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Reduction Of Energy Cost In A Three Star Hotel In Awka Through The Use Of Air Sealing Materials And Construction Techniques

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ABSTRACT

The rising energy costs and the urgent need for sustainable practices have stimulated a growing interest in reducing energy consumption in hotel buildings. One effective approach to achieve energy efficiency is through air sealing, which involves the use of appropriate materials and construction techniques to minimize air leakage. This journal presents a comprehensive review of the current state of knowledge regarding the reduction of energy costs through the implementation of air sealing materials and construction techniques in buildings. It examines the various aspects related to air sealing, including the importance of air leakage control, the selection and performance of air sealing materials, and the impact of different construction techniques on energy consumption. The journal also explores case studies and provides insights into the economic and environmental benefits associated with air sealing. Furthermore, the article explores various construction techniques for effective air sealing. It emphasizes the significance of proper installation of insulation, attention to detail during the construction process, and the use of blower door testing to identify areas of air leakage. Blower door testing allows for quantitative assessment and targeted sealing efforts, leading to optimized air sealing outcomes. The potential for energy cost reduction through air sealing is a key focus of the article. Studies have demonstrated that effective air sealing measures can result in energy savings ranging from 10% to 30%. The article highlights the economic and environmental benefits associated with energy cost reduction, including long-term financial savings, improved operational efficiency, and a reduced carbon footprint. It also discusses the challenges of limited awareness, upfront costs, and the need for skilled professionals, while emphasizing the role of policymakers and building codes in promoting the adoption of air sealing measures. In conclusion, the article underscores the significance of air sealing materials and construction techniques in achieving energy cost savings and enhancing sustainability in the built environment. By investing in air sealing measures, building owners can improve energy efficiency, lower operational expenses, and contribute to a more sustainable future. The combination of appropriate materials, construction techniques, and supportive policies can unlock substantial energy cost savings and lead to a more environmentally friendly built environment.

Keywords: Air Sealing, Energy Cost Reduction, Energy Efficiency, Building Envelope, Air Leakage

INTRODUCTION

In an era marked by rising energy costs and a pressing need for sustainable practices, reducing energy consumption in buildings has become a paramount goal. One highly effective approach to achieving energy efficiency is through the strategic implementation of air sealing materials and construction techniques. By minimizing air leakage, these measures can significantly reduce energy costs while improving the overall performance of buildings. Achieving energy efficiency in buildings is crucial for

reducing energy consumption, lowering costs, and mitigating environmental impacts. Effective control of air leakage through the implementation of air sealing measures plays a significant role in achieving energy efficiency. This article provides a detailed overview of the significance of air sealing in achieving energy efficiency and highlights its impact on reducing energy consumption in buildings (Smith, J. 2023).

Uncontrolled air leakage in buildings can lead to substantial energy losses and increased energy demands for heating and cooling systems. Implementing air sealing measures helps control air leakage by sealing gaps, cracks, and openings in the building envelope. This results in minimized energy wastage, improved indoor comfort, and reduced environmental impacts associated with excessive energy consumption. Air sealing plays a vital role in enhancing energy efficiency by preventing unwanted air infiltration and exfiltration. It ensures that conditioned air produced by heating and cooling systems remains inside the building while preventing outdoor air from entering (Smith, J. 2023). This reduces the need for constant temperature adjustments, resulting in significant energy savings and improved energy performance.

The selection of appropriate air sealing materials is essential for effective air sealing and optimal energy efficiency. Commonly used materials include weather stripping, caulks, and sealants. Weather-stripping is applied around windows and doors to create a tight seal when closed, minimizing air leakage. Caulks and sealants, available in various formulations such as silicone, acrylic, and polyurethane, are used to seal joints, seams, and penetrations, thereby preventing air infiltration. These materials provide durable and airtight seals, contributing to improved energy performance and reduced energy costs. In addition to selecting suitable materials, employing proper construction techniques is critical for effective air sealing. Proper installation of insulation, attention to detail during construction, and adherence to air sealing best practices are essential. Techniques such as blower door testing help measure the air tightness of a building and identify areas of air leakage. This allows targeted sealing efforts to be implemented, ensuring optimized energy efficiency (Johnson, S. 2022).

Impact on Energy Cost Reduction: Implementing air sealing measures can result in significant energy cost savings. Studies have consistently shown that effective air sealing can lead to energy savings ranging from 10% to 30%, depending on factors such as building size, location, and construction characteristics. By minimizing air leakage, buildings require less energy for heating and cooling, translating into substantial financial benefits for building owners (Davis, M. 2021). One highly effective approach to achieving energy efficiency is through the strategic implementation of air sealing materials and construction techniques. By minimizing air leakage, these measures can significantly reduce energy costs while improving the overall performance of buildings. Air sealing involves the meticulous sealing of gaps, cracks, and openings in the building envelope, which act as pathways for unwanted airflow (U.S. Department of Energy. 2020). By eliminating these leaks, the flow of heated or cooled air is better controlled, reducing the workload on HVAC systems and improving indoor comfort.

Air leakage in buildings can have a significant impact on energy consumption. Uncontrolled airflow through gaps, cracks, and openings allows heated or cooled air to escape, leading to increased energy demands for heating and cooling systems. According to the U.S. Department of Energy, air leakage can account for up to 30% of heating and cooling energy requirements in residential buildings, and even higher percentages in commercial structures (Walker, I., Sherman, M., & Park, B. 2016). Implementing air sealing measures provides several benefits beyond energy cost reduction. It improves indoor comfort by eliminating drafts and temperature inconsistencies, enhances indoor air quality by reducing the infiltration of pollutants, and contributes to the longevity of building materials by preventing moisture intrusion (ASHRAE. 2013). By addressing air leakage, building owners can create healthier and more energy-efficient spaces for occupants.

Advanced insulation materials also play a vital role in air sealing. Spray foam insulation, for example, can be applied to create a continuous air barrier and effectively seal cavities and voids within walls, roofs, and attics. It provides superior thermal resistance and air sealing properties, minimizing both energy loss and air infiltration (Davis, M. 2021). Construction Techniques for Air Sealing, In addition to selecting the right materials, employing appropriate construction techniques is crucial for effective air sealing. Proper installation of insulation, attention to detail during the construction process, and following air sealing best practices contribute to achieving optimal results.

The implementation of air sealing materials and construction techniques can yield substantial energy cost savings. By minimizing air leakage, buildings require less energy to maintain comfortable indoor temperatures. This directly translates into reduced heating and cooling expenses. The potential for energy cost reduction through air sealing varies depending on factors such as the building's size, location, and construction characteristics. However, studies have shown that effective air sealing measures can result in energy savings ranging from 10% to 30%. For example, a study conducted by the National Renewable Energy Laboratory (NREL) found that air sealing measures implemented in a range of building types led to energy savings between 10% and 40%, with an average of 24%.

The benefits of air sealing extend beyond energy cost reduction. By decreasing energy consumption, building owners can enjoy long-term financial savings and improved operational efficiency. The upfront investment in air sealing materials and construction techniques is often offset by the resulting energy savings, leading to a positive return on investment (ROI) over time. Several approved ways of reducing energy costs using building materials and construction techniques, Use of Insulation; adequate insulation can significantly reduce energy costs by keeping the building's interior temperature stable, regardless of the outdoor climate. The right type and amount of insulation can help to minimize heat transfer through walls, roofs, and floors (Hastings, 2004). High-Performance Windows; energy-efficient windows with low U-values and a high solar heat gain coefficient can reduce heating and cooling costs. The windows should also be appropriately installed to prevent air leaks. Reflective Roofing Materials; the use of reflective roofing materials, such as white roofs, can help to reduce cooling costs by reflecting solar radiation and preventing heat buildup in the building's interior and the use of green materials and construction techniques to reduce energy costs (Charles J. Kibert, 2005). The use of energy-efficient lighting systems, such as LED lights, can reduce lighting costs significantly. LED lights consume less energy than traditional incandescent bulbs and last longer, reducing the need for replacements and the use of softscape and hardscape materials which helps to explore how builders can reduce energy costs through the use of sustainable materials, passive solar design, and other green building strategies (David Johnston, 2008). Sustainable building materials, such as bamboo and bricks, are environmentally friendly. Using these materials can help to reduce the building's overall carbon footprint and passive solar design involves orienting the building and its windows to maximize solar gain and minimize heat loss. This approach can reduce heating and cooling costs by utilizing the sun's energy to heat the building naturally (Stephen A. Roosa, 2008).

Aim of study

The aim of using air sealing materials is to create a tighter and more efficient building envelope, reducing the energy required for heating and cooling. By minimizing air infiltration, improving insulation effectiveness, enhancing HVAC system efficiency, and preventing moisture issues, the building's energy consumption is reduced, resulting in lower energy costs for the occupants or owners

RESEARCH METHODS

The research method used in this project include qualitative and descriptive case study research methods. The choice of research methodology depends on the research questions, data availability, and the resources available. Qualitative Research, involves the collection and analysis of non-numerical data through methods such as interviews, observations, and document analysis to gain a deeper understanding of phenomena. And Case Study Research, involves the in-depth analysis of a specific case or situation. Primary data for the study includes information from direct sources.

FINDINGS

The Abuja Sheraton Hotel is situated on Ladi Kwadi Way, approximately 39 kilometers (24 miles) from Abuja International Airport. , the hotel was constructed between 1985 and 1989. It was used in May, I989, for the African Development Bank (ABD) Conferences in Abuja but was officially opened on the 15th of January, 1990. This implies that it was located on the heart of the newly growing Federal Capital Territory. (Plate 1).

Plate 1. Perspective view, Abuja Sheraton Hotel is situated on Ladi Kwadi Way, approximately 39 kilometers (24 miles) from Abuja International Airport.
Source; Nze (Retrieved April 18th, 2022)

In Enugu State, Nike Lake Resort is situated on the banks of the Nike Lake in Enugu. A short 15 minutes drive from the local airport and only 10 minutes from the city centre. It offers breathtaking views in a very secure and tranquil environment. Nike Rd. Abakpa, Nike, Enugu 400213 Nigeria (plate 2).

Plate 2. South view of the Enugu, Nike lake resort hotel.
Source; Nze (Retrieved April 18th, 2022)

Energy Cost Reduction, Numerous studies have consistently demonstrated that the implementation of air sealing measures in buildings leads to substantial energy cost reductions. Depending on factors such as building size, location, and construction characteristics, energy savings ranging from 10% to 30% have been observed. These savings result from the minimized air infiltration and exfiltration, reducing the workload on heating and cooling systems.

Improved Indoor Comfort, Effective air sealing measures contribute to improved indoor comfort by minimizing drafts, temperature variations, and moisture intrusion. By preventing uncontrolled air leakage, occupants experience more consistent temperatures, reduced cold/hot spots, and improved humidity control, resulting in a more comfortable and pleasant indoor environment.

Enhanced Building Durability, Air sealing measures help protect the building structure from moisture damage and the infiltration of pollutants, such as dust, pollen, and allergens. By sealing gaps and cracks, air sealing minimizes moisture intrusion, preventing issues like mold growth and rot. It also improves indoor air quality by reducing the entry of outdoor pollutants, promoting a healthier living and working environment.

Environmental Benefits, The implementation of air sealing measures contributes to environmental sustainability by reducing the carbon footprint associated with energy consumption. By lowering energy demands, air sealing helps mitigate greenhouse gas emissions from energy production, leading to a more environmentally friendly building operation.

Return on Investment (ROI), properly implemented air sealing measures offer a favorable return on investment. While there are upfront costs associated with materials, labor, and inspections, the long-term

energy cost savings outweigh these initial expenses. Depending on factors such as building size and energy rates, the payback period for air sealing measures can range from a few years to a decade, resulting in significant financial benefits for building owners.

Maintenance Considerations, Regular maintenance is crucial to ensure the ongoing effectiveness of air sealing measures. Over time, wear and tear, as well as building movement, can compromise the integrity of seals. Periodic inspections, reapplication of sealants, and addressing any identified issues promptly are essential to maintaining optimal energy efficiency and reaping the long-term benefits of air sealing.

Building Performance Testing, Conducting building performance tests, such as blower door tests and thermal imaging, can help identify areas of air leakage and evaluate the effectiveness of air sealing measures. These tests provide valuable data for targeted sealing efforts and ensure that the desired energy efficiency outcomes are achieved.

Importance of Proper Installation, Proper installation techniques are critical for effective air sealing. Inadequate installation can lead to compromised seals and reduced energy efficiency. Training and certification programs for contractors and tradespeople are essential to ensure the proper implementation of air sealing measures, maximizing their effectiveness and long-term performance.

Building Codes and Standards, The inclusion of air sealing requirements in building codes and standards is crucial for driving the adoption of air sealing measures. Incorporating specific guidelines and performance criteria for air sealing in building regulations can help ensure consistent implementation and raise the overall energy efficiency standards in the construction industry.

Collaborative Approach, Collaboration among various stakeholders, including architects, engineers, contractors, manufacturers, researchers, and policymakers, is vital for the successful implementation of air sealing measures. Sharing knowledge, best practices, and lessons learned can help drive innovation, improve industry standards, and overcome barriers to widespread adoption.

CONCLUSION

The reduction of energy costs through the use of air sealing materials and construction techniques represents a significant opportunity for hotel building owners and occupants alike. By investing in air sealing measures, buildings can achieve improved energy efficiency, lower operational expenses, and a reduced environmental impact. The combination of appropriate air sealing materials, construction techniques, and supportive policies can unlock substantial energy cost savings and contribute to a more sustainable future. The significance of air sealing in achieving energy efficiency is undeniable. Through the effective control of air leakage, buildings can optimize energy consumption, reduce energy costs, and contribute to a more sustainable future. By selecting appropriate air sealing materials, employing proper construction techniques, and conducting regular evaluations, hotel building owners can achieve substantial energy savings and promote a greener built environment.

RECOMMENDATIONS

Considering the findings of this research work, the following recommendations were made towards facilitating an effective and functional three star hotel design:

By encouraging an integrated design approach that incorporates air sealing measures from the initial stages of building design. Architects, engineers, and contractors should work collaboratively to incorporate air sealing as an integral part of the building envelope design, ensuring compatibility with other energy-efficient systems.

Building Codes and Standards should collaborate with policymakers and industry stakeholders to establish or update building codes and standards that require or incentivize air sealing measures. Incorporate specific guidelines for air sealing materials and techniques, ensuring their inclusion in new construction and renovation projects.

Performance Monitoring and Evaluation: Establish post-construction monitoring and evaluation programs to assess the effectiveness of air sealing measures. This will help identify any performance gaps, facilitate continuous improvement, and provide feedback for future projects

By emphasizing the importance of regular maintenance and periodic inspections of air sealing measures to ensure their long-term effectiveness. Encourage building owners to consider retrofitting existing buildings with air sealing measures, as retrofitting can significantly improve energy efficiency and reduce operational costs.

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