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Evaluation of Indoor Environmental Quality and Energy Consumption for an Industrial Workspace

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Abstract

This work aimed to assess an industrial workspace' sustainability and employees' well-being. A comprehensive approach was adopted, including data collection, field audits, and detailed measurements of indoor environmental quality—focusing on thermal, visual, and acoustic comfort, and indoor air quality. Employee feedback was also gathered through surveys to provide subjective assessments of office conditions. The results revealed the need for adjustments to improve thermal comfort, where thermostat settings and airflow required modification. Visual comfort was generally satisfactory, though task lighting was recommended in selected zones. Acoustic discomfort was identified as a major issue across the office, necessitating noise awareness initiatives and using sound-absorbing materials. Furthermore, indoor air quality concerns were raised in several zones, with recommendations including a fresh air ventilator, occupant density reduction, and rigorous maintenance implementation to prevent air contaminants. Energy performance assessments conducted between October and November 2022 identified substantial opportunities for energy conservation. Recommendations included installing timers for air conditioning systems, lighting, and office equipment, along with optimizing chiller and pump operation schedules. Implementing these measures could result in annual energy savings of 152,282 kWh, cost savings of 4240 OMR, and a reduction of 163.8 tons of CO_2 emissions. Additional recommendations include establishing a sustainability team, installing separate utility meters for more accurate monitoring, and deploying photovoltaic systems for energy generation. These strategies aim to enhance the office's sustainability without compromising occupant well-being, aligning with both current and future office design goals.

Keywords

Sustainability, Employee Well-Being, Indoor Environmental Quality, Energy Conservation, Office Retrofitting

Biographies

Saleh Al-Saadi is an associate professor and the Director of the Sustainable Energy Research Center (SERC) at Sultan Qaboos University (SQU), Muscat, Sultanate of Oman. He received his M.Sc. from the Department of Architectural Engineering, King Fahd University of Petroleum and Minerals, Saudi Arabia, in 2006 and his Ph.D. from the University of Colorado at Boulder in 2014 in Architectural Engineering. He joined SQU in 2007 after completing his MSc. Before that, Dr Saleh held several positions in PDO between 1997-2003 and then worked in Saudi Arabia as an MEP engineer between 2005-2007. In 2020, he became the first president of the ASHRAE Oman Chapter. His current research interests include modeling, design, and analysis of building energy systems, energy conservation, energy auditing and retrofitting opportunities in existing buildings, and renewable and sustainable energy applications for buildings.

Hanan Al-Khatri holds a PhD degree in Architecture (Science) from the University of Nottingham, UK. She is an assistant professor at the Department of Civil and Architectural Engineering and the Head of Quality Assurance and Academic Accreditation at the College of Engineering, Sultan Qaboos University. Hanan's research focuses on Indoor Environmental Quality with a special interest in Thermal Comfort and people's interaction with the built environment. She organised The Second International Conference of Comfort At The Extremes (CATE'21) at Sultan Qaboos University. She was a member of the Scientific Committee of several conferences including CATE'19, CATE'21, CATE'22, CATE'23, CATE'24, and Healthy Buildings 2023. Hanan's editorial experience includes being Editor at The Journal of Engineering Research (TJER), Review Editor at Frontiers in Built Environment, and the Lead Guest Editor of a special issue on Indoor Environmental Quality at the Building Research & Information Journal published by Taylor & Francis.