install air-conditioning or heating.[⁴⁷] Passive design improves thermal comfort in a building, thus reducing demand for heating or cooling. In many developing countries, however, most occupants do not currently heat or cool, due to economic constraints, as well as climate conditions which border lines comfort conditions such as cold winter nights in Johannesburg (South Africa) or warm summer days in San Jose, Costa Rica. At the

same time, as incomes rise, there is a strong tendency to introduce cooling and heating systems. If we recognize and reward passive design features that improve thermal comfort today, we diminish the risk of having to install HVAC systems in the future, or we at least ensure that such systems will be smaller and less frequently used. Or in case the heating or cooling system is not installed due to high cost, at least people should not suffer from discomfort indoors. To provide an example, in San Jose, Costa Rica, if a house were being designed with high level of glazing and small opening sizes, the internal temperature would easily rise above 30 °C (86 °F) and natural ventilation would not be enough to remove the internal heat gains and solar gains. This is why Virtual Energy for Comfort is important.

World Bank's assessment tool the EDGE software (Excellence in Design for Greater Efficiencies) illustrates the potential issues with discomfort in buildings and has created the concept of Virtual Energy for Comfort which provides for a way to present potential thermal discomfort. This approach is used to award for design solutions which improves thermal comfort even in a fully free running building. Despite the inclusion of requirements for overheating in CIBSE, overcooling has not been assessed. However, overcooling can be an issue, mainly in the developing world, for example in cities such as Lima (Peru), Bogota, and Delhi, where cooler indoor temperatures can occur frequently. This may be a new area for research and design guidance for reduction of discomfort.

Cooling Effect

[edit]

ASHRAE 55-2017 defines the Cooling Effect (CE) at elevated air speed (above 0.2 metres per second (0.66 ft/s)) as the value that, when subtracted from both the air temperature and the mean radiant temperature, yields the same SET value under still air (0.1 m/s) as in the first SET calculation under elevated air speed.^[1]

$$\text{SET}(t_a, t_r, v, \text{met}, \text{clo}, \text{RH}) = \text{SET}(t_a - \text{CE}, t_r - \text{CE}, v = 0.1, \text{met}, \text{clo}, \text{RH})$$

The CE can be used to determine the PMV adjusted for an environment with elevated air speed using the adjusted temperature, the adjusted radiant temperature and still air (0.2 metres per second (0.66 ft/s)). Where the adjusted temperatures are equal to the original air and mean radiant temperatures minus the CE.

Local thermal discomfort

[edit]

Avoiding local thermal discomfort, whether caused by a vertical air temperature difference between the feet and the head, by an asymmetric radiant field, by local convective cooling (draft), or by contact with a hot or cold floor, is essential to providing acceptable thermal comfort. People are generally more sensitive to local discomfort when their thermal sensation is cooler than neutral, while they are less sensitive to it when their body is warmer than neutral.[³³]

Radiant temperature asymmetry

[edit]

Large differences in the thermal radiation of the surfaces surrounding a person may cause local discomfort or reduce acceptance of the thermal conditions. ASHRAE Standard 55 sets limits on the allowable temperature differences between various surfaces. Because people are more sensitive to some asymmetries than others, for example that of a warm ceiling versus that of hot and cold vertical surfaces, the limits depend on which surfaces are involved. The ceiling is not allowed to be more than +5 °C (9.0 °F) warmer, whereas a wall may be up to +23 °C (41 °F) warmer than the other surfaces.[¹]

Draft

[edit]

While air movement can be pleasant and provide comfort in some circumstances, it is sometimes unwanted and causes discomfort. This unwanted air movement is called "draft" and is most prevalent when the thermal sensation of the whole body is cool. People are most likely to feel a draft on uncovered body parts such as their head, neck, shoulders, ankles, feet, and legs, but the sensation also depends on the air speed, air temperature, activity, and clothing.[¹]

Floor surface temperature

[edit]

Floors that are too warm or too cool may cause discomfort, depending on footwear. ASHRAE 55 recommends that floor temperatures stay in the range of 19–29 °C (66–84 °F) in spaces where occupants will be wearing lightweight shoes.[¹]

Standard effective temperature

[edit]

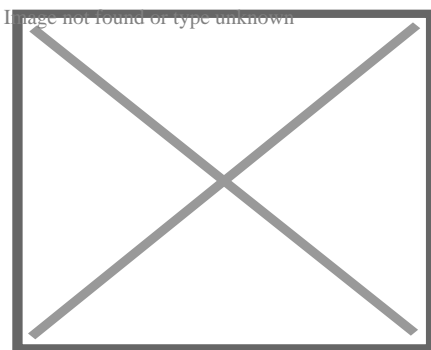
Standard effective temperature (SET) is a model of human response to the thermal environment. Developed by A.P. Gagge and accepted by ASHRAE in 1986,^[48] it is also referred to as the Pierce Two-Node model.^[49] Its calculation is similar to PMV because it is a comprehensive comfort index based on heat-balance equations that incorporates the personal factors of clothing and metabolic rate. Its fundamental difference is it takes a two-node method to represent human physiology in measuring skin temperature and skin wettedness.^[48]

The SET index is defined as the equivalent dry bulb temperature of an isothermal environment at 50% relative humidity in which a subject, while wearing clothing standardized for activity concerned, would have the same heat stress (skin temperature) and thermoregulatory strain (skin wettedness) as in the actual test environment.^[48]

Research has tested the model against experimental data and found it tends to overestimate skin temperature and underestimate skin wettedness.^[49]^[50] Fountain and Huizenga (1997) developed a thermal sensation prediction tool that computes SET.^[51] The SET index can also be calculated using either the CBE Thermal Comfort Tool for ASHRAE 55,^[9] the Python package pythermalcomfort,^[10] or the R package comf.

Adaptive comfort model

[edit]



Adaptive chart according to ASHRAE Standard 55-2010

The adaptive model is based on the idea that outdoor climate might be used as a proxy of indoor comfort because of a statistically significant correlation between them. The adaptive hypothesis predicts that contextual factors, such as having access to

environmental controls, and past thermal history can influence building occupants' thermal expectations and preferences.^[3] Numerous researchers have conducted field studies worldwide in which they survey building occupants about their thermal comfort while taking simultaneous environmental measurements. Analyzing a database of results from 160 of these buildings revealed that occupants of naturally ventilated buildings accept and even prefer a wider range of temperatures than their counterparts in sealed, air-conditioned buildings because their preferred temperature depends on outdoor conditions.^[3] These results were incorporated in the ASHRAE 55-2004 standard as the adaptive comfort model. The adaptive chart relates indoor comfort temperature to prevailing outdoor temperature and defines zones of 80% and 90% satisfaction.^[1]

The ASHRAE-55 2010 Standard introduced the prevailing mean outdoor temperature as the input variable for the adaptive model. It is based on the arithmetic average of the mean daily outdoor temperatures over no fewer than 7 and no more than 30 sequential days prior to the day in question.^[1] It can also be calculated by weighting the temperatures with different coefficients, assigning increasing importance to the most recent temperatures. In case this weighting is used, there is no need to respect the upper limit for the subsequent days. In order to apply the adaptive model, there should be no mechanical cooling system for the space, occupants should be engaged in sedentary activities with metabolic rates of 1–1.3 met, and a prevailing mean temperature of 10–33.5 °C (50.0–92.3 °F).^[1]

This model applies especially to occupant-controlled, natural-conditioned spaces, where the outdoor climate can actually affect the indoor conditions and so the comfort zone. In fact, studies by de Dear and Brager showed that occupants in naturally ventilated buildings were tolerant of a wider range of temperatures.^[3] This is due to both behavioral and physiological adjustments, since there are different types of adaptive processes.^[52] ASHRAE Standard 55-2010 states that differences in recent thermal experiences, changes in clothing, availability of control options, and shifts in occupant expectations can change people's thermal responses.^[1]

Adaptive models of thermal comfort are implemented in other standards, such as European EN 15251 and ISO 7730 standard. While the exact derivation methods and results are slightly different from the ASHRAE 55 adaptive standard, they are substantially the same. A larger difference is in applicability. The ASHRAE adaptive standard only applies to buildings without mechanical cooling installed, while EN15251 can be applied to mixed-mode buildings, provided the system is not running.^[53]

There are basically three categories of thermal adaptation, namely: behavioral, physiological, and psychological.

Psychological adaptation

[edit]

An individual's comfort level in a given environment may change and adapt over time due to psychological factors. Subjective perception of thermal comfort may be influenced by the memory of previous experiences. Habituation takes place when repeated exposure moderates future expectations, and responses to sensory input. This is an important factor in explaining the difference between field observations and PMV predictions (based on the static model) in naturally ventilated buildings. In these buildings, the relationship with the outdoor temperatures has been twice as strong as predicted.^[3]

Psychological adaptation is subtly different in the static and adaptive models. Laboratory tests of the static model can identify and quantify non-heat transfer (psychological) factors that affect reported comfort. The adaptive model is limited to reporting differences (called psychological) between modeled and reported comfort.^{[citation ne}

Thermal comfort as a "condition of mind" is *defined* in psychological terms. Among the factors that affect the condition of mind (in the laboratory) are a sense of control over the temperature, knowledge of the temperature and the appearance of the (test) environment. A thermal test chamber that appeared residential "felt" warmer than one which looked like the inside of a refrigerator.^[54]

Physiological adaptation

[edit]

Further information: Thermoregulation

The body has several thermal adjustment mechanisms to survive in drastic temperature environments. In a cold environment the body utilizes vasoconstriction; which reduces blood flow to the skin, skin temperature and heat dissipation. In a warm environment, vasodilation will increase blood flow to the skin, heat transport, and skin temperature and heat dissipation.^[55] If there is an imbalance despite the vasomotor adjustments listed above, in a warm environment sweat production will start and provide evaporative cooling. If this is insufficient, hyperthermia will set in, body temperature may reach 40 °C (104 °F), and heat stroke may occur. In a cold environment, shivering will start, involuntarily forcing the muscles to work and increasing the heat production by up to a factor of 10. If equilibrium is not restored, hypothermia can set in, which can be fatal.^[55] Long-term adjustments to extreme temperatures, of a few days to six months, may result in cardiovascular and endocrine

adjustments. A hot climate may create increased blood volume, improving the effectiveness of vasodilation, enhanced performance of the sweat mechanism, and the readjustment of thermal preferences. In cold or underheated conditions, vasoconstriction can become permanent, resulting in decreased blood volume and increased body metabolic rate.^[55]

Behavioral adaptation

[edit]

In naturally ventilated buildings, occupants take numerous actions to keep themselves comfortable when the indoor conditions drift towards discomfort. Operating windows and fans, adjusting blinds/shades, changing clothing, and consuming food and drinks are some of the common adaptive strategies. Among these, adjusting windows is the most common.^[56] Those occupants who take these sorts of actions tend to feel cooler at warmer temperatures than those who do not.^[57]

The behavioral actions significantly influence energy simulation inputs, and researchers are developing behavior models to improve the accuracy of simulation results. For example, there are many window-opening models that have been developed to date, but there is no consensus over the factors that trigger window opening.^[56]

People might adapt to seasonal heat by becoming more nocturnal, doing physical activity and even conducting business at night.

Specificity and sensitivity

[edit]

Individual differences

[edit]

Further information: Cold sensitivity

The thermal sensitivity of an individual is quantified by the descriptor *FS*, which takes on higher values for individuals with lower tolerance to non-ideal thermal conditions.^[58] This group includes pregnant women, the disabled, as well as individuals whose age is below fourteen or above sixty, which is considered the adult range. Existing literature provides consistent evidence that sensitivity to hot and cold surfaces usually declines with age. There is also some evidence of a gradual reduction in the effectiveness of the body in thermo-regulation after the age of sixty.^[58] This is mainly due to a more sluggish response of the counteraction mechanisms in lower parts of the body that are

used to maintain the core temperature of the body at ideal values.^[58] Seniors prefer warmer temperatures than young adults (76 vs 72 degrees F or 24.4 vs 22.2 Celsius).^[54]

Situational factors include the health, psychological, sociological, and vocational activities of the persons.

Biological sex differences

[edit]

While thermal comfort preferences between sexes seem to be small, there are some average differences. Studies have found males on average report discomfort due to rises in temperature much earlier than females. Males on average also estimate higher levels of their sensation of discomfort than females. One recent study tested males and females in the same cotton clothing, performing mental jobs while using a dial vote to report their thermal comfort to the changing temperature.^[59] Many times, females preferred higher temperatures than males. But while females tend to be more sensitive to temperatures, males tend to be more sensitive to relative-humidity levels.^{[60][61]}

An extensive field study was carried out in naturally ventilated residential buildings in Kota Kinabalu, Sabah, Malaysia. This investigation explored the sexes thermal sensitivity to the indoor environment in non-air-conditioned residential buildings. Multiple hierarchical regression for categorical moderator was selected for data analysis; the result showed that as a group females were slightly more sensitive than males to the indoor air temperatures, whereas, under thermal neutrality, it was found that males and females have similar thermal sensation.^[62]

Regional differences

[edit]

In different areas of the world, thermal comfort needs may vary based on climate. In China^[where?] the climate has hot humid summers and cold winters, causing a need for efficient thermal comfort. Energy conservation in relation to thermal comfort has become a large issue in China in the last several decades due to rapid economic and population growth.^[63] Researchers are now looking into ways to heat and cool buildings in China for lower costs and also with less harm to the environment.

In tropical areas of Brazil, urbanization is creating urban heat islands (UHI). These are urban areas that have risen over the thermal comfort limits due to a large influx of people and only drop within the comfortable range during the rainy season.^[64] Urban heat islands can occur over any urban city or built-up area with the correct conditions. [

In the hot, humid region of Saudi Arabia, the issue of thermal comfort has been important in mosques, because they are very large open buildings that are used only intermittently (very busy for the noon prayer on Fridays) it is hard to ventilate them properly. The large size requires a large amount of ventilation, which requires a lot of energy since the buildings are used only for short periods of time. Temperature regulation in mosques is a challenge due to the intermittent demand, leading to many mosques being either too hot or too cold. The stack effect also comes into play due to their large size and creates a large layer of hot air above the people in the mosque. New designs have placed the ventilation systems lower in the buildings to provide more temperature control at ground level.[⁶⁷] New monitoring steps are also being taken to improve efficiency.[⁶⁸]

Thermal stress

[edit]

Not to be confused with thermal stress on objects, which describes the change materials experience when subject to extreme temperatures.

The concept of thermal comfort is closely related to thermal stress. This attempts to predict the impact of solar radiation, air movement, and humidity for military personnel undergoing training exercises or athletes during competitive events. Several thermal stress indices have been proposed, such as the Predicted Heat Strain (PHS) or the humidex.[⁶⁹] Generally, humans do not perform well under thermal stress. People's performances under thermal stress is about 11% lower than their performance at normal thermal wet conditions. Also, human performance in relation to thermal stress varies greatly by the type of task which the individual is completing. Some of the physiological effects of thermal heat stress include increased blood flow to the skin, sweating, and increased ventilation.[⁷⁰][⁷¹]

Predicted Heat Strain (PHS)

[edit]

The PHS model, developed by the International Organization for Standardization (ISO) committee, allows the analytical evaluation of the thermal stress experienced by a working subject in a hot environment.[⁷²] It describes a method for predicting the sweat rate and the internal core temperature that the human body will develop in response to the working conditions. The PHS is calculated as a function of several physical parameters, consequently it makes it possible to determine which parameter or group of parameters should be modified, and to what extent, in order to reduce the risk of

physiological strains. The PHS model does not predict the physiological response of an individual subject, but only considers standard subjects in good health and fit for the work they perform. The PHS can be determined using either the Python package `pythermalcomfort`^[10] or the R package `conf`.

American Conference on Governmental Industrial Hygienists (ACGIH) Action Limits and Threshold Limit Values

[edit]

ACGIH has established Action Limits and Threshold Limit Values for heat stress based upon the estimated metabolic rate of a worker and the environmental conditions the worker is subjected to.

This methodology has been adopted by the Occupational Safety and Health Administration (OSHA) as an effective method of assessing heat stress within workplaces.^[73]

Research

[edit]

The factors affecting thermal comfort were explored experimentally in the 1970s. Many of these studies led to the development and refinement of ASHRAE Standard 55 and were performed at Kansas State University by Ole Fanger and others. Perceived comfort was found to be a complex interaction of these variables. It was found that the majority of individuals would be satisfied by an ideal set of values. As the range of values deviated progressively from the ideal, fewer and fewer people were satisfied. This observation could be expressed statistically as the percent of individuals who expressed satisfaction by *comfort conditions* and the *predicted mean vote* (PMV). This approach was challenged by the adaptive comfort model, developed from the ASHRAE 884 project, which revealed that occupants were comfortable in a broader range of temperatures.^[3]

This research is applied to create Building Energy Simulation (BES) programs for residential buildings. Residential buildings in particular can vary much more in thermal comfort than public and commercial buildings. This is due to their smaller size, the variations in clothing worn, and different uses of each room. The main rooms of concern are bathrooms and bedrooms. Bathrooms need to be at a temperature comfortable for a human with or without clothing. Bedrooms are of importance because they need to accommodate different levels of clothing and also different metabolic rates of people asleep or awake.^[74] Discomfort hours is a common metric used to evaluate the thermal performance of a space.

Thermal comfort research in clothing is currently being done by the military. New air-ventilated garments are being researched to improve evaporative cooling in military settings. Some models are being created and tested based on the amount of cooling they provide.^[75]

In the last twenty years, researchers have also developed advanced thermal comfort models that divide the human body into many segments, and predict local thermal discomfort by considering heat balance.^{[76][77][78]} This has opened up a new arena of thermal comfort modeling that aims at heating/cooling selected body parts.

Another area of study is the hue-heat hypothesis that states that an environment with warm colors (red, orange yellow hues) will feel warmer in terms of temperature and comfort, while an environment with cold colors (blue, green hues) will feel cooler.^{[79][80][81]} The hue-heat hypothesis has both been investigated scientifically^[82] and ingrained in popular culture in the terms warm and cold colors ^[83]

Medical environments

[edit]



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Whenever the studies referenced tried to discuss the thermal conditions for different groups of occupants in one room, the studies ended up simply presenting comparisons of thermal comfort satisfaction based on the subjective studies. No study tried to reconcile the different thermal comfort requirements of different types of occupants who compulsorily must stay in one room. Therefore, it looks to be necessary to investigate the different thermal conditions required by different groups of occupants in hospitals to reconcile their different requirements in this concept. To reconcile the differences in the required thermal comfort conditions it is recommended to test the possibility of using different ranges of local radiant temperature in one room via a suitable mechanical system.

Although different researches are undertaken on thermal comfort for patients in hospitals, it is also necessary to study the effects of thermal comfort conditions on the quality and the quantity of healing for patients in hospitals. There are also original researches that show the link between thermal comfort for staff and their levels of productivity, but no studies have been produced individually in hospitals in this field. Therefore, research for coverage and methods individually for this subject is recommended. Also research in terms of cooling and heating delivery systems for

patients with low levels of immune-system protection (such as HIV patients, burned patients, etc.) are recommended. There are important areas, which still need to be focused on including thermal comfort for staff and its relation with their productivity, using different heating systems to prevent hypothermia in the patient and to improve the thermal comfort for hospital staff simultaneously.

Finally, the interaction between people, systems and architectural design in hospitals is a field in which require further work needed to improve the knowledge of how to design buildings and systems to reconcile many conflicting factors for the people occupying these buildings.^[84]

Personal comfort systems

[edit]

Personal comfort systems (PCS) refer to devices or systems which heat or cool a building occupant personally.^[85] This concept is best appreciated in contrast to central HVAC systems which have uniform temperature settings for extensive areas. Personal comfort systems include fans and air diffusers of various kinds (e.g. desk fans, nozzles and slot diffusers, overhead fans, high-volume low-speed fans etc.) and personalized sources of radiant or conductive heat (footwarmers, legwarmers, hot water bottles etc.). PCS has the potential to satisfy individual comfort requirements much better than current HVAC systems, as interpersonal differences in thermal sensation due to age, sex, body mass, metabolic rate, clothing and thermal adaptation can amount to an equivalent temperature variation of 2–5 °C (3,6–9 °F), which is impossible for a central, uniform HVAC system to cater to.^[85] Besides, research has shown that the perceived ability to control one's thermal environment tends to widen one's range of tolerable temperatures.^[3] Traditionally, PCS devices have been used in isolation from one another. However, it has been proposed by Andersen et al. (2016) that a network of PCS devices which generate well-connected microzones of thermal comfort, and report real-time occupant information and respond to programmatic actuation requests (e.g. a party, a conference, a concert etc.) can combine with occupant-aware building applications to enable new methods of comfort maximization.^[86]

See also

[edit]

- ASHRAE
- ANSI/ASHRAE Standard 55
- Air conditioning
- Building insulation
- Cold and heat adaptations in humans
- Heat stress

- Mean radiant temperature
- Mahoney tables
- Povl Ole Fanger
- Psychrometrics
- Ralph G. Nevins
- Room air distribution
- Room temperature
- Ventilative cooling

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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

- 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

**Measurement
and control**

- Air flow meter
- Aquastat
- BACnet
- Blower door
- Building automation
- Carbon dioxide sensor
- Clean air delivery rate (CADR)
- Control valve
- Gas detector
- Home energy monitor
- Humidistat
- HVAC control system
- Infrared thermometer
- Intelligent buildings
- LonWorks
- Minimum efficiency reporting value (MERV)
- Normal temperature and pressure (NTP)
- OpenTherm
- Programmable communicating thermostat
- Programmable thermostat
- Psychrometrics
- Room temperature
- Smart thermostat
- Standard temperature and pressure (STP)
- Thermographic camera
- Thermostat
- Thermostatic radiator valve
- Architectural acoustics
- Architectural engineering
- Architectural technologist
- Building services engineering
- Building information modeling (BIM)
- Deep energy retrofit
- Duct cleaning
- Duct leakage testing
- Environmental engineering
- Hydronic balancing
- Kitchen exhaust cleaning
- Mechanical engineering
- Mechanical, electrical, and plumbing
- Mold growth, assessment, and remediation
- Refrigerant reclamation
- Testing, adjusting, balancing

**Professions,
trades,
and services**

Industry organizations

- AHRI
- AMCA
- ASHRAE
- ASTM International
- BRE
- BSRIA
- CIBSE
- Institute of Refrigeration
- IIR
- LEED
- SMACNA
- UMC
- Indoor air quality (IAQ)

Health and safety

- Passive smoking
- Sick building syndrome (SBS)
- Volatile organic compound (VOC)
- ASHRAE Handbook
- Building science
- Fireproofing

See also

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

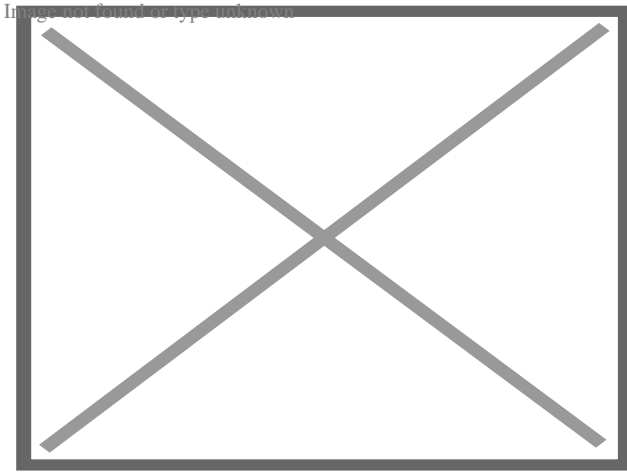
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About Manufactured housing



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A modern "triple wide" home

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

United States

[edit]

Definition

[edit]

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

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

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

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

History

[edit]

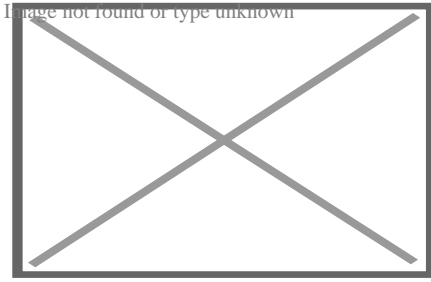
The original focus of this form of housing was its ability to relocate easily. Units were initially marketed primarily to people whose lifestyle required mobility. However, beginning in the 1950s, these homes began to be marketed primarily as an inexpensive form of housing designed to be set up and left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

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

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

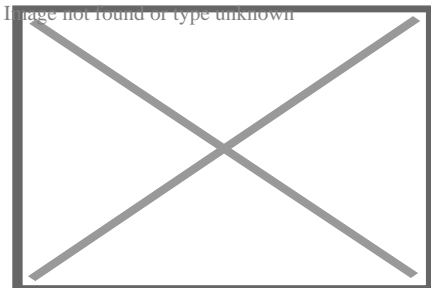
Modern manufactured homes

[edit]

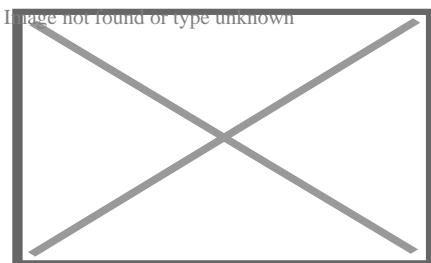


A manufactured house ready to be assembled in Grass Valley, California

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



A manufactured house just before construction of its garage



Stick built garage being added to a new manufactured house

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

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

High-performance manufactured housing

[edit]

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

Difference from modular homes

[edit]

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

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

Difference from IRC codes homes (site built)

[edit]

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

Fire Protection

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

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

Bay Area

[edit]

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

Bulk material storage

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Bulk material storage

Construction starts with the frame

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**Construction starts with
the frame**

Interior wall assemblies are attached

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**Interior wall assemblies
are attached**

Exterior wall assemblies are set in place

○

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**Exterior wall
assemblies are set in
place**

Roof assembly is set atop the house

○

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**Roof assembly is set
atop the house**

Drywall completed

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Drywall completed
House is ready for delivery to site

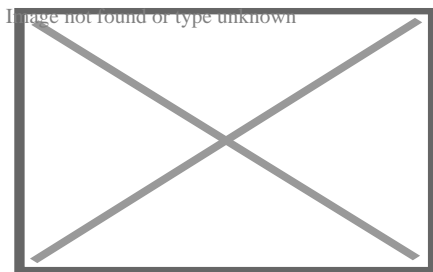
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House is ready for
delivery to site

Australia

[edit]



An Australian modern prefabricated house

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

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

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

Construction process

[edit]


A manufactured home is built entirely inside a huge, climate-controlled factory by a team of craftsmen. The first step in the process is the flooring, which is built in sections,

each attached to a permanent chassis with its own wheels and secured for transport upon the home's completion. Depending on the size of the house and the floorplan's layout, there may be two, three or even four sections. The flooring sections have heating, electrical and plumbing connections pre-installed before they are finished with laminate, tile or hardwood. Next, the walls are constructed on a flat level surface with insulation and interior Sheetrock before being lifted by crane into position and secured to the floor sections. The interior ceilings and roof struts are next, vapor sealed and secured to each section's wall frame before being shingled. Then, the exterior siding is added, along with the installation of doors and windows. Finally, interior finishing, such as sealing the drywall, is completed, along with fixture installation and finishing the electrical and plumbing connections. The exposed portions of each section, where they will eventually be joined together, are wrapped in plastic to protect them for transport.

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

See also

[edit]

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

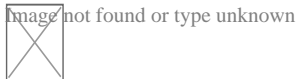
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[edit]

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- [^] ***a b*** *"What is a Manufactured Home?"* Manufactured Housing Institute's National Communities Council, accessed 6 July 2011 Archived 23 March 2012 at the

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

About Durham Supply Inc

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Things To Do in Tulsa County

Photo

Center of the Universe

4.4 (4471)

Photo

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Philbrook Museum of Art

4.8 (3790)

Photo

Image not found or type unknown

The Blue Dome

4.5 (60)

Photo

Guthrie Green

4.7 (3055)

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Tulsa Botanic Garden

4.7 (1397)

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Bob Dylan Center

4.9 (245)

Driving Directions in Tulsa County

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

Driving Directions From Lincoln Christian School to Durham Supply Inc

Driving Directions From Brookhaven Hospitales to Durham Supply Inc

Air conditioning system supplier

Furnace repair service

Furnace store

Heating contractor

HVAC contractor

Mobile Home Furnace Installation

Driving Directions From Center of the Universe to Durham Supply Inc

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Driving Directions From Center of the Universe to Durham Supply Inc

Mobile home supply store

Air conditioning repair service

Air conditioning store

Reviews for Durham Supply Inc

Durham Supply Inc

Image not found or type unknown

B Mann

(5)

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

Durham Supply Inc

Image not found or type unknown

Ethel Schiller

(5)

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

Durham Supply Inc

Image not found or type unknown

Gerald Clifford Brewster

(5)

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

Durham Supply Inc

Image not found or type unknown

Dennis Champion

(5)

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

Durham Supply Inc

Image not found or type unknown

Ty Spears

(5)

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

Simplifying Approval Steps for Mobile Home HVAC Financing [View GBP](#)

Check our other pages :

- [Evaluating Different Financing Packages for Mobile Home HVAC](#)
- [Evaluating Carrier Options for Mobile Home Air Conditioning](#)
- [Investigating No Payment Period Deals for Mobile Home Cooling](#)
- [Identifying Compatible Parts Across Multiple Mobile Home Brands](#)

Frequently Asked Questions

What documentation is typically required for mobile home HVAC financing approval?

Generally, you'll need proof of income, identification, credit history, and details about the mobile home. Some lenders may request additional documents depending on your financial situation.

How can I improve my chances of getting approved for HVAC financing?

To improve your chances, ensure you have a good credit score, stable income, and provide complete and accurate documentation. You might also consider applying with a co-signer if needed.

Are there specific lenders that specialize in mobile home HVAC financing?

Yes, some lenders focus specifically on manufactured or mobile homes and offer tailored financing options for HVAC systems. Its beneficial to research these specialized lenders as they may offer more flexible terms.

Can I get pre-approved for an HVAC loan before selecting a contractor or system?

Yes, many lenders offer pre-approval processes which allow you to understand your budget and interest rates before committing to a purchase or contractor.

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Google Business Profile

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

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