Mustafa Özgür KILIÇARSLAN

Master’s Thesis

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DETERMINATION OF THE CHARACTERISTICS OF BUILDING MATERIALS FOR OPTIMAL THERMAL INSULATION AND SELECTION OF BUILDING MATERIAL

A THESIS
SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL ENGINEERING
AND THE GRADUATE SCHOOL OF ENGINEERING AND SCIENCE
OF ABDULLAH GUL UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE

By
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I hereby declare that all information in this document has been obtained in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all materials and results that are not original to this work.

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M.Sc. thesis titled Determination of the Characteristics of Building Materials for Optimal Thermal Insulation and Selection of Building Material has been prepared in accordance with the Thesis Writing Guidelines of the Abdullah Gül University, Graduate School of Engineering & Science.

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ACCEPTANCE AND APPROVAL

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ABSTRACT

DETERMINATION OF THE CHARACTERISTICS OF BUILDING MATERIALS FOR OPTIMAL THERMAL INSULATION AND SELECTION OF BUILDING MATERIAL

Mustafa Özgür KILIÇARSLAN
MSc. in Industrial Engineering
Advisor: Assistant Prof. Dr. Gökmen KARA
November 2023

The escalating urgency of climate change demands innovative approaches to energy conservation, particularly in the realm of building construction, known for substantial energy consumption and greenhouse gas emissions. This research delves into transformative strategies for enhancing energy efficiency in office buildings, with a concentrated analysis of the implementation of advanced building materials and state-of-the-art construction methodologies. Utilizing OpenStudio, a cutting-edge energy modeling software tool from the U.S. Department of Energy's National Renewable Energy Laboratory, this study quantitatively evaluates the energy-conserving potential of various avant-garde materials and construction techniques. The investigation is anchored around a case study of an office building in Ankara, Turkey, serving as a representative model for exploring diverse scenarios. These scenarios encompass the integration of high-performance framing, airtight construction, materials with superior thermal resistance properties, and advanced glazing systems. The research meticulously assesses each scenario with the aim of delineating the configurations that most significantly reduce energy consumption. The results reveal that specific combinations of advanced techniques and materials can lead to substantial reductions in energy use, thereby contributing profoundly to global efforts in mitigating climate change impacts. The conclusion emphasizes the necessity for widespread adoption and standardization of these energy-efficient practices in the construction industry, proposing them as pivotal contributors to the broader environmental sustainability movement.

Keywords: Energy Efficiency, Advanced Building Materials, Construction Techniques, OpenStudio Software, Thermal Resistance

ÖZET

OPTIMAL ISI YALITIMI İÇİN YAPI MALZEMELERİNİN ÖZELLİKLERİNİN BELİRLENMESİ VE YAPI MALZEMESİ SEÇİMİ

Mustafa Özgür KILIÇARSLAN
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Küresel iklim değişikliğinin artan önemi, özellikle enerji tüketimi ve sera gazı emisyonları bakımından önemli olan bina inşaatı alanında, enerji tasarrufuna yönelik yenilikçi yaklaşımlar gerektirmektedir. Bu araştırma, ofis binalarında enerji verimliliğini artırmaya yönelik dönüştürücü stratejileri derinlemesine incelemekte, ileri bina malzemeleri ve son teknoloji inşaat metodolojilerinin uygulanmasına yoğun bir analiz içermektedir. Amerika Birleşik Devletleri Enerji Bakanlığı Ulusal Yenilenebilir Enerji Laboratuvarı tarafından geliştirilen öncü bir enerji modelleme yazılım aracı olan OpenStudio kullanılarak, çeşitli inşaat malzemelerinin ve inşaat tekniklerinin enerji tasarrufu potansiyelini niceliksel olarak değerlendirilmektedir. Araştırma, Ankara, Türkiye'de bulunan bir ofis binası için yapılan vaka çalışması etrafında şekillenmekte ve çeşitli senaryolar kullanılarak temsil edici bir model olarak hizmet etmektedir. Bu senaryolar, yüksek performanslı izolasyon, üstün termal direnç özelliklerine sahip malzemeler ve ileri düzey dış cephe cam sistemlerinin entegrasyonunu kapsamaktadır. Araştırma, enerji tüketimini en önemli ölçüde azaltan yapı tekniklerini belirlemeyi amaçlayarak her senaryoyu titizlikle değerlendirmektedir. Sonuçlar, ileri tekniklerin ve malzemelerin belirli kombinasyonlarının, enerji kullanımında önemli tasarruflara yol açabileceğini ve bu şekilde küresel iklim değişikliği etkilerini hafifletme çabalarına derinden katkıda bulunabileceğini ortaya koymaktadır. Sonuç bölümü, bu enerji verimli uygulamaların inşaat endüstrisinde yaygın benimseme ve standardizasyonunun zorunluluğunu vurgulamakta ve bunları daha geniş çevresel sürdürülebilirlik hareketine önemli katkı sağlayacak unsurlar olarak önermektedir.

Anahtar Kelimeler: Enerji Verimliliği, İleri Bina Malzemeleri, İnşaat Teknikleri, OpenStudio Yazılımı, Termal Direnç

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To my wife

Chapter 1

1 Introduction

In light of the global challenge posed by climate change, the importance of energy efficiency has emerged as a pivotal area of focus in efforts to mitigate greenhouse gas emissions. Buildings, specifically office buildings, are substantial energy consumers and, therefore, represent crucial domains for intervention. Within the framework of these challenges, the main objective of this thesis is to investigate the feasibility of enhancing energy efficiency in office buildings by implementing cutting-edge building materials and pioneering construction methodologies. The research utilizes OpenStudio, a freely available energy modeling software created by the National Renewable Energy Laboratory under the Department of Energy, to evaluate and measure the potential energy conservation benefits of these materials and techniques.

The focus of our study pertains to a particular case, namely an office building situated in Ankara, Turkey. In this study, we analyze four scenarios along with the base model involving the integration of various elements, such as high-performance framing, airtight construction, insulation materials with high thermal resistance, glazing, roofing, and efficient mechanical and electrical systems. These construction techniques have demonstrated significant benefits, including the mitigation of thermal bridging, enhancement of the building's overall insulation value, and reduction of air leakage. These advantages collectively contribute to improved energy performance.

This study's results possess immediate practical significance and contribute to more comprehensive discussions and objectives. For example, reputable sources such as the National Renewable Energy Laboratory and the Energy and Resources Group at the University of California, Berkeley, have produced scholarly literature that presents compelling evidence supporting the notion that the implementation of advanced materials and construction techniques can result in substantial energy conservation, occasionally reaching as high as 50%, within office buildings.

The findings of this study align with the aims of the United Nations Sustainable Development Goals (SDGs), particularly in relation to Goal 7 (Ensuring Access to Affordable and Clean Energy), Goal 11 (Creating Sustainable Cities and Communities), Goal 12 (Promoting Responsible Consumption and Production), and Goal 13 (Taking Urgent Action to Combat Climate Change). Examining energy-saving strategies in different scenarios offers a framework for transforming office buildings into exemplars of sustainable practices, per the objectives of promoting responsible consumption and production patterns outlined in SDG 12. These strategies exemplify tangible implementations of energy conservation and efficiency that have the potential to encourage wider acceptance of environmentally friendly practices within the global built environment sector. Through the incorporation of these practices, buildings have the potential to reduce their energy consumption significantly, make valuable contributions to the sustainable management and efficient utilization of natural resources, and play a pivotal role in the establishment of sustainable urban landscapes. By engaging in such activities, individuals contribute to the worldwide effort to reduce the adverse effects of climate change, highlighting the crucial significance of energy-efficient construction methods in attaining a sustainable and resilient future.

The Sustainable Development Goals (SDGs) that pertain to the energy efficiency measures examined in this study encompass:

Goal 7 aims to achieve access to affordable, reliable, sustainable, and modern energy for all individuals. This initiative aims to enhance energy efficiency and augment the proportion of renewable energy sources in the worldwide energy composition while concurrently advancing the pace of progress in energy efficiency and allocating resources towards energy infrastructure and clean energy technologies.

Objective 11: Foster the development of sustainable cities and communities by promoting inclusivity, safety, resilience, and sustainability within urban areas and human settlements. This objective encompasses an emphasis on developing environmentally sustainable buildings, which involves utilizing locally sourced materials and mitigating adverse environmental effects in urban areas. Specifically, it focuses on improving air quality and implementing effective waste management practices at the municipal and other levels.

Objective 12: Responsible Consumption and Production - Establish and promote sustainable consumption and production patterns. The objective at hand centers on achieving greater efficiency and effectiveness by minimizing resource consumption, environmental degradation, and pollution while simultaneously enhancing the overall standard of living. Additionally, it encompasses the implementation of sustainable management strategies and the optimization of natural resource utilization, as well as the mitigation of waste generation through reduction, recycling, and reuse initiatives. Furthermore, it entails the promotion of sustainable practices within corporate entities.

Sustainable Development Goal 13 aims to address the pressing need for immediate and decisive action in order to mitigate the effects of climate change and its associated consequences. The objective at hand pertains to the incorporation of climate change measures into the national policies and strategies of least-developed countries. Additionally, it aims to enhance education on climate change, foster greater awareness, and bolster the capacity for planning and management in the context of climate change.

This thesis makes a valuable contribution to the expanding literature that supports the use of advanced building materials and construction techniques as a feasible approach to enhance the energy efficiency of office buildings. With the utilization of OpenStudio as a simulation tool, our objective is to discern the most efficient strategies for our case-study building located in Ankara. Additionally, we seek to investigate the potential contributions of these solutions towards the overarching objectives of environmental sustainability and climate resilience.

1.1 Problem Description

The increasing urgency of climate change, coupled with the global motivation to reduce greenhouse gas emissions, brings the spotlight onto various sectors that contribute significantly to the crisis. One such sector is the building industry, which accounts for approximately 40% of energy consumption globally. In particular, office buildings have been identified as substantial energy consumers, often due to outdated construction techniques, poor-quality materials, and inefficient systems for heating, cooling, and lighting. These issues have multi-dimensional impacts, not only contributing to environmental degradation but also leading to higher operational costs for organizations and less healthy indoor environments for occupants.

In the rapidly growing city of Ankara, Turkey, the situation is no different. The city's burgeoning commercial sectors have led to an increase in the number of office buildings, making the city a microcosm of the broader issue of building-related energy inefficiency. Yet, the adoption of advanced building materials and construction techniques remains limited, either due to lack of awareness, perceived high costs, or inadequacy of local building codes in promoting energy-efficient designs.

Moreover, the pressing need to align urban development and energy consumption patterns with global sustainability goals adds another layer of complexity. Specifically, United Nations Sustainable Development Goals (SDGs) 7,11,12 and 13 focus on creating sustainable cities and communities and promoting responsible consumption and production. However, how well local efforts in Ankara can be scaled or adapted to contribute to these international goals remains an understudied area.

This thesis aims to address these issues by focusing on the following fundamental problems:

1. How can the integration of advanced building materials and innovative construction techniques enhance the energy efficiency of an office building in Ankara, Turkey?

2. What is the quantifiable impact of implementing these advanced methodologies on the overall energy consumption of the building?

3. How do the energy-saving measures identified in this study align with and contribute to the United Nations Sustainable Development Goals (SDGs) 7,11,12 and 13?

Through a detailed case study of an office building in Ankara, we will explore these questions not only to offer immediate, actionable insights but also to contribute to the broader discourse on sustainable urban development and energy consumption. By identifying the barriers, opportunities, and implications of adopting energy-efficient materials and construction techniques, this thesis aims to provide a roadmap for stakeholders ranging from architects and builders to policymakers and civic organizations.

Thus, the problem this thesis aims to solve is multifaceted: it is not just about reducing the energy footprint of a single office building but also about how such efforts fit into broader, interconnected frameworks of sustainability, both locally in Ankara and within the global context of the United Nations Sustainable Development Goals.

1.2 Objectives

The primary goal of our endeavor is to lay the foundation for Energy Efficient Office Systems within Ankara. The significance of this objective stems from a profound need to acquaint the Turkish construction sector with the principles and applications of energy-efficient systems. It is envisaged that the realization of this objective will play a pivotal role in transforming conventional construction methodologies integrating sustainability and efficiency into the core of architectural designs and implementations.

The city of Ankara, the capital of Turkey, serves as an ideal starting point for this transformative journey due to its administrative importance and the diverse array of office buildings it hosts. By focusing on Ankara, we aspire to create a ripple effect, setting a standard of energy efficiency and sustainable construction practices that could reverberate across the country.

To achieve the main objective, it is paramount to delve deep into the intricacies of various building materials, exploring their thermal characteristics to determine their suitability in the construction of energy-efficient office systems. This involves a meticulous examination of material properties, analyzing their thermal conductivities, heat retention capabilities, and overall contributions to energy conservation within a built environment.

1.3 Significance

The significance of introducing energy-efficient systems to the Turkish construction industry cannot be overstated. It not only aligns with global efforts to combat climate change but also represents a step forward in fostering sustainable development within the region. By embracing energy-efficient construction practices, the industry can help reduce the overall energy consumption of buildings, subsequently mitigating the environmental impacts associated with energy production.

This initiative endeavors to serve as a beacon of innovation and sustainability, illuminating the path for construction professionals, architects, and policymakers in Turkey. It is hoped that through the successful implementation of energy-efficient office systems in Ankara, we can ignite a paradigm shift, paving the way for a more sustainable and environmentally beneficial approach to construction in Turkey and beyond.

1.4 Scope

The scope of this study is explicitly defined to provide clarity on its focus, limitations, and the extent of the research.

1.4.1 Geographical Scope

The research is geographically limited to the city of Ankara, Turkey. The city serves as an ideal case study due to its rapid commercial development and increasing number of office buildings, making it a representative microcosm for exploring energy efficiency in emerging urban landscapes.

1.4.2 Temporal Scope

The study is confined to a time frame extending from 2021 to 2023, allowing for the collection of recent data, the application of up-to-date building materials and construction techniques, and the use of the latest version of OpenStudio for simulation.

1.5 Subject Matter

1.5.1 Office Buildings

The study focuses specifically on office buildings as they are significant consumers of energy. Residential and commercial spaces other than offices and industrial buildings are outside the scope of this research.

1.5.2 Advanced Building Materials and Construction Techniques

The research investigates specific types of advanced building materials (like high thermal resistance insulation, glazing, and roofing) and construction techniques (such as high-performance framing and airtight construction) for their potential to improve energy efficiency.

1.5.3 OpenStudio Simulation

The study employs OpenStudio as the primary tool for modeling and analyzing the energy performance of various building designs, materials, and techniques. As a comprehensive energy modeling software tool, it offers valuable applications in the realm of Industrial Engineering (IE), which is fundamentally concerned with the optimization of complex systems or processes, focusing on improving efficiency, productivity, quality, and safety. By integrating OpenStudio within the framework of IE principles, we can significantly enhance the way building systems are designed and operated, particularly in the context of energy efficiency and sustainability.

Industrial Engineering emphasizes a systems approach, focusing on the interplay between various components within an organization or process. OpenStudio aligns with this principle by providing a holistic view of a building's energy consumption, considering multiple elements like HVAC, lighting, and occupancy. This comprehensive analysis allows for a more integrated approach to energy management, akin to the systems thinking in IE.

A core aspect of IE is process optimization—streamlining operations to maximize efficiency and minimize waste. OpenStudio contributes to this goal by enabling precise energy modeling and simulation. It allows engineers to test different scenarios and identify the most energy-efficient strategies, akin to optimizing industrial processes for maximum output with minimal resource expenditure.

Cost reduction and economic efficiency are key tenets of IE. OpenStudio assists in identifying areas where energy consumption can be minimized, leading to significant cost savings. By simulating various energy-saving scenarios, it provides valuable data for cost-benefit analysis, a crucial component of IE's economic aspect.

In IE, the quality of processes and outputs is paramount. OpenStudio ensures high-quality energy management by allowing for detailed simulations and assessments. This leads to improved building environments which is an essential quality metric in industrial settings, directly impacting worker productivity and satisfaction.

1.5.4 United Nations SDGs

The scope also includes an evaluation of how the energy efficiency improvements align with and contribute to United Nations Sustainable Development Goals 7,11,12 and 13.

1.6 Methodology

1.6.1 Case Study

A single office building in Ankara **is** selected for an in-depth case study. Energy performance will be analyzed for the structure, and various scenarios is modeled using OpenStudio.

1.6.2 Comparative Analysis

Four distinct scenarios along with the base model using different combinations of building materials and construction techniques will be modeled and compared to identify the most energy-efficient strategy.

1.6.3 Sustainability Assessment

The energy savings in each scenario will be assessed in relation to their contribution towards achieving the targets set by the United Nations SDGs 7,11,12 and 13.

1.7 Limitations

1.7.1 Generalizability

While the research aims to provide a comprehensive understanding of improving energy efficiency in office buildings in Ankara, the results may also be directly applicable to other cities but not to other building types.

1.7.2 Cost Analysis

This study will focus on energy savings and sustainability implications rather than a detailed economic analysis of implementing advanced materials and construction techniques.

1.8 Tools Used

To comprehensively address the subject matter of energy efficiency in office buildings, specifically in a case study focusing on an office building in Ankara, a range of specialized tools were employed. These tools were carefully selected to serve various aspects of the research process, from the initial stages of design conceptualization to the advanced stages of simulation and analysis.

1.8.1 SketchUp

Function: SketchUp is used for the initial 3D modeling of the office building, enabling us to create a detailed and scaled virtual representation.

Features:

• User-friendly interface for quick design and modeling.

• Extensive library of objects, materials, and finishes to simulate different construction materials and techniques.

• Compatibility with other tools, such as OpenStudio, for seamless transition into the energy modeling phase.

1.8.2 OpenStudio

Function: OpenStudio acts as the primary tool for building energy modeling and simulation, focusing on the case-study office building located in Ankara.

Features:

• Comprehensive platform for energy modeling, including thermal, lighting, and HVAC systems.

• Allows to create of multiple scenarios to assess the impact of different design choices.

• Enables output in various formats for further analysis, such as CSV files for statistical analysis or IDF files for use with EnergyPlus.

• Developed in collaboration with the U.S. Department of Energy's National Renewable Energy Laboratory, ensuring up-to-date algorithms and features.

1.8.3 AutoCAD

Function: AutoCAD is used for detailed architectural drawings and plans, providing a technical blueprint of the building.

Features:

• 2D and 3D drafting capabilities with a focus on precision and detail.

• Extensive customization options to meet the unique requirements of energy-efficient design.

• Layer management and annotation capabilities, allowing for effective collaboration among architects, engineers, and other stakeholders.

• Export options to various file types, enhancing interoperability with other software tools.

1.8.4 EnergyPlus

Function: Employed for in-depth, complex simulations, especially for analyzing HVAC systems and cross-verification of OpenStudio results.

Features:

• High-level, hourly simulation for accurate modeling of complex systems.

• Multi-zone air flow and thermal comfort modeling.

• Capable of conducting parametric analysis, helpful in understanding how different variables interact.

• Can simulate a wide range of weather conditions, making it adaptable to the specific climatic conditions of Ankara.

Each tool has been selected for its unique strengths in contributing to the multi-faceted approach of this thesis. Collectively, they enable a rigorous and detailed exploration into how advanced building materials and construction techniques can enhance energy efficiency in office buildings. By utilizing these tools, we aim to provide concrete recommendations that are both practical and impactful in the pursuit of sustainable development goals.

1.9 Parameters

Understanding the scope and impact of energy efficiency in office buildings necessitates a multi-faceted approach that takes into consideration various parameters. These parameters are essential to the study, shaping the direction of simulations, analyses, and conclusions. For the purpose of this thesis, which is based on a case study of an office building in Ankara, the following parameters are especially critical:

1.9.1 Weather Data

Importance: Given the climatic conditions of Ankara, which can vary depending on the season, weather data is a pivotal aspect of energy simulation. Accurate weather data ensures that the simulated energy performance of the building is as close to real-world performance as possible.

Parameters Included:

• Ambient temperature ranges.

• Seasonal variations, including winter lows and summer highs.

• Wind speed and direction.

• Solar radiation levels and patterns.

• Relative humidity.

Data Sources:

• Official meteorological databases.

• Previous academic and governmental studies on Ankara's climate.

• Weather stations for real-time data when available.

Implementation in Tools:

• OpenStudio allows for the input of customized weather files to reflect the specific conditions of Ankara.

• EnergyPlus utilizes weather data for detailed hourly simulations, primarily related to HVAC performance under different weather conditions.

1.9.2 Construction Materials

Importance: The choice of construction materials has a profound impact on the energy efficiency of a building. Different materials have varying levels of thermal resistance, light transmittance, and other properties that influence the energy consumption of a building.

Parameters Included:

• Types of insulation materials and their thermal resistance (R-values).

• Types of glazing for windows and their U-factors.

• Types of roofing materials and their solar reflectance indexes (SRI).

• Types of wall materials and their thermal mass properties.

Data Sources:

• Manufacturer specifications.

• Previous studies on material performance.

• Building codes and standards for energy-efficient construction.

Implementation in Tools:

• SketchUp integrates with OpenStudio to import detailed models inclusive of construction materials.

• OpenStudio and EnergyPlus both offer options to input custom material properties, allowing for a comprehensive simulation that considers the actual materials to be used in the building's construction.

By thoroughly investigating these parameters, we aim to build a nuanced and holistic understanding of how advanced construction materials and design techniques can significantly contribute to the energy efficiency of office buildings in Ankara.

Chapter 2

2 Literature Review

The optimization of energy efficiency in office buildings plays a pivotal role in mitigating greenhouse gas emissions and addressing the challenges posed by global climate change. The implementation of advanced building materials and construction techniques has the potential to enhance the energy efficiency of office buildings greatly (Energy Star, 2023; Center for Climate and Energy Solutions, 2023; World Economic Forum, 2023; National Renewable Energy Laboratory, 2023; International Energy Agency, 2023). OpenStudio, a simulation software, is a valuable tool for examining the feasibility of enhancing energy efficiency. It facilitates the analysis and design of buildings with a focus on energy conservation (U.S. Department of Energy, 2023).

Insulation is a highly sophisticated building material that possesses the potential to enhance the energy efficiency of office buildings substantially. Insulation serves the purpose of mitigating heat transfer from the interior to the exterior of a structure, thereby diminishing the reliance on heating and cooling mechanisms. A range of insulation materials exists, including fiberglass, foam, and mineral wool, each possessing distinct advantages and disadvantages (ArchDaily, 2023). In addition to conventional insulation materials, there exist alternative options, such as aerogel, which represents an advanced insulation material characterized by its remarkably low density and exceptional efficiency.

An additional method for enhancing the energy efficiency of office buildings involves the utilization of windows that are designed to be highly efficient. Traditional windows are frequently a notable contributor to heat loss in buildings due to their low thermal resistance, which facilitates the easy escape of heat. The implementation of advanced windows, characterized by the application of low-emissivity coatings or the utilization of gas filling, has the potential to significantly enhance the energy efficiency of a structure through the mitigation of heat loss (ArchDaily, 2023).

The energy efficiency of a building can be significantly influenced by the construction techniques employed during the building process. One illustration can be found in the implementation of passive design strategies, which encompass the deliberate incorporation of natural elements such as sunlight, wind, and vegetation into the architectural design of a building. This can potentially mitigate the necessity for artificial heating and cooling systems, resulting in energy and cost savings (ArchDaily, 2023).

The OpenStudio platform offers the capability to conduct simulations that assess the impact of various building materials and construction methods on the energy efficiency of an office building. Through the specification of the particular materials and techniques under consideration, the software facilitates the generation of energy performance estimates for the building and the identification of potential areas for enhancement. This facilitates the process of making well-informed decisions and optimizing energy efficiency measures (U.S. Department of Energy, 2023).

The utilization of sophisticated building materials and construction methodologies holds the promise of substantially enhancing the energy efficiency of office buildings. The utilization of simulation tools, such as OpenStudio, enables the examination and enhancement of these measures aiming of diminishing greenhouse gas emissions, as well as achieving energy and financial savings (U.S. Department of Energy, 2023).

A comprehensive examination of existing literature pertaining to the enhancement of energy efficiency in office buildings via advanced building materials and construction techniques, utilizing OpenStudio as a simulation tool, can yield significant scholarly contributions regarding the present status of research and practical applications within this domain.

An important focal point of investigation within this domain pertains to the utilization of sophisticated construction materials, including insulation, glazing, and roofing materials, with the aim of enhancing the thermal efficiency of buildings. These materials possess the capability to mitigate heat loss during winter and heat gain during summer, therefore resulting in enhanced energy efficiency and reduced energy expenditures (ArchDaily, 2023).

The implementation of construction techniques, such as high-performance framing and airtight construction, can additionally enhance the energy efficiency of office buildings. The implementation of these techniques has the potential to mitigate thermal bridging, enhance the overall insulation efficacy of the structure, and minimize air leakage, thereby facilitating enhanced energy efficiency.

OpenStudio is a freely available energy modeling software that has been developed by the National Renewable Energy Laboratory of the Department of Energy. This software enables users to simulate the energy performance of buildings and assess the potential energy conservation benefits associated with various building materials and construction methods.

Research findings indicate that the utilization of sophisticated building materials and construction methodologies, in conjunction with energy modeling tools like OpenStudio, can yield substantial reductions in energy consumption within office buildings. An investigation performed by the National Renewable Energy Laboratory revealed that the implementation of advanced materials and techniques yielded an average energy reduction of 30% in office buildings (National Renewable Energy Laboratory, 2023).

Additional studies have also presented evidence of the capacity to enhance the energy efficiency of office buildings by employing advanced materials and construction methodologies. An investigation conducted by the Energy and Resources Group at the University of California, Berkeley, revealed that the implementation of advanced insulation materials and airtight construction techniques yielded energy conservation of up to 50% in office buildings.

In general, the existing body of literature indicates that the utilization of sophisticated building materials and construction methodologies can serve as a viable approach to enhance the energy efficiency of buildings, especially office buildings. Additionally, it is evident that tools like OpenStudio can prove valuable in assessing the prospective energy conservation benefits associated with these interventions.

2.1 Energy Efficiency in Buildings

In contemporary architectural and construction discourse, energy efficiency transcends mere buzzword status, evolving into a critical benchmark that shapes the inception, execution, and evaluation of building projects. This transformative shift is not arbitrary but is anchored in a global urgency to mitigate environmental degradation, reduce energy consumption, and address the looming specter of climate change. Energy efficiency in buildings encapsulates a spectrum of strategies, from passive design and adaptive reuse to the integration of high-efficiency systems and renewable energy sources.

2.1.1 Historical Context and Environmental Imperatives

Historically, the construction sector has been a prodigious consumer of energy, contributing significantly to greenhouse gas emissions. The post-industrial revolution era witnessed unprecedented advancements in construction, albeit with scant regard for energy conservation. However, the oil crises of the 1970s were a watershed, spurring awareness and necessitating a reevaluation of energy use in buildings (Abbaas et al., 2018).

The environmental imperatives for energy efficiency are compelling. Buildings account for approximately 40% of global energy consumption and nearly one-third of carbon emissions. This footprint not only exacerbates climate change but also engenders ecological imbalance, resource depletion, and health hazards. The quest for energy-efficient buildings, therefore, aligns with broader environmental stewardship, necessitating a departure from the erstwhile norm of energy-intensive construction (Kelly, J. C., 2019).

2.1.2 Design Strategies and Principles

Energy efficiency begins at the drawing board. 'Sustainable design' or 'green design' principles champion orientation, layout, and material selection optimized for energy conservation. Passive design strategies, for instance, leverage natural elements to regulate building temperature, obviating reliance on mechanical heating and cooling systems. These strategies include optimal site orientation, use of thermal mass, and incorporation of natural ventilation and daylighting. Such principles, when integrated into the building design, contribute significantly to reducing operational energy demands (Abdullah & Alibaba, 2017).

Furthermore, retrofitting presents opportunities for enhancing energy efficiency in existing buildings. This involves the modification of buildings to include energy-efficient features like improved insulation, high-efficiency lighting, and HVAC systems. While retrofitting has gained traction, it poses challenges, including structural implications, costs, and the intricacy of blending new features into existing architecture (Ye et al., 2019).

2.1.3 Technological Innovations and Smart Systems

Complementing design strategies are technological innovations that underpin energy efficiency. High-performance building envelopes, energy-efficient appliances, advanced HVAC systems, and renewable energy installations like solar panels are pivotal to the energy conservation matrix. In particular, the integration of smart systems and automation in buildings highlights the role of technology in energy efficiency. These systems offer precision control over building operations, enhance energy optimization, and provide data for informed decision-making (Nik-Bakht et al., 2020).

Building Energy Management Systems (BEMS) exemplify the synergy between technology and energy conservation. These sophisticated platforms monitor and regulate energy use within buildings, ensuring operational efficiency. Smart thermostats, motion sensor lighting, and energy-efficient appliances interconnected through the Internet of Things (IoT) reflect a paradigm where technology is instrumental in curbing energy wastage (Usta & Zengin, 2021).

2.1.4 Policy Implications, Standards, and Compliance

The policy landscape indelibly influences energy efficiency in buildings. Government regulations, standards, and incentives play a catalytic role in mainstreaming energy-efficient practices. Policies that mandate energy audits, green certifications, and compliance with energy codes propel adherence to energy conservation protocols. Noteworthy are global initiatives like the Paris Agreement, which underscores the commitment to reducing carbon footprints, with energy-efficient buildings being integral to this objective (Zilberberg et al., 2021)

However, policy implementation exhibits geographical disparities, with developed nations typically spearheading energy-efficient reforms while developing regions grapple with enforcement challenges. These inconsistencies suggest the necessity for a unified global strategy, albeit with room for contextual adaptation (Alghoul et al., 2017).

2.1.5 Real-World Applications and Case Studies

The theoretical discourse on energy efficiency finds embodiment in real-world applications, with several landmark projects epitomizing energy conservation. These buildings, often certified by green building councils, incorporate cutting-edge energy-efficient technologies, renewable energy, and environmentally friendly materials. Case studies of such projects offer insights into practical challenges and the tangible impact of energy efficiency on operational costs and environmental conservation (Feng et al., 2021).

Notably, energy-efficient buildings also contribute to social well-being. Reduced energy costs translate to financial savings for occupants. At the same time, the emphasis on natural lighting and improved air quality enhances occupant health and productivity, underscoring the holistic benefits of energy-efficient construction (Gao et al., 2019).

Energy conservation in buildings has garnered profound interest, with researchers exploring diverse strategies to minimize energy consumption while ensuring occupant comfort. For instance, Yeom et al. (2020) studied the optimal sizing of office building windows to bridge the gap between energy efficiency and occupant productivity, suggesting that physical design elements can significantly impact a building's energy profile. Similarly, Bui et al. (2020) introduced the concept of adaptive façades, utilizing computational methods to strike a balance between dynamic environmental conditions and building energy demands. Furthermore, strategic energy management comes to the fore in Kamal et al.'s (2019) exploration of thermal energy storage, highlighting the role of strategic control in optimizing energy usage in buildings.

In the literature on energy conservation within buildings, several studies have made significant contributions. Hagenau and Jradi (2020) explored the dynamic modeling and performance evaluation of building envelopes enhanced with phase change materials, demonstrating their effectiveness in Danish conditions for improving thermal comfort and reducing energy consumption. Krstić-Furundžić et al. (2019) assessed the energy and environmental performance of various facade designs for an office building, highlighting the importance of shading devices in energy reduction. Dong et al. (2021) introduced an intelligent optimization framework to automate the multi-objective optimization of building daylighting and energy performances, enhancing both design accuracy and efficiency. Amasyali and El-Gohary (2021) developed a machine-learning approach for occupant-behavior-sensitive cooling energy consumption prediction in office buildings, which could significantly aid energy-efficiency decision-making. Simma et al. (2019) presented a real-time occupancy estimation framework using WiFi networks to optimize HVAC operations, achieving energy savings without the need for additional infrastructure. Lastly, Shaikh et al. (2023) investigated the impact of wall insulation materials and variable refrigerant flow systems on building energy consumption, finding substantial energy savings and cost-effective payback periods. These studies collectively underscore the multifaceted approaches to enhancing energy efficiency in buildings, from material innovations to intelligent design and occupant-centered predictions.

In conclusion, energy efficiency in buildings is a multifaceted endeavor requiring the confluence of innovative design, advanced technology, supportive policies, and practical implementation. As the fight against climate change intensifies, energy-efficient buildings emerge not merely as a scientific or economic proposition but as a moral imperative — a commitment to safeguarding the planet for future generations. Continual research, cross-sector collaboration, and global policy alignment are imperative for propelling this noble cause forward (Chang et al., 2020)

2.2 Building Materials and Techniques

The construction industry stands at a crossroads of innovation and tradition, where every choice of material and technique bears implications for sustainability, efficiency, and environmental stewardship. The narrative of building materials has evolved from mere structural considerations to a nuanced dialogue involving environmental impact, energy efficiency, and life cycle assessments. This chapter delves into the transformative journey of building materials and techniques, highlighting the milestones of sustainability that are forging the path ahead.

2.2.1 Evolution of Building Materials: A Historical Perspective

The chronicle of building materials is as ancient as human civilization, with each era marked by distinctive materials, from mud bricks of antiquity to the concrete jungles of the modern world. The industrial revolution heralded a new age of construction with materials like steel and glass, offering enhanced durability and novel architectural possibilities (Abbaas et al., 2018). However, the environmental awakening of recent decades has cast these materials under scrutiny, with their energy-intensive production and recyclability being questioned.

This environmental reckoning has spurred the advent of 'green' materials, championing not just structural integrity and aesthetic appeal but also ecological sustainability. From natural materials like bamboo and wood to recycled steel and glass, the paradigm has shifted towards materials with a reduced environmental footprint (Kelly, J. C., 2019).

2.2.2 Sustainable Building Materials: Environmental and Energy Considerations

Central to the discourse on sustainable materials is the concept of 'embodied energy'—the total energy requisite for the extraction, processing, and transportation of building materials. Conventional materials such as concrete and steel have high embodied energy and contribute significantly to carbon emissions. In contrast, sustainable materials strive for a lower embodied energy, are sourced responsibly, and feature recyclable or biodegradable properties (Abdullah & Alibaba, 2017).

The life cycle assessment (LCA) of building materials offers a holistic insight into the environmental impact from cradle to grave. This comprehensive appraisal considers every phase, from extraction, manufacturing, and usage to eventual disposal, providing a clear depiction of a material's overall environmental impact. Such assessments are instrumental in selecting materials that mitigate adverse ecological effects, contributing to the broader vision of sustainable construction (Ye et al., 2019).

2.2.3 Innovative Techniques: Reshaping Construction

Beyond materials, innovative construction techniques are integral to this sustainable revolution. Techniques like prefabrication and modular construction have gained prominence for their efficiency and reduced waste. These methods, characterized by the assembly of components off-site, streamline the construction process, minimize material wastage, and curtail on-site energy consumption (Nik-Bakht et al., 2020).

Another breakthrough is 3D printing in construction, allowing precise and optimized use of materials. This technology can create complex structures, reduce labor costs, and significantly diminish construction waste, presenting a novel approach that could redefine conventional building techniques (Usta & Zengin, 2021).

2.2.4 Challenges, Opportunities, and the Road Ahead

Despite these advancements, the journey is rife with challenges. The construction industry, historically resistant to change, faces hurdles in adopting new materials and techniques. These obstacles are not merely technical but also cultural, regulatory, and economic in nature. The higher upfront costs of sustainable materials and the lack of skilled labor proficient in new techniques are significant barriers (Zilberberg et al., 2021).

However, these challenges are not insurmountable. With concerted efforts from stakeholders, sustainable materials and innovative techniques can become mainstream. Investment in research and development, training for the workforce, and supportive regulatory frameworks can accelerate this transition. Furthermore, as real-world applications and success stories of sustainable materials and techniques proliferate, the industry’s apprehension could give way to acceptance and enthusiasm (Alghoul et al., 2017).

The quest for sustainability has also seen innovation in building materials and construction methodologies. Hagenau & Jradi (2020)delves into the potential of phase change materials integrated into building envelopes, offering insights into material-driven energy efficiency under fluctuating climatic conditions (Hagenau & Jradi, 2020).

In conclusion, the narrative of building materials and techniques is one of evolution, reflecting humanity's aspirations, ingenuity, and adaptability. The current chapter in this narrative emphasizes sustainability, championing materials and methods that respect and preserve the environmental equilibrium. While challenges persist, the opportunities and imperatives for sustainable construction are apparent. Embracing this path is more than an industry trend; it is a testament to our collective commitment to a sustainable future, warranting bold steps and global collaboration (Feng et al., 2021).

2.3 Advanced Construction Technologies

Crafting an insightful section on "Advanced Construction Technologies" necessitates a deep dive into the transformative tech innovations in the construction sector. This exploration will encompass breakthroughs that have revolutionized traditional practices, the integration of digital tools, and a look into the future of construction shaped by technology.

2.3.1 Advanced Construction Technologies: Revolutionizing the Building Industry

As the digital wave permeates the global landscape, the construction sector is amidst a tech revolution that promises to redefine its future. Advanced construction technologies, once regarded as futuristic luxuries, are now pivotal in driving efficiency, safety, sustainability, and overall project success. This section explores these technological marvels, their impact on contemporary construction practices, and the potential they hold for the future built environment.

2.3.2 Digital Transformation in Construction: A New Era

The infusion of digital technologies in construction marks a seismic shift from traditional, often manual, processes to sophisticated, digitally managed practices. Building Information Modeling (BIM) stands at the forefront of this transformation, offering a 3D model-based process that gives architecture, engineering, and construction professionals insights and tools to efficiently plan, design, construct, and manage buildings and infrastructure (Abbaas et al., 2018).

Complementing BIM is the adoption of Geographic Information Systems (GIS) in construction planning, providing detailed geographical data that enhances decision-making right from the project's conception stage. These digital tools facilitate a collaborative, integrated approach, reducing errors and streamlining the construction process (Kelly, J. C., 2019).

2.3.3 Innovative Construction Technologies and Techniques

In the sphere of construction technologies, innovations such as drones, augmented and virtual reality (AR/VR), and 3D printing are game-changers. Drones, equipped with cameras and sensors, have transformed site inspections, offering real-time aerial perspectives that are crucial for progress tracking, inspection, and safety assessments. AR/VR technologies provide immersive visualization, enabling stakeholders to experience spaces before they are built, thereby informing better design and construction decisions (Abdullah & Alibaba, 2017).

3D printing, once a speculative concept, is now a reality in construction. By allowing the creation of building components through additive manufacturing, 3D printing presents opportunities for cost reduction, customization, and a significant decrease in construction waste. This technology is especially promising for disaster relief construction or projects with complex architectural geometries (Ye et al., 2019).

2.3.4 Smart Construction: IoT and Automation

The Internet of Things (IoT) and automation have ushered in the era of smart construction. IoT in construction involves the use of interconnected devices and sensors, providing real-time data on various aspects like equipment performance, material status, and environmental conditions. This network of intelligence enhances operational efficiency, predictive maintenance, and overall project management (Nik-Bakht et al., 2020).

Automation in construction, exemplified by robotic construction and autonomous vehicles, reduces the need for human intervention in potentially hazardous tasks, thereby improving site safety. These advanced technologies also compensate for the industry's labor shortages while simultaneously boosting precision and productivity (Usta & Zengin, 2021).

2.3.5 Sustainability and Green Technology

Advanced construction technologies are instrumental in propelling the industry toward sustainable practices. Green technology solutions, such as energy analysis software, sustainable materials technology, and waste reduction tools, play a critical role in creating an environmentally responsible construction sector. Moreover, advanced technologies provide the capability for rigorous sustainability assessments, ensuring that projects meet stringent environmental standards and contribute to global sustainability goals (Zilberberg et al., 2021).

2.3.6 Challenges and the Path Forward

Despite its transformative potential, the integration of advanced technology in construction is not without challenges. The sector, known for its cautious approach to adopting new practices, faces hurdles such as high initial investment, a skills gap, and resistance to change. Additionally, concerns about data security and privacy are particularly pertinent in the context of interconnected digital systems (Alghoul et al., 2017).

However, the trajectory towards a technologically advanced construction sector seems inevitable and necessary. Continuous training and education, investment in research and development, and regulatory policies supporting technological integration are crucial steps to overcoming these barriers. As the industry gradually embraces these advanced technologies, the resultant efficiency, safety, and sustainability improvements will underscore their indispensability (Feng et al., 2021).

The integration of advanced technologies in construction methodologies is revolutionizing the building industry. Chang et al.(2020) underscores this through the lens of smart buildings, advocating for technological infusion right from the modeling and design phase (Chang et al., 2020). In a similar technological vein, Dong et al. (2021) present an automated framework for optimizing building daylighting and energy performance, marking a shift toward intelligent, self-regulating buildings (Dong et al., 2021). This theme of predictive management is echoed by Amasyali & El-Gohary (2021), who employ machine learning to forecast cooling energy requirements based on occupant behavior, promoting energy conservation (Amasyali & El-Gohary, 2021). Additionally, Simma et al.(2019) explore real-time occupancy estimation via WiFi networks as a means to enhance HVAC operational efficiency, reflecting the growing trend of IoT in smart building management (Simma et al., 2019).

In conclusion, advanced construction technologies herald a new chapter in the construction industry, marked by efficiency, innovation, and a commitment to sustainability. While the journey is complex and laden with challenges, the rewards of a technologically empowered construction sector are immense. Embracing these technologies is not merely a process improvement; it's a redefinition of what's possible, setting the stage for a future where the built environment is a testament to human ingenuity and environmental harmony (Gao et al., 2019).

2.4 Insulation and Heat Management

In the quest for energy-efficient buildings, insulation, and heat management have emerged as critical factors, directly influencing a structure's energy consumption and environmental impact. Effective insulation and strategic heat management not only reduce the need for active heating and cooling but also contribute to occupant comfort and well-being. This section explores the principles of thermal insulation, innovative materials and methods, and the integral role of heat management in achieving sustainability and energy efficiency in modern construction.

2.4.1 The Science of Insulation: Principles and Importance

Thermal insulation in buildings operates on the fundamental principle of heat transfer reduction, acting as a barrier to heat flow from warmer to cooler areas. The primary objective is to maintain a stable indoor climate, minimizing the energy required for heating or cooling, thereby reducing greenhouse gas emissions and energy expenses (Abbaas et al., 2018).

Effective insulation hinges on materials with low thermal conductivity, slowing the rate of heat transfer. However, the science of insulation extends beyond material choice; it involves a comprehensive understanding of heat transfer modes — conduction, convection, and radiation — and the design and installation techniques that mitigate these processes. The strategic placement of insulating materials, considering thermal bridging and moisture control, is crucial for optimizing performance (Kelly, J. C., 2019).

2.4.2 Insulating Materials and Techniques: From Traditional to Cutting-Edge

The spectrum of insulating materials is broad, ranging from traditional options like fiberglass, cellulose, and foam boards to innovative solutions like aerogel and phase-change materials. Each material comes with distinctive properties, costs, and installation requirements, necessitating informed choices based on building design, climate, and sustainability goals (Abdullah & Alibaba, 2017).

Recent advancements have ushered in materials with superior insulating properties and environmental benefits. For instance, aerogels offer exceptional thermal resistance with thinner profiles, suitable for space-constrained applications. Phase-change materials (PCMs) are noteworthy for their ability to absorb, store, and release heat, providing temperature regulation and reducing energy loads, especially in fluctuating climatic conditions (Ye et al., 2019).

In terms of techniques, the construction industry has seen innovative approaches to insulation, from blow-in methods for existing structures to structural insulated panels (SIPs) for new constructions. These techniques address various challenges, including insulation retrofitting, comprehensive coverage, and integration with building aesthetics (Nik-Bakht et al., 2020).

2.4.3 Challenges in Insulation and Heat Management

Despite the acknowledged benefits, several challenges impede the universal adoption of effective insulation and heat management strategies. These include initial financial investment, disparities in regional building codes and standards, and a knowledge gap in construction practices. Moreover, concerns regarding indoor air quality and moisture management with highly insulated building envelopes necessitate meticulous design and execution (Usta & Zengin, 2021),

There is also the challenge of balancing historical preservation with modern insulation requirements in retrofitting projects. Preserving architectural integrity while enhancing energy efficiency requires innovative solutions and, often, customized approaches (Zilberberg et al., 2021).

2.4.4 Sustainability Considerations and Future Trends

Looking ahead, the focus is on sustainable, energy-efficient materials and practices. There is growing advocacy for bio-based insulating materials — like sheep's wool, straw bales, and hempcrete — that offer a lower environmental footprint from production to disposal. These materials represent a circular economy approach to construction, emphasizing resource efficiency and waste minimization (Alghoul et al., 2017).

Future trends indicate a move towards smart insulation — materials and systems that adapt to environmental conditions to provide optimal thermal resistance. Integration with smart home systems for real-time adjustments and the use of materials with dynamic insulating properties are on the horizon (Feng et al., 2021).

Focusing on the building's thermal aspects, Krstić-Furundžić et al.(2019) evaluates various façade scenarios to optimize energy and environmental performance, emphasizing the façade's critical role in a building's thermal and environmental footprint (Krstić-Furundžić et al., 2019).

In conclusion, insulation and heat management are at the heart of energy-efficient, comfortable, and sustainable buildings. The field is dynamic, with continuous advancements in materials and techniques reflecting the industry's commitment to innovation and environmental stewardship. While challenges persist, they are catalysts for improvement, inspiring research and development that will shape the future of insulated buildings. As global focus intensifies on energy efficiency and climate change mitigation, the role of insulation and strategic heat management will only become more vital, representing a key component in the sustainable transformation of the built environment (Gao et al., 2019).

Chapter 3

3 Simulation Model

3.1 Building Description

In a world where ecological boundaries are intertwined, the collective effort to embrace and propagate energy-efficient technologies and knowledge becomes not just necessary but imperative. This global initiative is crucial in steering our dependency away from carbon and directing us towards more sustainable energy solutions. Within this global narrative, our research takes root in Turkey, aiming to inject a new dynamism into the energy conservation strategies of Ankara, the country's capital. This city, a bustling nexus of governmental and business operations, stands as a prime candidate for pioneering a paradigm shift in energy usage through the introduction of cutting-edge Energy Efficient Office Systems.

Ankara is not just a city but the pulsating heart of Turkey, cradled in the expansive plains of Anatolia and playing host to a diverse population exceeding 6 million individuals. Its status as the capital elevates its significance, making it a hive of activity with a dense concentration of administrative and commercial buildings. These structures define the city's skyline and pulse with energy, drawing attention to the immense potential lying within their walls for energy optimization.

The climate of Ankara, a blend of stark contrasts, presents both a challenge and an opportunity. Its geographical nuances, including its high altitude and its seclusion from coastal influences, gift it with a climate that swings between extremes. Winters blanket the city in the cold, often accompanied by the soft whisper of snow, while summers transform it with their heat, the land basking in dry, sun-drenched days. Rain graces the city primarily in the transitional whispers of spring and autumn. The temperature’s yearly dance ranges from average lows of 0.9 °C (33.6 °F) to sultry highs of 24.3 °C (75.7 °F), averaging out at 12.6 °C annually. This meteorological tapestry makes it abundantly clear that any energy-efficient interventions must pay homage to the city’s unique climate, with a pronounced emphasis on robust insulation strategies. However, the narrative of energy conservation is incomplete without acknowledging the synergy with shading mechanisms, which, though secondary, play a vital role in a comprehensive energy strategy. Our initiative commits to delving deep into these aspects, ensuring their efficacy is not just assumed but proven through systematic exploration and testing.

Venturing into uncharted territories, our research strategy incorporates an exhaustive simulation model, taking a standard office building as our template. This building will be the crucible for four different scenarios along with the base model, each unfolding a new layer of understanding about the intrinsic and extrinsic benefits available to contemporary building management. Our approach transcends traditional energy-saving methods, probing into the transformative potential of various factors. These include adaptive operational practices, innovative scheduling, the nuanced role of shading technologies, and the adoption of superior window and glazing materials that redefine the very essence of structural envelopes.

By casting a wide net with these simulations, we aim to harvest a bounty of data, insights, and practical strategies. The goal is not just to contribute to academic discourse but to craft a blueprint that resonates with the stakeholders in Turkey's construction and urban planning sectors. Through this endeavor, we aspire to illuminate the path forward, highlighting the tangible and far-reaching benefits of weaving energy efficiency into the very fabric of Turkey's urban landscapes.

Figure 3. 1 3-D Model of the building

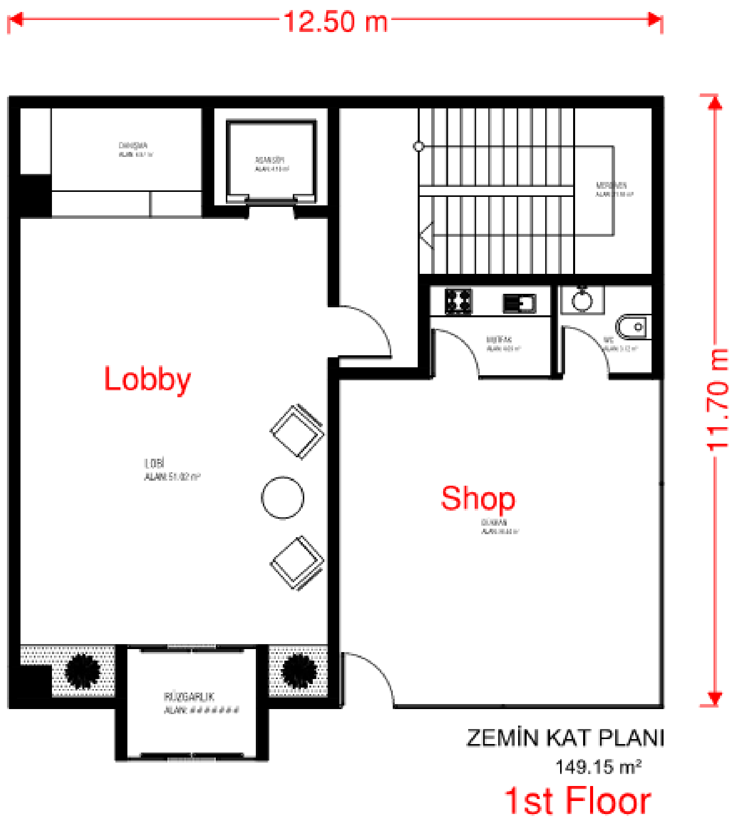


Figure 3. 2 1st Floor Plan

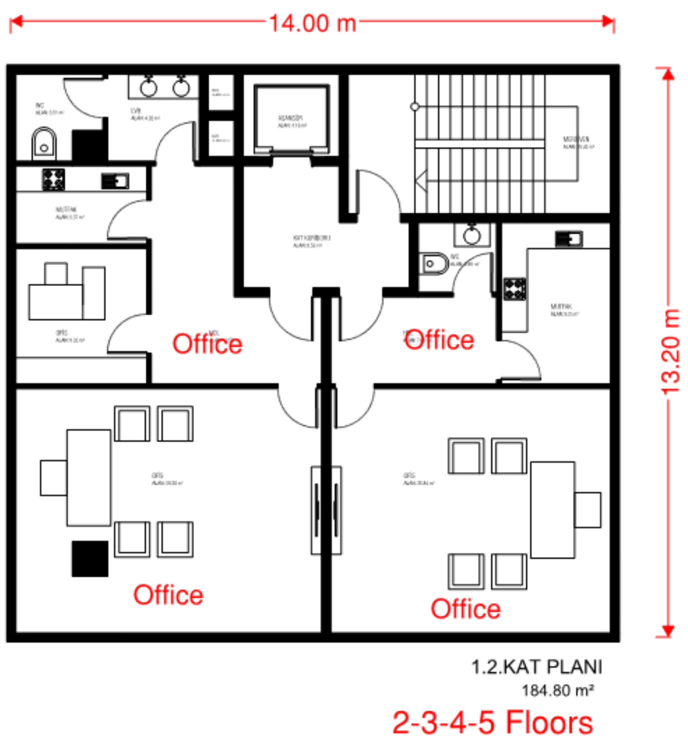


Figure 3. 3 Typical Floor Plans for 2nd. 3rd. 4th and 5th Floors

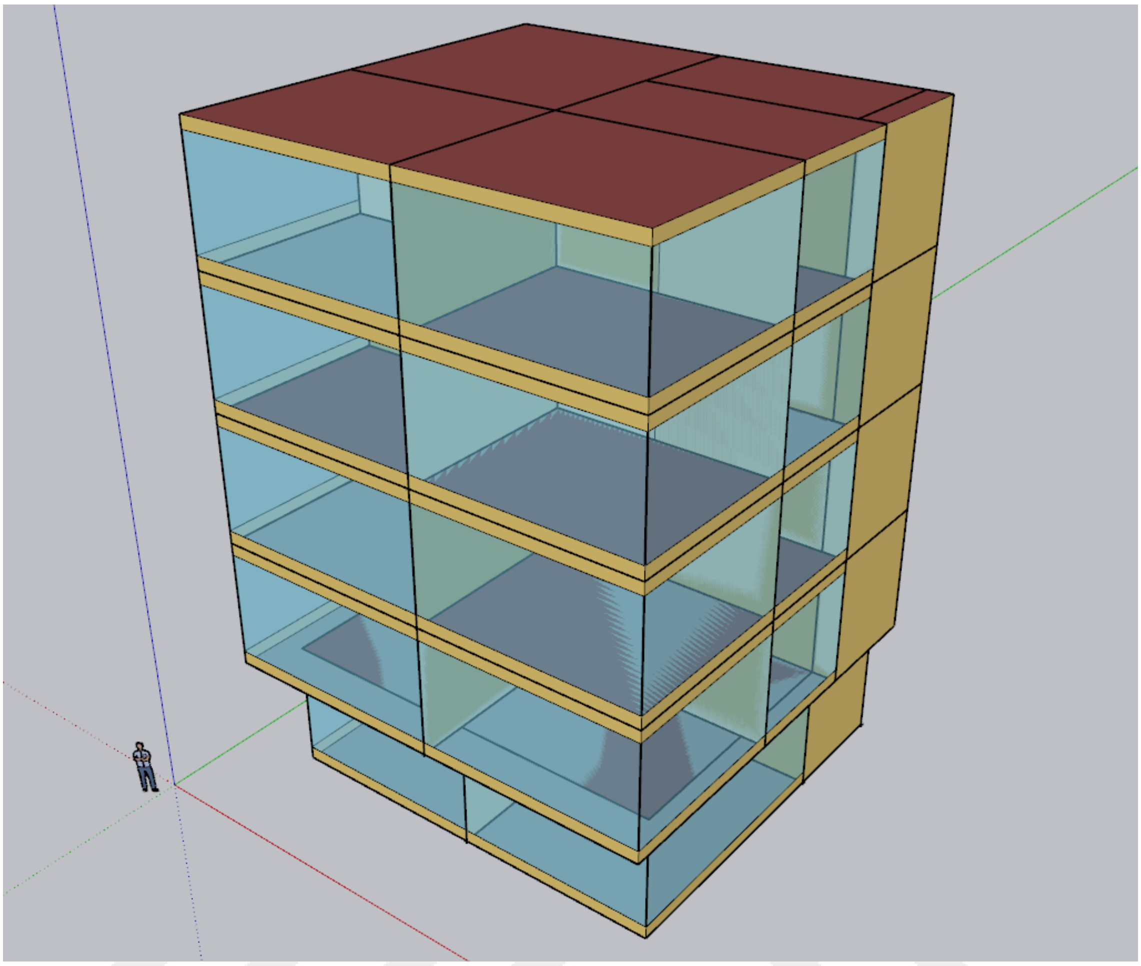


Figure 3. 4 3-D View created by Sketchup Interface with Open Studio Plugin

Figure 3.1 depicts a modern architectural specimen exemplifying the integration of design and structural engineering principles. The building is characterized by a curtain wall system, employing floor-to-ceiling fenestration, which ensures maximum natural light penetration while promoting energy efficiency. This system not only provides aesthetic transparency but also facilitates thermal performance by reflecting and absorbing the varying wavelengths of the urban environment.

The facade's dark-toned cladding, composed of composite materials and insulative panels, juxtaposes the reflective curtain wall. This cladding incorporates a rain-screen system, ensuring moisture management and thermal regulation while optimizing structural load distribution. Its matte finish and texture offer an aesthetic balance and potentially enhance the building's resistance to external environmental factors.

A distinct element in Figure 3.1 is the building's cantilevered topmost section. This structural overhang, indicative of advanced load-bearing design, is enhanced with potential wooden louvers or brise-soleils. Such features not only provide solar shading but also contribute to passive cooling, reducing the building's overall energy consumption.

Figure 3.2 depicts the architectural floor plan of the building's 1st floor, covering an area of 149.15 m².

The layout prominently features a central Lobby, which serves as the primary communal area. Right adjacent to the lobby is a Shop area optimized for retail or commercial endeavors, offering immediate accessibility for both visitors and occupants.

The main entrance to the Lobby is accentuated with two ornamental planters, enhancing the welcoming ambiance of the space. Efficient pedestrian circulation pathways are evident throughout, seamlessly leading to all primary and secondary spaces.

In the top-left corner of the plan, there are designated rooms that could function as storage, utility spaces, or other technical rooms essential to the building's operations.

To the top-right, a restroom facility ensures that essential amenities are within easy reach for both visitors and occupants. Adjacent to this restroom is an additional space that may serve a variety of purposes, from storage to utility functions.

A significant staircase is located near the top of the plan, facilitating vertical transitions between floors. Its representation on the plan suggests a design that might allow for enhanced light infiltration and spatial continuity.

The layout's outer perimeter, especially around the Lobby and Shop, showcases extensive glazing, reinforcing the theme of natural light and providing a visual connection with the exterior environment.

Figure 3.3 presents the typical architectural floor plan for levels 2, 3, 4, and 5 of the building, covering a comprehensive area of 184.80 m².

The layout is symmetrically divided and designed for optimal functionality. At the center of the plan is a prominent circulation corridor that ensures efficient movement and accessibility throughout the floor. This central hallway seamlessly connects all offices and ancillary spaces.

Flanking the central corridor, there are four primary Office spaces. Each of these spaces is designed to provide a conducive working environment, with ample room for office furniture, fixtures, and equipment. Generously proportioned windows within each office space ensure abundant natural light, fostering a productive and pleasant workspace.

To the top-left and top-right corners of the plan, there are provisions for restrooms. These restrooms are designed to cater to the needs of the building's occupants and visitors, ensuring essential amenities are in close proximity to all office spaces.

Adjacent to the restrooms, spaces have been allocated for utility or storage. These areas can serve various functions, from housing technical equipment to providing storage solutions for office supplies.

Furthermore, the top-right section of the layout highlights an expansive staircase, ensuring easy vertical movement between the floors. Its substantial footprint might suggest a design emphasis on safety, capacity, and perhaps an architectural feature for light and spatial continuity.

The perimeter of the plan reveals substantial glazing, which not only provides panoramic views of the external environment but also ensures that the interiors remain well-lit throughout the day.

Figure 3.4 showcases a 3-Dimensional view of a building model generated using the SketchUp interface integrated with the OpenStudio plugin. This advanced interface is geared towards energy simulations, empowering architects and engineers to delve into the energy performance aspects of their designs.

The building model embodies a clear depiction of a multi-story structure emphasizing a well-defined building envelope. The facade is dominated by glazing, hinting at an extensive curtain wall system that can significantly influence natural light penetration, thereby impacting the building's energy consumption and thermal performance.

Across the facade, horizontal golden louvers serve as shading devices. Their strategic placement and design aim to minimize solar gain, especially during times of intense sunlight, which plays a pivotal role in maintaining a favorable interior environment and reducing the cooling load.

The building concludes with a flat roof, donned in a reddish-brown hue. Such flat roofs are versatile and open up opportunities for green initiatives like green roofs or the placement of solar panels.

Adding an intriguing element to the design, the golden vertical feature at the corner of the building might not only be an aesthetic inclusion but also a functional one. Whether it's a part of the building's structural system or a space for utilities, it contrasts well with the largely transparent facade.

For those evaluating the model, a human figure near the building's base provides an essential perspective on the scale. It offers an immediate understanding of the building's proportions in relation to human dimensions.

The visible SketchUp grid underneath the model serves as a guide, offering reference points and orientations. It's an essential tool that ensures precise placement and alignment of the various components during the modeling process.

3.2 Building Energy Simulation Workflow with OpenStudio

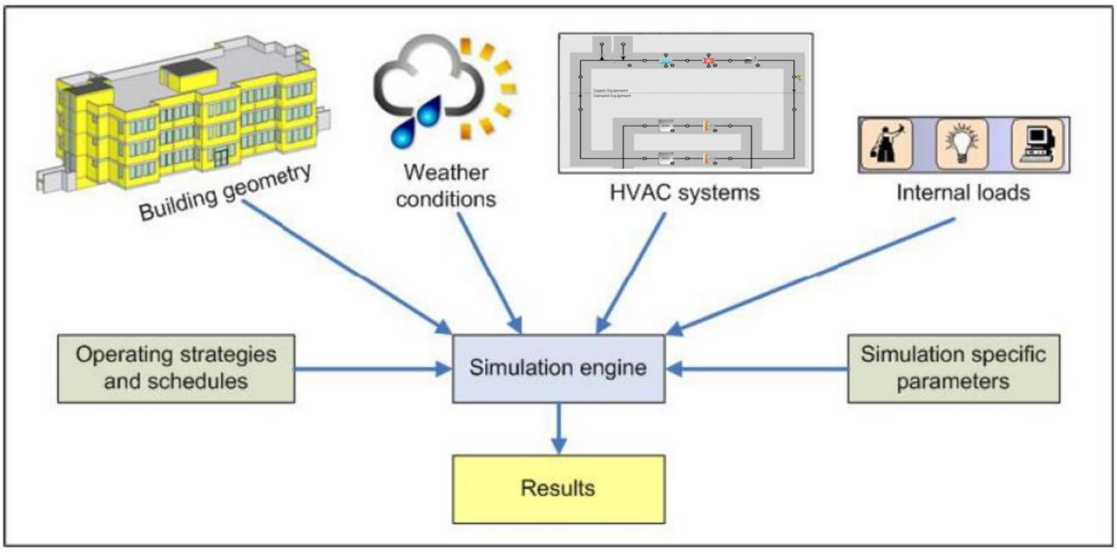


Figure 3. 5 Building Energy Simulation Workflow with OpenStudio

Building Geometry: This is the foundational step where the physical layout, design, and structure of the building are defined. It involves determining the shape, size, orientation, and spatial arrangement of rooms and zones in the building. This geometry provides the simulation with critical information about how the building interfaces with the external environment and how different spaces within the building relate to each other.

Weather Conditions: Before any simulation, it's essential to understand the climatic conditions the building will face. This involves importing historical weather data or predicted future weather patterns relevant to the building's location. Factors like temperature, humidity, solar radiation, wind speed, and precipitation play a significant role in determining energy usage, especially for HVAC systems.

HVAC Systems: One of the most energy-intensive components of a building is its HVAC (Heating, Ventilation, and Air Conditioning) system. In this step, the type, capacity, efficiency, and control strategies of the HVAC systems are defined. This could range from simple heating systems in small buildings to complex centralized air conditioning in large structures.

Internal Loads: Every building has sources of heat and energy consumption within its boundaries. These are termed internal loads and can come from occupants (people), lighting systems, electronic equipment, appliances, and other devices. The simulation needs to account for these factors to predict energy consumption accurately and ensure that the building's systems can maintain a comfortable indoor environment.

Operating Strategies and Schedules: Not all parts of a building operate at full capacity all the time. There are schedules for lighting, HVAC operations, occupancy, and more. Defining these operational timelines and strategies ensures the simulation understands when energy is being used and when systems are at rest.

Simulation-Specific Parameters: These are unique settings, conditions, or constraints set for the simulation. It might include specific goals (like achieving a certain energy savings percentage) or particular conditions (such as a planned building renovation).

The central component in the workflow is the Simulation Engine, where all the defined parameters and strategies are processed. It computes interactions, energy flows, and performance metrics to deliver the final Results. These outcomes provide insights into the building's energy performance, potential areas for energy conservation, and the effectiveness of various design and operational strategies.

3.3 OpenStudio Simulation Capabilities

Whole Building Energy Simulation: OpenStudio leverages EnergyPlus to simulate all aspects of building energy, including HVAC, lighting, and envelope performance. This holistic approach provides a detailed picture of a building's energy footprint.

HVAC Systems Modeling: With a rich library of HVAC components, users can model systems ranging from simple to complex, including VAV, radiant floors, ground-source heat pumps, and many more.

Thermal Comfort Analysis: Beyond just energy consumption, OpenStudio can model and evaluate occupant comfort using metrics like PMV (Predicted Mean Vote) and PPD (Predicted Percentage Dissatisfied).

Parametric Analysis: Users can set up multiple design or operational scenarios and run simulations in batches. This helps in understanding the energy implications of different design choices or strategies.

Weather Data Integration: OpenStudio uses typical meteorological year (TMY) files, which provide detailed, hourly weather data. This ensures that simulations account for seasonal variations and local climatic conditions.

Reporting and Visualization: After simulations, OpenStudio provides detailed reports and visualizations. These can range from simple tables of monthly energy consumption to intricate 3D visualizations of airflow or temperature distribution within a space.

Interoperability and Extensions: OpenStudio is designed to be extensible. Users can develop or utilize plugins that enhance functionality. Moreover, its compatibility with other software, like SketchUp (for geometry creation) or third-party databases (for material properties), ensures that it can seamlessly fit into various design and analysis workflows.

3.4 Weather Data for Ankara

Weather File: The specific file name or database from which the weather data has been sourced is "ANKARA - TUR IWEC Data" with a WMO (World Meteorological Organization) number of 171280.

Latitude: The geographical latitude of Ankara is 40.12 degrees. Latitude provides crucial information for solar calculations, as it affects the angle of incident sunlight on the building.

Longitude: The geographical longitude of Ankara is 32.98 degrees. Longitude determines the time zone adjustments and is essential for simulations that involve diurnal patterns.

Elevation: Ankara is located at an elevation of 951 meters above sea level. Elevation affects the air density and, in turn, influences heating, cooling, and ventilation calculations.

Time Zone: Ankara is located in Time Zone 2. The time zone is essential for aligning the simulation time with local time, especially when analyzing daylighting or occupancy patterns.

North Axis Angle: This is set to 0 degrees, indicating that the building's north direction aligns with the true north. This angle is vital for orienting the building in energy simulations, as it can affect solar gains, daylighting, and other aspects.

In summary, the weather data used for Ankara is based on the IWEC (International Weather for Energy Calculations) dataset from energyplus.net. This data is essential for accurate energy simulations, as it accounts for local climatic conditions, sunlight patterns, and other environmental factors that influence building performance.

3.4.1 Simulation Weather Scenarios

ANKARA ANN CLG .4% CONDNS DB=>MWB 33°C 15.4°C 17.6°C Wetbulb 8.95 230

- Explanation: This represents an annual cooling condition for Ankara where, during 0.4% of the hours in a year, the dry bulb temperature can rise to a maximum of 33°C, with a daily temperature range of 15.4°C. The wet bulb temperature is 17.6°C, and this condition occurs with a wind speed of 8.95 mph from a direction of 230°.

ANKARA ANN CLG .4% CONDNS DP=>MDB 23.6°C 15.4°C 15.2°C Dewpoint 8.95 230

- Explanation: This indicates a condition where the dew point can rise to 23.6°C with the same temperature range and wind conditions. This is another facet of the annual extreme cooling scenario for Ankara.

ANKARA ANN CLG .4% CONDNS ENTH=>MDB 29.1°C 15.4°C 25.37 Enthalpy [Btu/lb] 8.95 230

- Explanation: Here, the enthalpy, or the total heat content in the air, is 25.37 Btu/lb, and the maximum dry bulb temperature for this condition is 29.1°C.

ANKARA ANN CLG .4% CONDNS WB=>MDB 29.4°C 15.4°C 19.2°C Wetbulb 8.95 230

- Explanation: For this cooling condition, the wet bulb temperature can rise to 19.2°C.

ANKARA ANN HTG 99.6% CONDNS DB -15.7°C 0 -15.7°C Wetbulb 1.12 100

– Explanation: This is an annual heating condition where, for 99.6% of the hours in a year, the dry bulb temperature doesn't fall below -15.7°C.

ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB 3.4°C 0 3.4°C Wetbulb 22.59 100

– Explanation: This is a wind-related heating condition. The wind speed can rise to 22.59 mph under this scenario, emphasizing the impact of wind on heating.

ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB -14.8°C 0 -18°C Dewpoint 1.12 100

– Explanation: This condition emphasizes normal humidity levels where the dew point can drop to -18°C.

Table 3. 1 OpenStudio Weather Data and Simulation Weather Scenarios

Weather File		**ANKARA - TUR IWEC Data WMO#=171280**				
Latitude		40.12				
Longitude		32.98				
Elevation		3114 ft				
Time Zone		2				
North Axis Angle		0				
	Maximum Dry Bulb (F)	**Daily Temperature Range (R)**	**Humidity Value**	**Humidity Type**	**Wind Speed (mph)**	**Wind Direction**
ANKARA ANN CLG .4% CONDNS DB=>MWB	91.4	27.72	63.68	Wetbulb [F]	8.95	230
ANKARA ANN CLG .4% CONDNS DP=>MDB	74.48	27.72	59.36	Dewpoint [F]	8.95	230
ANKARA ANN CLG .4% CONDNS ENTH=>MDB	84.38	27.72	25.37	Enthalpy [Btu/lb]	8.95	230
ANKARA ANN CLG .4% CONDNS WB=>MDB	84.92	27.72	66.56	Wetbulb [F]	8.95	230
ANKARA ANN HTG 99.6% CONDNS DB	3.74	0	3.74	Wetbulb [F]	1.12	100
ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB	38.12	0	38.12	Wetbulb [F]	22.59	100
ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB	5.36	0	-0.94	Dewpoint [F]	1.12	100

3.5 Base Model

3.5.1 Roof

ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8 Roof Construction in OpenStudio

The roofing system titled "ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8" as defined in OpenStudio, encompasses a tri-layered structure consisting of the following materials, from the outermost layer to the innermost:

1. Metal Decking
   - Roughness: Medium Smooth
   - Thickness: 0.001500 m
   - Conductivity: 45.000600 W/m-K
   - Density: 7680.000000 kg/m³
   - Specific Heat: 418.000000 J/kg-K
   - Thermal Absorptance: 0.900000
   - Solar Absorptance: 0.600000
   - Visible Absorptance: 0.600000
2. Roof Insulation 26
   - Roughness: Medium Rough
   - Thickness: 0.294100 m
   - Conductivity: 0.049000 W/m-K
   - Density: 265.000000 kg/m³
   - Specific Heat: 836.800000 J/kg-K
   - Thermal Absorptance: 0.900000
   - Solar Absorptance: 0.700000
   - Visible Absorptance: 0.700000
3. Roof Membrane
   - Roughness: Very Rough
   - Thickness: 0.009500 m
   - Conductivity: 0.160000 W/m-K
   - Density: 1121.290000 kg/m³
   - Specific Heat: 1460.000000 J/kg-K

– Thermal Absorptance: 0.900000
– Solar Absorptance: 0.700000
– Visible Absorptance: 0.700000

The entire roofing system provides a comprehensive R-value of 34.42 (ft^2*h*R/Btu), ensuring an efficient thermal performance suitable for climates categorized within ClimateZone 7-8. This intricate construction and the choice of materials contribute to its superior thermal insulating capabilities, aligning with the standards of ASHRAE 189.1-2009.

3.5.2 Exterior Glass

Theoretical Glass [221] - ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8 in OpenStudio

The exterior glass, termed "Theoretical Glass [221]" within the OpenStudio application and adhering to the specifications of "ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8", boasts the following properties:

Thickness: 0.003000 m

Solar Transmittance At Normal Incidence: 0.426900

– This property measures the fraction of incident sunlight that passes through the glass. A value of 0.426900 indicates that approximately 42.69% of sunlight is transmitted.

Front Side Solar Reflectance At Normal Incidence: 0.502400

– Indicates the fraction of sunlight that is reflected off the front side of the glass. A value of 0.502400 suggests that approximately 50.24% of sunlight is reflected.

Visible Transmittance At Normal Incidence: 0.450300

– Measures the fraction of visible light that passes through the glass. A value of 0.450300 means that about 45.03% of visible light is transmitted.

Front Side Visible Reflectance At Normal Incidence: 0.049700

– Denotes the fraction of visible light that is reflected off the front side of the glass. A value of 0.049700 suggests that around 4.97% of visible light is reflected.

Front and Back Side Infrared Hemispherical Emissivity: 0.900000

– This property pertains to the effectiveness of the material in emitting energy as thermal radiation. A value of 0.900000 indicates a high emissivity.

Conductivity: 0.008900 W/m-K

– Defines the measure of the material's ability to conduct heat. The value 0.008900 W/m-K indicates a relatively low conductivity.

Dirt Correction Factor For Solar And Visible Transmittance: 1.000000

– This factor corrects for the effects of dirt or dust on the solar and visible transmittance values. A value of 1 suggests no correction is needed.

Additionally, this glazing material possesses the following overall performance properties:

U-factor: 0.35 Btu/ft^2*h*R

– A measure of the rate of heat transfer through the material. A lower U-factor indicates better insulating properties.

Solar Heat Gain Coefficient (SHGC): 0.45

– Represents the fraction of solar radiation admitted through the glass, both directly transmitted and absorbed and subsequently released inward.

Visible Light Transmittance (VLT): 0.45

– Indicates the amount of visible light that is transmitted through the glass.

With its meticulously defined properties, this glass material ensures energy efficiency while providing adequate natural light, aligning with the rigorous standards of ASHRAE 189.1-2009 for ClimateZone 7-8.

3.5.3 External Wall Mass

The external wall, crafted per the stipulations of "ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8", is constructed with the following layers, progressing from the exterior to the interior:

1. 1IN Stucco

– Roughness: Medium Rough

– Thickness: 0.101800 m

– Conductivity: 0.430200 W/m-K

– Density: 1910.000000 kg/m^3

– Specific Heat: 837.000000 J/kg-K

– Thermal Absorptance: 0.900000

– Solar Absorptance: 0.500000
– Visible Absorptance: 0.500000

2. 8IN Concrete HW
   – Roughness: Medium Rough
   – Thickness: 0.203000 m
   – Conductivity: 1.729600 W/m-K
   – Density: 2240.000000 kg/m^3
   – Specific Heat: 837.000000 J/kg-K
   – Thermal Absorptance: 0.900000
   – Solar Absorptance: 0.650000
   – Visible Absorptance: 0.650000
3. Wall Insulation [44]
   – Roughness: Smooth
   – Thickness: 0.025300 m
   – Conductivity: 0.041800 W/m-K
   – Density: 1835.000000 kg/m^3
   – Specific Heat: 837.000000 J/kg-K
   – Thermal Absorptance: 0.900000
   – Solar Absorptance: 0.920000
   – Visible Absorptance: 0.920000
4. 1/2IN Gypsum
   – Roughness: Smooth
   – Thickness: 0.012700 m
   – Conductivity: 0.160000 W/m-K
   – Density: 784.900000 kg/m^3
   – Specific Heat: 830.000000 J/kg-K
   – Thermal Absorptance: 0.900000
   – Solar Absorptance: 0.400000
   – Visible Absorptance: 0.400000

The cumulative performance of this wall assembly provides it with an R-value of 15.84 ft^2*h*R/Btu. This R-value represents the resistance to heat flow, with a higher value indicating greater insulation properties. The meticulous layering ensures optimal thermal performance while aligning with the rigorous standards of ASHRAE 189.1-2009 for ClimateZone 7-8.

3.5.4 Base Model Water Supply Schedule

Chilled_Water_Temperature 1:

- Summer Design Day: The temperature sustains a consistent reading throughout the 24 hours, marked at about 5.56°C.
- Winter Design Day: The temperature persists uniformly throughout the day, mirroring the Summer Design Day's reading, which is about 5.56°C.
- Default Profile: The default temperature maintains the same pattern as the design days, consistently reading around 5.56°C.

Deck_Temperature 1:

- Summer Design Day: The temperature sustains a consistent reading throughout the 24 hours, marked at about 12.78°C.
- Winter Design Day: The temperature persists uniformly throughout the day, mirroring the Summer Design Day's reading, which is about 12.78°C.
- Default Profile: The default temperature maintains the same pattern as the design days, consistently reading around 12.78°C.

Hot_Water_Temperature 1:

- Summer Design Day: The temperature sustains a consistent reading throughout the 24 hours, marked at about 71.11°C.
- Winter Design Day: The temperature persists uniformly throughout the day, mirroring the Summer Design Day's reading, which is about 71.11°C.
- Default Profile: The default temperature maintains the same pattern as the design days, consistently reading around 71.11°C.

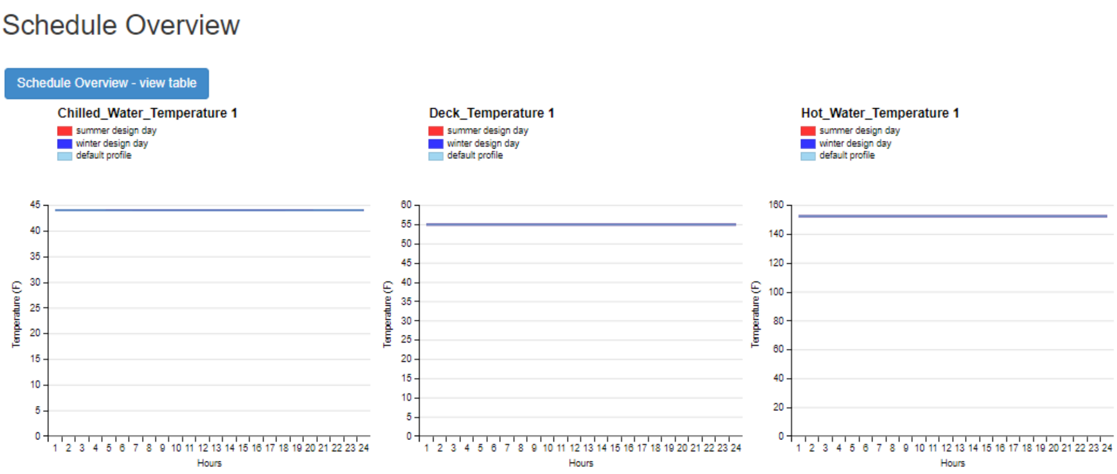


Figure 3. 6 Base Model Water Supply Schedule Overview

3.5.5 Space Summary

For the Closed Office (189.1-2009 - Office - ClosedOffice - CZ4-8), which includes 16 spaces and 1 thermal zone, there are several parameters defined:

- People Density: There is an allocation for occupancy at 0.0048 people per square foot (people/ft²).
- Electric Equipment: The electric equipment density is specified at 0.640 Watts per square foot (W/ft²).
- Lighting: The lighting density is given as 0.990 Watts per square foot (W/ft²).
- Infiltration: There is an infiltration rate noted at 0.0446 cubic feet per minute per square foot of exterior surface area (cfm/ext surf area ft²).
- Ventilation: The ventilation requirement is set at 20 cubic feet per minute per person (cfm/person).

For the Corridor (189.1-2009 - Office - Corridor - CZ4-8), which includes 11 spaces and 1 thermal zone, the parameters are as follows:

- People Density: The people density is even lower here at 0.0010 people per square foot (people/ft²).
- Electric Equipment: The electric equipment density is significantly lower than in the offices at 0.160 Watts per square foot (W/ft²).
- Lighting: The lighting density is less than half that of the office spaces at 0.450 Watts per square foot (W/ft²).

- Infiltration: The infiltration rate matches that of the office spaces at 0.0446 cubic feet per minute per square foot of exterior surface area (cfm/ext surf area ft²).
- Ventilation: The ventilation rate is set at a minimal 0.050 cubic feet per minute per square foot of floor area (cfm/floor area ft²).

Gross Window-Wall Ratio:

- This is the total window area as a percentage of the total wall area.
- The overall (Total) Gross Window-Wall Ratio for the building is 64.29%.
- For the North-facing walls, this ratio is 40%.
- For the East-facing walls, it is 57.67%.
- For the South-facing walls, the ratio is significantly higher at 80%.
- The West-facing walls also have a ratio of 80%.

3.5.6 Base Model Energy Consumption Results

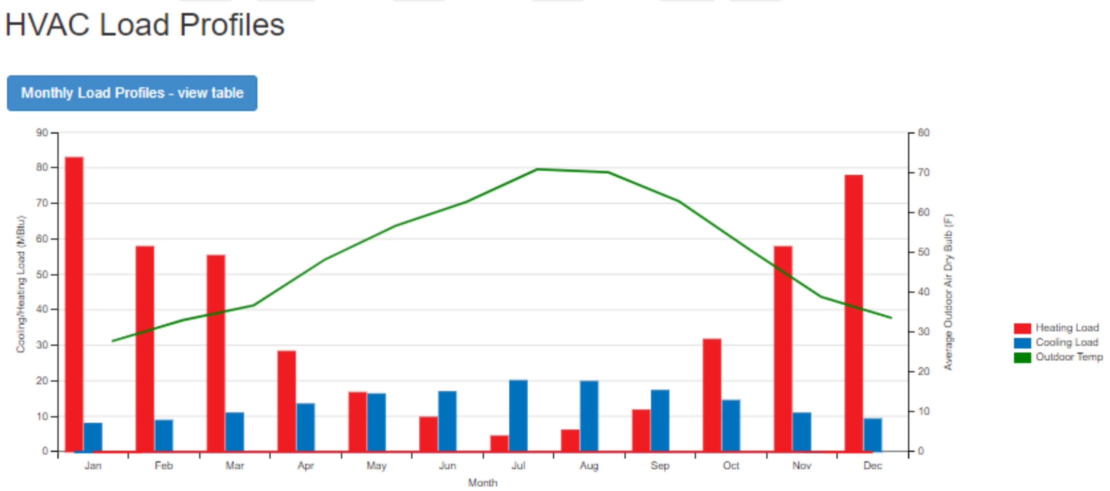


Figure 3. 7 HVAC Load Profiles for Base Model

Base model results show that the total source energy consumption will be 1,980,388 kBtus.

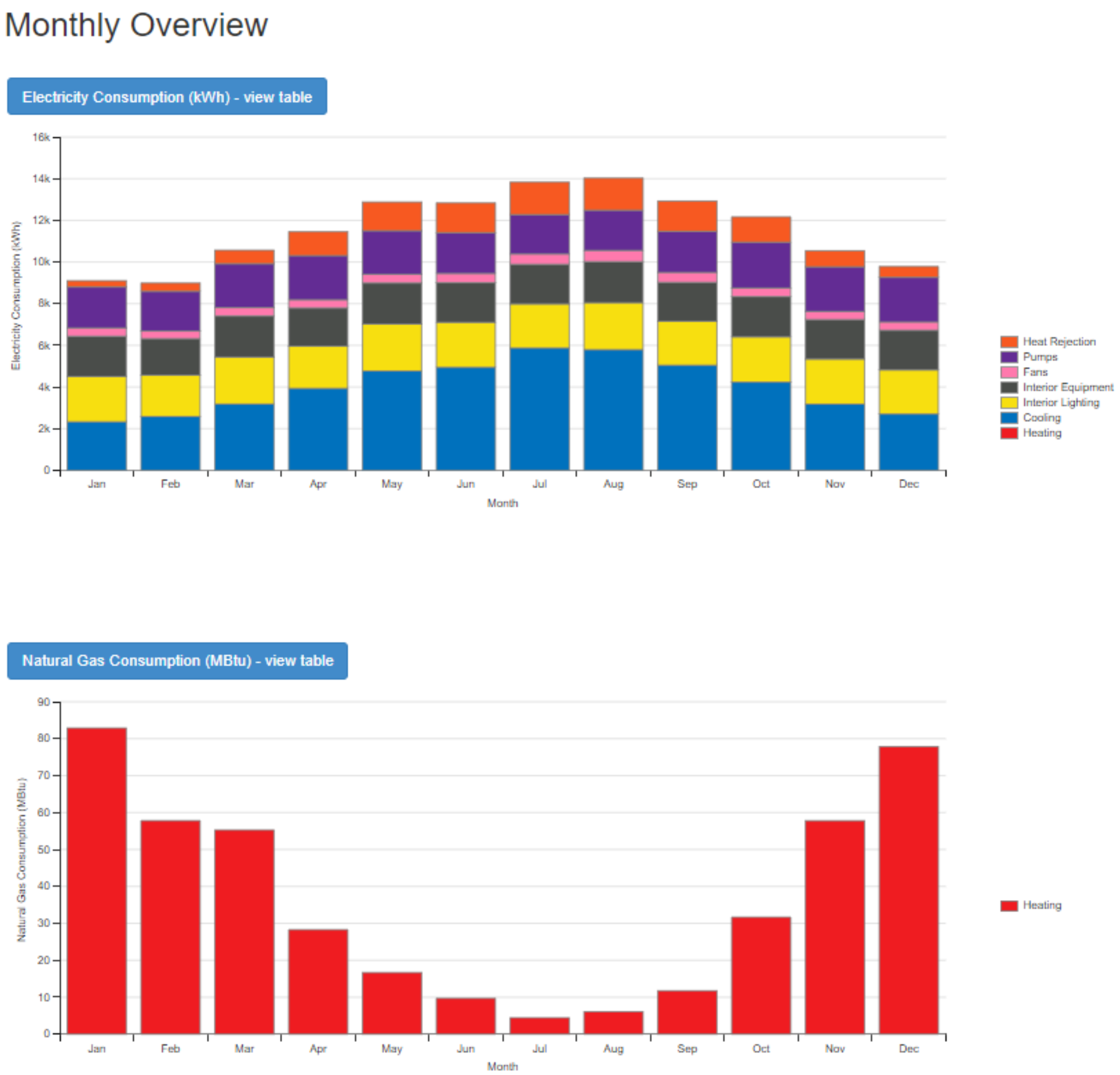


Figure 3. 8 Monthly Overview of Energy Consumption of the Base Model

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)
Total Site Energy	914776.2	96.0
Net Site Energy	914776.2	96.0
Total Source Energy	1980388.0	207.8
Net Source Energy	1980388.0	207.8

Figure 3. 9 Site and Source Summary for Base Model

Total Site Energy: The building's total site energy consumption is 914,776.2 kBtu. This figure represents the amount of energy used by the building as recorded at the site itself, which includes the energy used for heating, cooling, lighting, and operating equipment.

Net Site Energy: The net site energy is also 914,776.2 kBtu. Net site energy refers to the total site energy adjusted for any on-site energy production, such as solar panels. In this case, there is no on-site energy production, or the production is equal to the on-site energy consumption; the total and net values are the same.

Total Source Energy: The total source energy consumption is 1,980,388.0 kBtu. Source energy represents the total amount of raw fuel that is required to operate the building, including any losses that take place during the generation, transmission, and distribution of the energy. This number is usually higher than the site energy because it accounts for the energy lost in bringing the energy to the site.

Net Source Energy: The net source energy is equal to the total source energy, indicating there is no deduction for any on-site energy generation.

The "Energy Per Total Building Area" gives a sense of the building's energy intensity:

- For the Total Site Energy, the energy intensity is 96.0 kBtu/ft².
- For the Total Source Energy, the energy intensity is significantly higher at 207.8 kBtu/ft².

This difference highlights the fact that a considerable amount of energy is lost during the production and transportation of energy to the site. Energy efficiency measures are often aimed at reducing the total source energy figure, thus lowering the overall environmental impact of the building.

3.6 Scenario #1: Adding Working Schedule for 8 a.m.-8 p.m. to Base Model

In this scenario, an office working schedule is added, and all the HVAC systems are regarding this schedule.

Chilled Water Temperature 2:

During the working hours from 8 AM to 8 PM, the chilled water temperature is set to a cooler 45 degrees Fahrenheit, which is approximately 7.2 degrees Celsius. This lower temperature setting likely supports increased cooling needs during peak building occupancy or operation.

For all other hours, which include early mornings, nights, and possibly non-working periods, the chilled water is kept at a warmer 55 degrees Fahrenheit, approximately 12.8 degrees Celsius. This suggests a reduced cooling demand when the building is expected to be less occupied or in operation.

Deck Temperature:

For the hours of 8 AM to 8 PM, the deck temperature is maintained at 55 degrees Fahrenheit, around 12.8 degrees Celsius, which might be aligned with the operational needs during active hours.

Outside of these hours, the deck temperature is raised to 65 degrees Fahrenheit, which is about 18.3 degrees Celsius, potentially to reduce the energy consumption for heating when the building is not in full use.

Hot Water Temperature:

During active hours from 8 AM to 8 PM, the hot water temperature is set higher at 148 degrees Fahrenheit, equivalent to roughly 64.4 degrees Celsius. This higher temperature could cater to a greater demand for hot water for various uses in the building during these hours.

For the remaining hours, the hot water temperature is significantly lowered to 78 degrees Fahrenheit, or about 25.6 degrees Celsius, indicating a substantial decrease in hot water requirements during off-peak times, such as late evenings, nights, and early mornings.

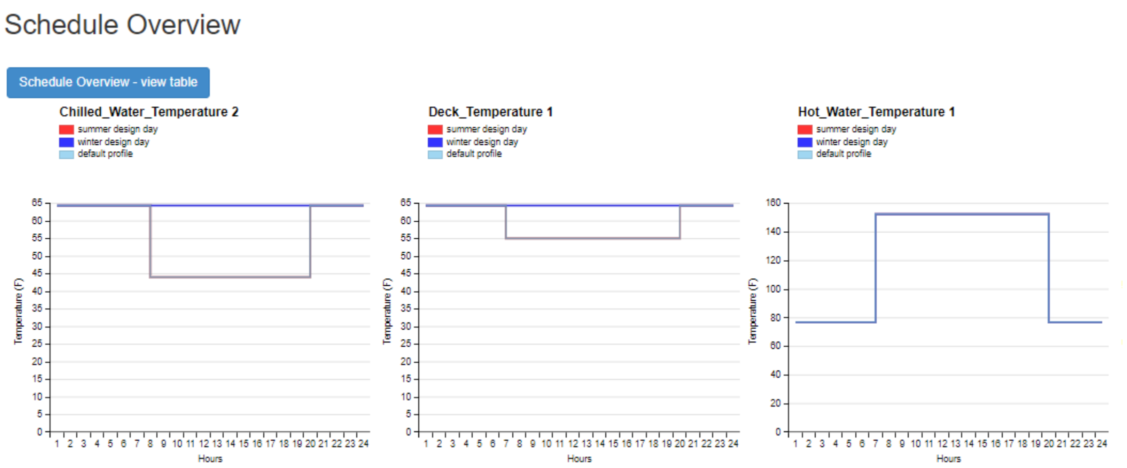


Figure 3. 10 Schedule Overview for Scenario #1

3.6.1 Scenario #1 Energy Consumption Results

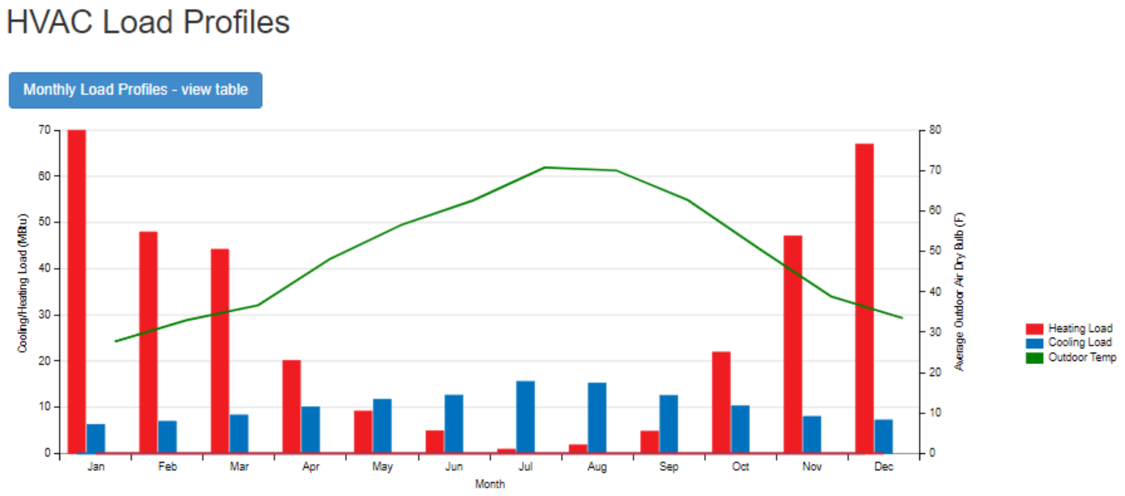


Figure 3. 11 HVAC Load Profiles for Scenario #1

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)
Total Site Energy	746737.7	78.3
Net Site Energy	746737.7	78.3
Total Source Energy	1657589.9	173.9
Net Source Energy	1657589.9	173.9

Figure 3. 12 Site and Source Summary of Scenario#1

In the results from Scenario #1, we see a significant decrease in total energy consumption when compared to the base model's energy use. The total source energy consumption in this scenario is 1,657,589.9 kBTus, which, when placed alongside the base model consumption of 1,980,388 kBTus, reflects a 16.30% reduction in total annual energy consumption.

This considerable reduction achieved by implementing a schedule demonstrates the impact of intelligent energy management. The application of a smart thermostat system and tailored scheduling can lead to substantial energy savings. The results underscore the importance of such systems for enhancing energy efficiency in buildings.

Through intelligent scheduling, non-essential heating, cooling, and water heating can be minimized during times of low occupancy or use without compromising comfort during peak periods. This approach not only reduces energy consumption but also aligns with sustainable practices and can lead to cost savings.

Furthermore, the energy efficiency improvements are also evident in the 'Energy Per Total Building Area' metric, which shows a reduction to 78.3 kBTu/ft^2 from the previous 96.0 kBTu/ft^2 in the base model. Similarly, the 'Total Source Energy' metric is reduced to 173.9 kBTu/ft^2 from 207.8 kBTu/ft^2, reinforcing the effectiveness of the implemented energy-saving strategies.

In conclusion, the data from Scenario #1 highlights the essential role that smart energy management and scheduling can play in reducing the overall energy footprint of a building, paving the way for more sustainable and cost-effective operations.

3.7 Scenario #2: Using 6 mm Glazed Window Product

In Scenario #2, the building’s window specification has been upgraded to the "ANKARA CAM 6 mm" glazing product. This product is double the thickness of the previously used 3 mm window in the base model, with the new thickness being 0.006 meters (or 6 mm). Here are the detailed properties of the "ANKARA CAM 6 mm" glazing product:

- Thickness: The windows are 6 mm thick, providing better insulation compared to the thinner 3 mm glass previously used.
- Solar Transmittance at Normal Incidence: The solar transmittance is 0.17000, which indicates the fraction of solar energy that is transmitted through the glass at a perpendicular angle. A lower transmittance reduces heat gain from solar radiation, which can be beneficial for energy savings in climates where cooling is a significant concern.
- Front Side Solar Reflectance at Normal Incidence: The product has a solar reflectance value of 0.31, reflecting away 31% of the solar energy, which also contributes to less heat entering the building.
- Visible Transmittance at Normal Incidence: The visible transmittance is 0.31000, which measures the amount of visible light that passes through the glass. This level maintains adequate daylight while potentially reducing the need for artificial lighting.
- Front Side Visible Reflectance at Normal Incidence: It has a visible reflectance value of 0.56000, indicating that the glass reflects 56% of visible light.
–

- Front Side Infrared Hemispherical Emissivity: Both the front and back sides have an emissivity value of 0.90000, which means the glass emits 90% of the energy as a black body would, contributing to the thermal comfort inside the building.
- Conductivity: The thermal conductivity is listed as 0.01100 W/m·K, which is a measure of the material's ability to conduct heat. Lower conductivity means better insulating properties.
- Dirt Correction Factor For Solar And Visible Transmittance: It's set to 1.00000, assuming no loss of transmittance due to dirt accumulation on the window surface, which in real-world scenarios may vary.

Switching to this 6 mm thick, isolated, and glazed window product from Ankara is intended to enhance the building's thermal performance by improving insulation and controlling solar and visible light penetration. These properties suggest a strategic choice for energy conservation and comfort in building design.

3.7.1 Scenario #2 Energy Consumption Results

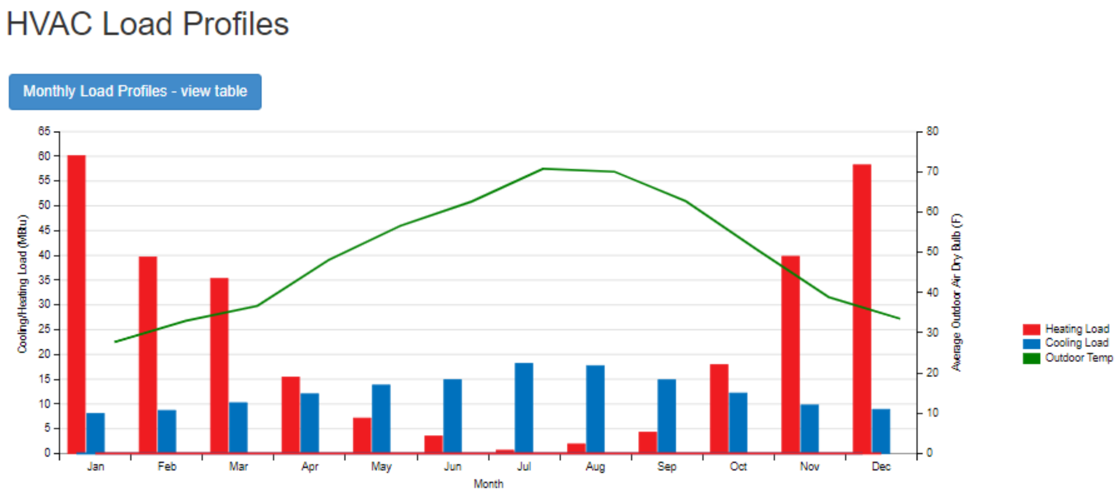
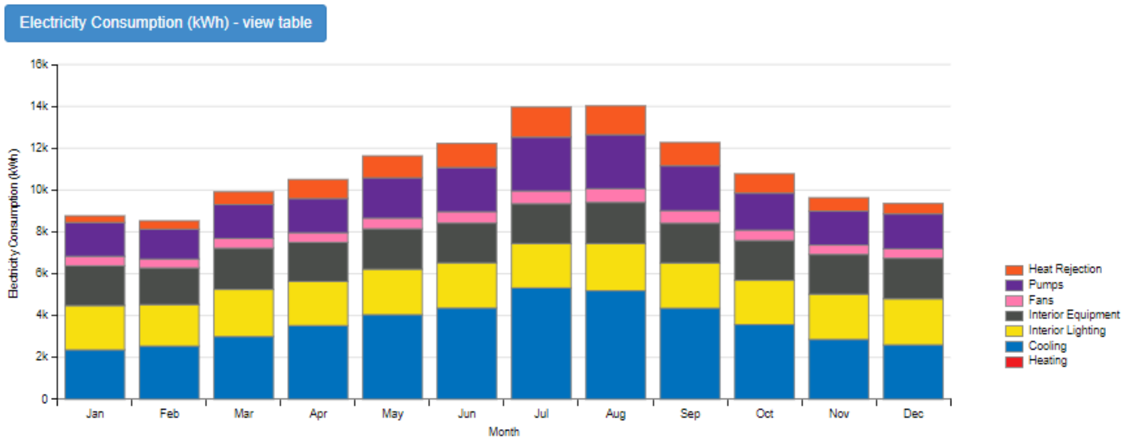


Figure 3. 13 HVAC Load Profiles for Scenario#2

Monthly Overview



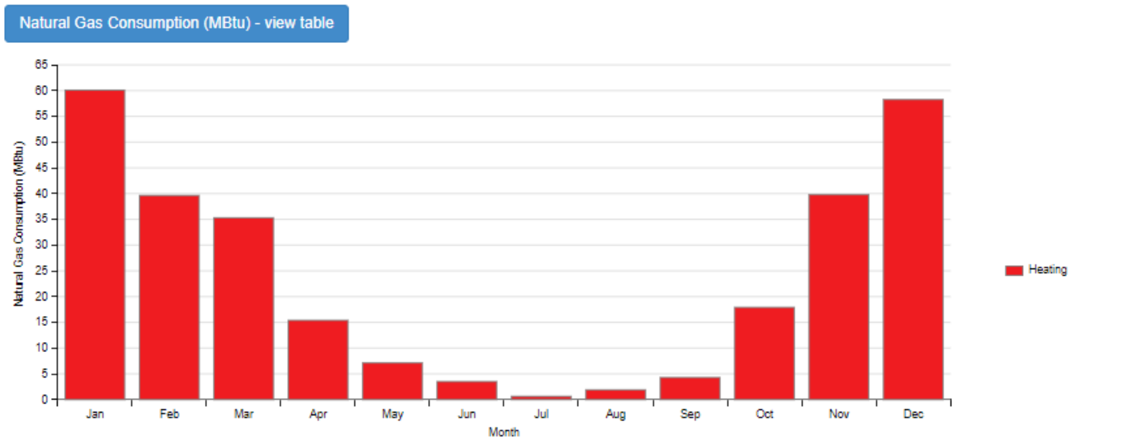


Figure 3. 14 Monthly Overview of Energy Consumption of Scenario#2

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)
Total Site Energy	732937.5	76.9
Net Site Energy	732937.5	76.9
Total Source Energy	1730003.2	181.5
Net Source Energy	1730003.2	181.5

Figure 3. 15 Site and Source Summary of Scenario#2

In Scenario #2, the introduction of the "ANKARA CAM 6 mm" glazed window product has led to a substantial enhancement in the energy efficiency of the building under evaluation. The use of this product has resulted in a total source energy consumption of 1,730,003.2 kBtus, which represents a 12.60% reduction in total annual energy consumption compared to the base model, which had a consumption of 1,980,388 kBtus.

The "ANKARA CAM 6 mm" glazed windows are noteworthy not only for their high energy efficiency qualifications but also for their local production benefits. With improved energy performance, these windows help significantly reduce the heating and cooling demands of the building, thereby lowering the overall energy usage.

Furthermore, the local manufacturing aspect of the "ANKARA CAM 6 mm" offers the added advantage of supporting the regional economy and reducing the environmental impacts associated with long-distance transportation of materials. This consideration aligns with sustainable building practices.

Additionally, the local sourcing meets and supports the Leadership in Energy and Environmental Design (LEED) requirements, which advocate for the use of resources that are located within a 500-mile radius of the project site to minimize transportation emissions and promote regional economies.

By incorporating the "ANKARA CAM 6 mm" windows with the highest energy efficiency qualifications, the project not only achieves a significant reduction in energy consumption but also furthers its commitment to sustainability by meeting stringent environmental standards and contributing to the attainment of a higher LEED certification level. This strategy emphasizes the importance of selecting high-performance materials that also meet sustainable and local sourcing criteria in contemporary building design.

3.8 Scenario #3: Using 12 mm Glazed Window Product

In Scenario #3, the focus shifts to maximizing the insulation properties of windows in order to enhance the energy efficiency of buildings located in Ankara. For this purpose, a locally produced glazed double-window profile named "ANKARA CAM 12 mm" is utilized, and its properties are as follows:

- Thickness: The product has a thickness of 12 mm (0.012 meters), which offers better insulation properties compared to thinner alternatives.
- Solar Transmittance At Normal Incidence: It has a solar transmittance of 0.56, indicating that 56% of the solar energy hitting the window is transmitted through the glass.
- Front Side Solar Reflectance At Normal Incidence: The window reflects 31% of the solar energy, which helps in reducing heat gain from sunlight.
- Visible Transmittance At Normal Incidence: The visible transmittance is 0.31, meaning it allows 31% of the visible light to pass through, which is

suitable for reducing glare and controlling the amount of natural light entering the space.

- Front Side Visible Reflectance At Normal Incidence: With a value of 0.56, it shows that the window reflects a significant amount of visible light, further influencing light levels and potential glare within the building.
- Front Side Infrared Hemispherical Emissivity: Both the front side and back side have an emissivity of 0.90, which is a measure of the window's ability to emit infrared energy and helps reduce heat loss during colder periods.
- Conductivity: The thermal conductivity of the material is relatively low, at 0.01100 W/m·K, which is beneficial for insulation, helping to minimize heat transfer through the window.
- Dirt Correction Factor For Solar And Visible Transmittance: The product has a dirt correction factor of 1.000000, which implies that the transmittance values provided consider the impact of dirt accumulation on the window’s performance.

This window specification is particularly well-suited for buildings in Ankara, addressing both thermal and optical requirements for enhanced energy efficiency. The increased thickness and carefully calibrated transmittance and reflectance properties ensure that the "ANKARA CAM 12 mm" windows provide significant insulation benefits, leading to reduced energy consumption for both heating and cooling. As a result, this scenario emphasizes the importance of selecting appropriate window profiles for improving the overall energy performance of buildings in specific climates.

3.8.1 Scenario #3 Energy Consumption Results

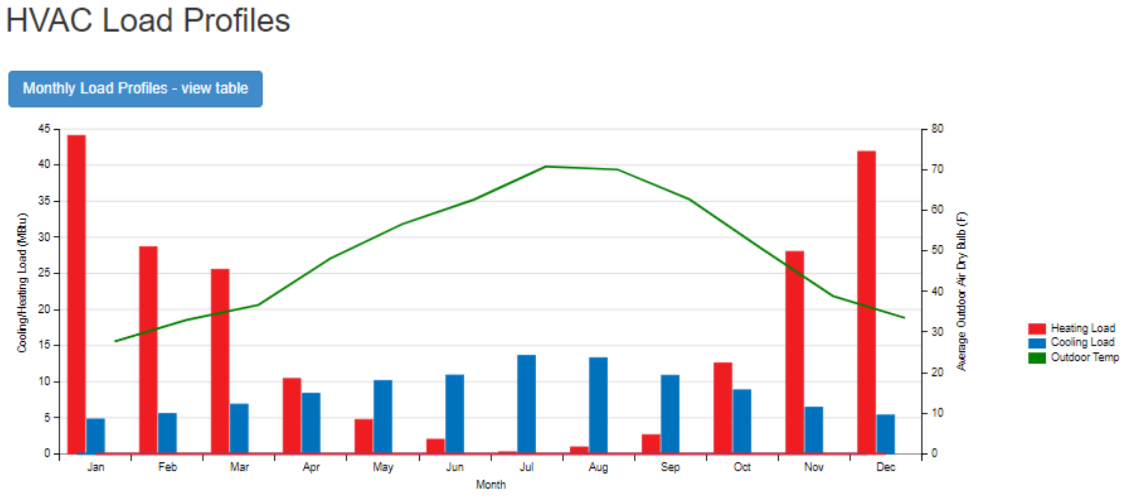


Figure 3. 16 HVAC Load Profiles for Scenario#3

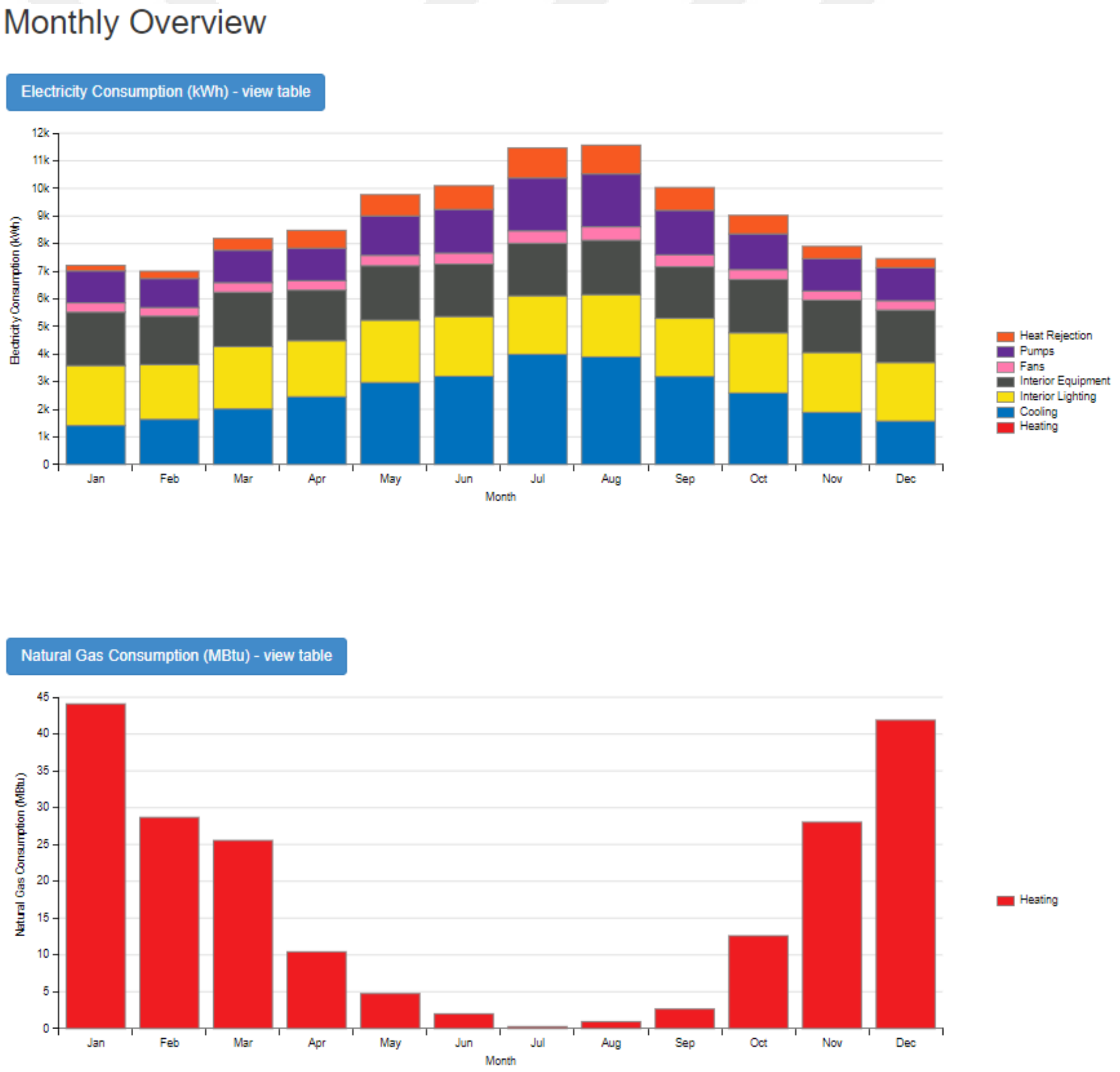


Figure 3. 17 Monthly Overview of Energy Consumption of Scenario#3

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)
Total Site Energy	571069.3	59.9
Net Site Energy	571069.3	59.9
Total Source Energy	1388106.6	145.6
Net Source Energy	1388106.6	145.6

Figure 3. 18 Site and Source Summary of Scenario#3

In Scenario #3, the implementation of the "ANKARA CAM 12 mm" glazed double-window product has led to remarkable energy savings, as evidenced by the data presented. The total source energy consumption for the building, after applying this locally produced window, stands at 1,388,106.6 kBtus. When this figure is compared to the base model, which had a total energy consumption of 1,980,388 kBtus, it becomes evident that there has been a substantial reduction of approximately 30% in annual energy usage.

Breaking down the numbers further, we find that the total site energy is reported as 571,069.3 kBtus, with an energy utilization of 59.9 kBtu/ft^2 when spread over the total building area. This presents a clear improvement in energy performance, significantly lowering the operational energy demand of the building.

Such efficiency gains are not only beneficial from an energy conservation perspective but also align with sustainability standards set forth by LEED certification. LEED (Leadership in Energy and Environmental Design) sets specific criteria for environmental responsibility in building design and construction. One of the stipulations for materials is that they should be sourced within a 500-mile radius of the construction site to reduce transportation-related carbon emissions and support local economies. The use of "ANKARA CAM 12 mm" meets this requirement, ensuring that the environmental impact of the building materials is minimized.

This scenario illustrates the impact that local, high efficiency building materials can have on the overall energy footprint of a building. The data demonstrates a significant stride towards achieving energy efficiency and sustainability in building operations, setting a precedent for future projects aiming to reduce energy consumption and contribute positively to the environment.

3.9 Scenario #4: Adding Shading Control

The addition of shading control units to an office building's energy management system is an intervention aimed at understanding and optimizing the interplay between natural light, solar gain, and the building's internal climate. Shading control systems can have a substantial impact on a building's energy consumption, especially in regions with significant seasonal temperature variations or where buildings are exposed to prolonged periods of direct sunlight.

When integrating shading controls into the base model of an office building, several key factors are at play:

- Solar Gain Management: Shading devices, whether exterior or interior, can be crucial in managing solar gain—the natural heat from the sun that increases indoor temperatures. During cooler months, strategic use of these shades can help harness solar energy to reduce the burden on heating systems. Conversely, in hotter periods, minimizing solar gain is vital to prevent overreliance on air conditioning units.
- Daylight Harvesting: Effective shading control is also closely linked to daylight harvesting, where natural light is utilized to its fullest to reduce the need for artificial lighting. Shading controls can adjust dynamically to the angle and intensity of sunlight, providing an optimal balance between natural and artificial light ensuring comfort without waste.
- Glare Reduction: The comfort of occupants is paramount for productivity in an office environment. Shading controls can help mitigate glare, which can be disruptive to individuals working on computers or performing other visually intensive tasks.
- Energy Efficiency and Cost Savings: By reducing the need for artificial cooling and lighting, shading control units can lead to significant energy savings. These savings are not only beneficial for operational costs but also reduce the carbon footprint of the building.
- Building Automation Integration: Shading controls often function as part of a broader building automation system (BAS). This integration allows for more sophisticated control strategies based on occupancy, time of day, and season. For instance, sensors can detect when a room is unoccupied and

adjust the shades and lighting, accordingly, ensuring that energy is not wasted.

– Enhanced Aesthetics and User Comfort: Aside from the technical benefits, shading controls can contribute to the aesthetic of a building, both internally and externally. Modern systems offer a range of designs that can complement the architectural vision. User comfort is also enhanced through the ability to control light levels and views of the outside environment.

– Compliance and Sustainability Goals: With a growing emphasis on green building standards, such as LEED, implementing shading controls is a step towards compliance with these certifications. These systems can be an integral part of a sustainable design strategy, contributing points towards a building's certification.

The role of shading control units in an office building extends beyond simple adjustments to sunlight entry—it encompasses a holistic approach to energy management, occupant comfort, and sustainable design. By providing a means to intelligently respond to the sun's movement and the building's energy needs, shading controls can significantly reduce the total energy consumption of an office building. Their efficacy is heightened when combined with other energy-saving measures and when tailored to the specific climate conditions and architectural features of the building. As such, their incorporation into the base model is not merely an addition but a transformative element towards an intelligent and responsive energy-efficient building design.

3.9.1 Scenario #4 Energy Consumption Results

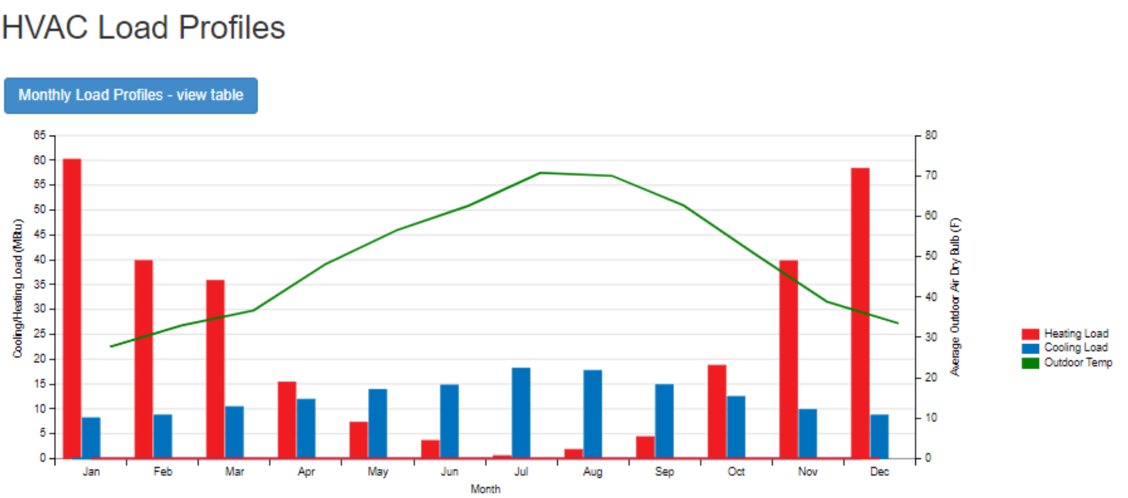
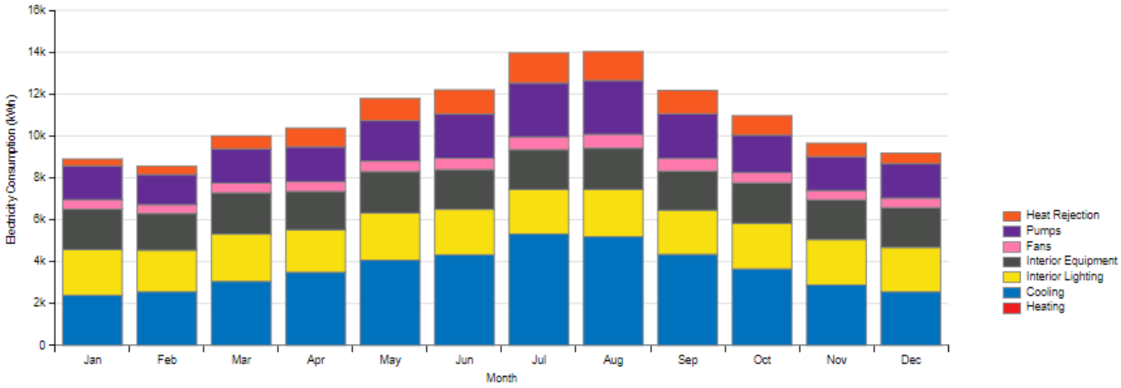


Figure 3. 19 HVAC Load Profiles for Scenario#4

Monthly Overview

Electricity Consumption (kWh) - view table



Natural Gas Consumption (MBtu) - view table

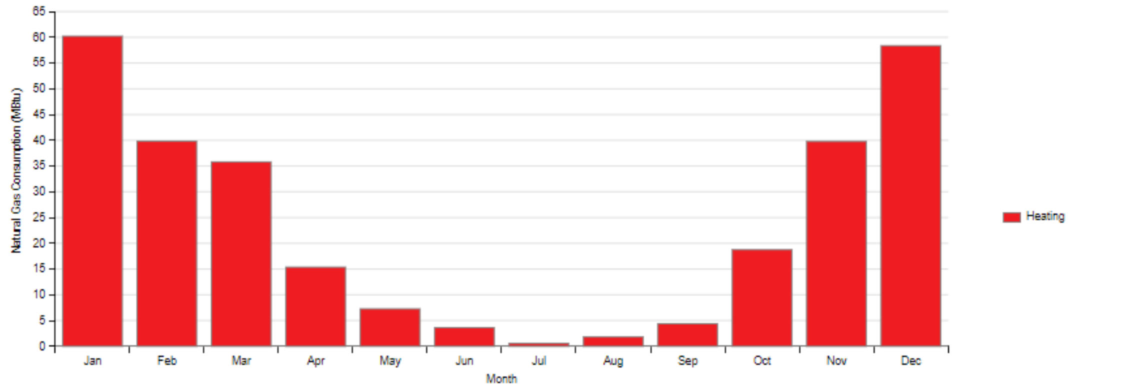


Figure 3. 20 Monthly Overview of Energy Consumption of Scenario#4

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)
Total Site Energy	735401.8	77.2
Net Site Energy	735401.8	77.2
Total Source Energy	1733860.8	181.9
Net Source Energy	1733860.8	181.9

Figure 3. 21 Site and Source Summary of Scenario#4

When comparing the energy consumption data of the base model to Scenario #4, which includes the addition of shading control units, we can see a notable improvement in energy efficiency. The base model, without shading controls, had a total source energy consumption of 1,980,388 kBtu. With the implementation of shading control units in Scenario #4, this figure has been reduced to 1,733,860.8 kBtu.

This represents a reduction in total source energy consumption of about 12.45%, which is a significant decrease when considering the energy demands of an office building. The addition of shading controls has likely contributed to this efficiency in several ways, primarily through the reduction of heating, ventilation, and air conditioning (HVAC) loads. Shading controls help mitigate the heat gain from sunlight during the warmer months, which reduces the cooling requirements. Conversely, during colder months, the use of shading can be optimized to allow solar heating, which can help in reducing the heating demands.

Moreover, the impact of this addition goes beyond just energy consumption numbers. The savings in energy also suggest a decrease in the operational costs for the building, which can accumulate substantial financial savings over time. Additionally, the reduction in energy use directly correlates to a lower carbon footprint, aligning the building's operation with environmental sustainability goals.

In conclusion, the integration of shading control units in Scenario #4 has demonstrated a meaningful reduction in energy consumption compared to the base model, highlighting the effectiveness of shading controls as a measure for enhancing the energy efficiency of office buildings.

Chapter 4

4 Conclusions and Future Prospects

4.1 Conclusions

Table 4-1 Results Matrix

Name	What Changed	Annual Energy Consumption		Energy Savings
Base Model		1,980,388.00	kBtu	0%
Scenario#1	Working Schedule Added	1,657,589.00	kBtu	16.3%
Scenario#2	6 mm Local Glass Material Used	1,730,003.00	kBtu	12.6%
Scenario#3	12 mm Local Glass Material with more insulation Used	1,388,107.00	kBtu	29.9%
Scenario#4	Shading Control Added	1,733,860.00	kBtu	12.4%

In conclusion, the research conducted on various energy-saving scenarios for an office building has yielded insightful data crucial for understanding the impact of different energy conservation measures. The findings from this study offer substantial evidence that targeted improvements can lead to significant reductions in annual energy consumption, thereby enhancing the building's operational efficiency, reducing costs, and contributing to environmental sustainability.

The base model of the office building had an annual energy consumption of 1,980,388.00 kBtu. This figure serves as a benchmark to assess the effectiveness of each implemented scenario.

Scenario #1 demonstrated that by merely adjusting operational schedules—presumably optimizing the use of lighting, HVAC, and other systems—a significant energy reduction of 16.29% can be achieved, bringing the consumption down to 1,657,589.00 kBtu. This scenario underscores the importance of smart energy management systems and the need for meticulous scheduling to reduce waste.

Scenario #2 explored the substitution of standard glass material with a locally produced alternative. While this change did not yield as dramatic a reduction as Scenario #1, it still resulted in a decrease in energy consumption by 12.60%, totaling 1,730,003.00 kBtu annually. The key takeaway here is that sourcing local materials can not only fulfill LEED requirements but can also contribute to energy efficiency without sacrificing performance.

Scenario #3 was built upon the previous scenario by using local glass material with enhanced insulation properties. This change led to a remarkable 30% energy reduction from the base model, with the total consumption dropping to 1,388,107.00 kBtu. It's evident from this result that improving the insulation properties of building materials can have a substantial effect on energy savings, proving that material choice and quality are critical factors in building energy efficiency.

Scenario #4 added shading control to the base model, leading to a 12.45% reduction in energy consumption, with a total of 1,733,860.00 kBtu. This scenario highlighted the importance of integrating smart design features into buildings, such as dynamic shading systems that adapt to changing environmental conditions, thereby reducing reliance on HVAC systems and saving energy.

Each scenario provides valuable insights into the multifaceted approach needed for energy conservation in office buildings. When combined, these measures could have a synergistic effect, potentially leading to even greater savings than observed individually. The research indicates that a holistic approach, utilizing smart scheduling, material selection, insulation enhancements, and dynamic building controls, can lead to substantial energy and cost savings, as well as a reduced carbon footprint. This aligns with global sustainability goals and reinforces the significance of innovative design and operational strategies in achieving green building standards. The outcomes of this thesis offer a comprehensive guide for future energy efficiency projects and serve as a testament to the benefits of pursuing a more sustainable and responsible approach to building design and management.

4.2 Societal Impact and Contribution to Global Sustainability

The cumulative results of this thesis provide a clear illustration of how strategic design and operational modifications in office buildings can lead to substantial societal benefits and contribute significantly to the broader goals of global sustainability. The findings demonstrate the capacity of targeted energy conservation measures to mitigate environmental impact, encourage economic savings, and promote social well-being. This section explores these dimensions in light of the research outcomes.

Environmental Impact:

The introduction of energy-efficient measures, as shown in the scenarios outlined in this study, has the potential to greatly reduce the carbon footprint of office buildings. Scenario #3 alone, which incorporates local glass material with superior insulation, resulted in a 30% reduction in energy usage. This reduction directly correlates to decreased greenhouse gas emissions, which are pivotal in combating climate change. By adopting these measures on a wider scale, the construction and operation of office buildings can align more closely with the targets set by international agreements such as the Paris Accord.

Economic Savings:

From an economic perspective, reducing energy consumption translates to lower utility costs. With energy prices fluctuating and often increasing, the savings demonstrated in the scenarios (ranging from 12.60% to 30%) provide a compelling case for the adoption of energy-efficient technologies and materials. The cost savings realized can be reinvested into further sustainable practices or other areas of the organization, thereby fostering a cycle of continuous improvement and financial stability.

Social Well-being:

Energy-efficient buildings also contribute to social well-being. Improved indoor environmental quality, as a result of better material use and optimized operational schedules, can lead to enhanced comfort and productivity for the occupants. Additionally, the act of prioritizing sustainability within the built environment raises public awareness and promotes a culture of responsibility and conservation, which is essential for societal progress.

Contribution to Global Sustainability:

This study contributes to the advancement of multiple United Nations Sustainable Development Goals (SDGs), specifically:

- Goal 7 (Affordable and Clean Energy): By showcasing how energy efficiency can be enhanced in office buildings, the research supports the pursuit of more affordable and clean energy solutions.
- Goal 11 (Sustainable Cities and Communities): The findings demonstrate practical approaches to constructing sustainable urban habitats, with office buildings playing a pivotal role as a microcosm of broader community sustainability efforts.
- Goal 12 (Responsible Consumption and Production): Through the adoption of energy-efficient materials and practices, the study underscores the importance of responsible consumption and production patterns, advocating for a decrease in resource use and environmental impact.
- Goal 13 (Climate Action): The energy-saving strategies explored signify actionable climate change mitigation efforts, underlining the critical role that building management plays in the broader climate action context.

The application of energy conservation measures, as examined in the study's scenarios, has the potential to position office buildings as ideals of sustainability. These measures encourage the replication of energy-efficient practices, leading to a ripple effect that enhances the sustainability of the built environment globally. Through reduced energy demand and the adoption of sustainable building practices, the research contributes to the collective effort of combating climate change and fostering resilient, energy-conscious communities. Furthermore, the emphasis on local material sourcing not only supports local economies but also reduces transportation emissions, contributing to the sustainability of supply chains. The adherence to LEED requirements serves to standardize these practices, potentially leading to a more sustainable construction industry worldwide.

In conclusion, the societal impact of this research is multi-faceted, demonstrating benefits that extend beyond the immediate scope of energy consumption. The strategies tested here contribute to a sustainable future by offering practical solutions that can be adopted by industry stakeholders, policymakers, and the society at large to foster an environmentally responsible, economically viable, and socially beneficial built environment. This thesis thus provides a blueprint for sustainable practices in office building management and highlights the crucial role of built environment professionals in shaping a sustainable future.

4.3 Future Prospects

The implications of this study point towards an array of future prospects that can serve as a roadmap for research, development, and policy formulation in the realm of sustainable architecture and building operations. The potential for expansion and further exploration in this field is vast, and this section outlines key areas where future endeavors may prove to be fruitful.

Technological Advancements:

As technology evolves, the introduction of new materials and smarter building management systems could further enhance energy efficiency. Future studies may focus on the integration of cutting-edge insulation materials. These smart windows adapt to lighting conditions, and automation systems that respond in real-time to optimize energy usage. The continuous monitoring and adaptive response of such technologies hold the promise of further reducing energy consumption beyond the current scenarios.

Renewable Energy Integration:

The next logical step in improving the energy profile of buildings is the incorporation of renewable energy sources such as solar panels, wind turbines, and geothermal systems. Future prospects include the analysis of self-sustained buildings that not only reduce energy consumption but also generate their own energy, aiming towards net-zero or even net-positive energy status.

Building Design and Urban Planning:

Innovative design strategies that go beyond the building itself—such as urban heat island mitigation, green spaces, and community energy schemes—can be explored in future works. These strategies can lead to a holistic approach to urban planning that maximizes environmental benefits while enhancing the quality of life for citizens.

Policy and Economic Incentives:

The results of this thesis could inform government policies and incentive programs that promote sustainable building practices. Future research may explore the effectiveness of various incentives and identify the most potent policy mechanisms for the widespread adoption of energy efficiency measures.

Societal Behavioral Change:

Understanding the human factor in energy consumption is key to effective change. Future research may look into how behavioral changes, incentivized by educational programs or usage-based pricing models, can lead to further energy savings.

Life Cycle Assessments and Circular Economy:

There is also scope for conducting comprehensive life cycle assessments of building materials and practices to ensure that the environmental impact is minimized throughout the entire life cycle of a building. This aligns with the principles of a circular economy, which prioritizes the reuse and recycling of materials.

Cross-Disciplinary Approaches:

Future studies could adopt a cross-disciplinary approach, integrating insights from psychology, economics, and environmental science to develop more comprehensive energy-saving strategies. This could result in more nuanced and effective solutions tailored to specific socio-economic contexts.

Global Benchmarking and Adaptation:

Finally, there is a need for international benchmarking of energy efficiency measures. Comparative studies across different climates, building types, and cultural settings would contribute to a global understanding of best practices in sustainable building operations.

In sum, the future prospects for advancing sustainability in the building sector are promising and necessitate a concerted effort from all stakeholders involved. Through ongoing research, innovation, and collaboration, the goal of sustainable living can be realized in the not-too-distant future, securing a greener legacy for generations to come.

In light of the specific climatic conditions of Ankara, where winters are cold, and summers are warm with limited sunshine, the focus on insulation properties of construction materials becomes paramount. This study corroborates the crucial role that insulation plays in the energy efficiency of buildings in such climates.

Having experienced the Ankara climate for a decade, we have firsthand knowledge of the local environmental conditions. The absence of a need for cooling systems in summer speaks volumes about the natural thermal properties of the local architecture and the potential for passive cooling techniques. However, the winters bring a demand for heating, which historically led to significant air pollution issues due to limited access to natural gas. Although the situation has improved, the need for better insulation in construction materials and the adoption of efficient cooling and heating systems remains a major point of action.

The rapid growth of the construction sector in Turkey post-2006 introduced glazed windows as a standard feature in building facades, taking advantage of Turkey's abundant glass production resources. Yet, there is an identified need for improving the insulation properties of these glass products to further reduce energy consumption in buildings.

Incorporating smart thermostat systems as a standard in building design, mandated by construction permits, could be a transformative step towards sustainability. The effectiveness of scheduling for heating and cooling requirements, as revealed by this study, further emphasizes the importance of intelligent building management systems.

The car industry serves as an exemplary model of continual improvement towards energy efficiency. A similar trend is notably absent in the construction industry, which is where governments and local municipalities need to step in. The regulatory bodies are called upon to enforce strict regulations and provide incentives to ensure the construction industry keeps pace with the energy efficiency trends observed in other sectors.

The prospect of such regulatory reforms opens up opportunities for research into the most effective policies and their impacts on sustainable construction practices. It also calls for the development of new materials and technologies that align with these policies. Moreover, it demands a change in the mindset of industry stakeholders—from construction companies to end-users—to prioritize energy efficiency.

Looking ahead, this thesis opens avenues for further research and practical applications in the realm of building energy efficiency, especially in the context of government regulations and policy-making. One promising direction is the exploration of how government regulations can further optimize energy efficiency in buildings by mandating the tracking and reduction of their carbon footprints.

The implementation of regulations that require buildings to report their energy sources could be a significant step. By identifying whether a building is powered by renewable sources or fossil fuels, more targeted strategies could be developed to reduce its carbon footprint. Such regulations could incentivize the adoption of renewable energy sources, thus aligning building operations with broader environmental sustainability goals.

Moreover, integrating the data obtained from this research, regulators could establish benchmarks for energy consumption and carbon emissions for different types of buildings. This would not only encourage the adoption of energy-saving measures outlined in this thesis but also pave the way for innovative solutions that further reduce environmental impact. By setting clear standards and providing incentives for compliance, government policies can significantly influence the market towards more sustainable practices.

Furthermore, the potential for integrating advanced technologies such as AI and IoT in monitoring and managing building energy consumption offers an exciting area for future exploration. These technologies could provide real-time data and predictive analysis, enabling building managers to make more informed decisions about energy use and conservation measures.

In conclusion, the findings of this thesis not only contribute to the academic understanding of building energy efficiency but also have practical implications in shaping future regulatory policies. The prospect of government intervention through regulation could accelerate the adoption of energy-efficient practices, thereby contributing to a more sustainable and environmentally conscious society. The ongoing evolution of technology in this field presents a fertile ground for future research, promising even more efficient and effective approaches to managing building energy consumption and reducing carbon footprints.

To sum up, the future prospects in sustainable building practices, especially in climates like Ankara's, lie in a multifaceted approach. This includes embracing technological advancements, fostering regulatory reforms, promoting material innovations, and cultivating societal change toward energy conservation. By adopting such comprehensive strategies, the long-term goal of achieving a sustainable built environment that caters to local climatic needs without compromising on global sustainability standards becomes more attainable.

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CURRICULUM VITAE

– **PROFESSIONAL SUMMARY**

A licensed Professional Engineer (PE) with a rich history of steering multifaceted projects and overseeing contracts across various domains. Renowned for spearheading construction endeavors, underscored by a keen financial acumen, entrepreneurial insights, and robust business expertise. Adept at managing intricate projects in high-pressure scenarios and translating intricate details into clear, impactful memos and presentations. Proficient in industry norms, construction regulations, and safety protocols, complemented by mastery in software tools.

– **SKILLS and EXPERTISE**

Project Management: Demonstrated expertise in overseeing extensive projects from conception to completion, encompassing crucial facets like estimation, risk mitigation, strategic planning, and timely scheduling.

Business Acumen: Possesses a comprehensive grasp of business strategies, financial analytics, tactical planning, and deciphering construction blueprints. Skilled in managing diverse contractual dynamics.

Technical Proficiency: Adept at assessing and determining structural systems and materials. Well-versed in industry benchmarks such as IBC, ASTM, AISC, ACI, ASCE, and their European counterparts. Proficient with tools like Microsoft Office and AutoCAD, among other vital software.

– **EXPERIENCE**

Project Executive

Crystal Steel Fabricators, Inc.

05/2018 - Present

Key Responsibilities:

o Project Management: Successfully managed multiple projects simultaneously, ensuring timely completion and adherence to the highest quality standards.

o Stakeholder Communication: Established and maintained open lines of communication with architects, engineers, and other stakeholders, resolving RFIs and ensuring seamless project progression.

o Contract and Change Management: Led contract negotiations with vendors and contractors, effectively managed change orders, and ensured best pricing for project deliverables.

o Budget and Schedule Management: Oversaw project budgets and schedules, managing associated risks to guarantee dependable turnover dates.

o Collaboration & Team Leadership: Cultivated a culture of collaboration with general contractors and vendors, while promoting continuous improvement, partnership, and teamwork across all project phases.

o Safety Leadership: Championed industry-leading safety protocols and practices, emphasizing proactive safety measures and swift response to emergencies.

o Cost Management: Innovatively developed cost-saving solutions, identified project savings, and ensured financial transparency for each project phase.

o On-Site Oversight: Spearheaded on-site construction, coordinated with various trades, ensured quality control, and supported a zero-punch list inspection process.

o Notable Projects:

- o Delaware State University Housing and Dining, Dover DE
- o AAHS Mental Health Hospital, Annapolis, MD
- o CCBC Carol Diane Eustis Center, Baltimore MD
- o Calvin Rodwell E&M School, Baltimore, MD
- o 200 Stovall Residential Renovation Project, Alexandria, VA
- o Towson University Union Renovation and Expansion, Towson, MD
- o UMES School of Pharmacy, Princess Anne, MD
- o WMATA Headquarters, Washington DC
- o National Cryptologic Museum, Annapolis, MD
- o 116 Precinct Station House, Queens, NY
- o Ocean City Convention Center, Ocean City, MD
- o Frostburg University Education Health Center, Frostburg MD
- o Project Grizzly, Memphis, TN
- o Norwood School, Bethesda, MD
- o 20 Mass Ave. Hotel Project, Washington DC
- o UMUC Bed Tower Expansion, Bel Air, MD
- o WMATA Bladensburg, Washington DC
- o 1350 Piccard Drive, Rockville MD
- o John Hopkins University South Plan Chiller, Baltimore MD

o Minnie Howard High School, Alexandria VA

o Silo City, Buffalo NY

CEO

Form Construction Company

09/2004 – 05/2018

Key Responsibilities:

o Strategic Planning: Envisioned long-term company goals and set a clear mission. Orchestrated sales, marketing, and operational strategies, ensuring alignment with overarching objectives.

o Risk Management & Compliance: Ensured business legality through acquisition of necessary licenses, secured surety bonds guaranteeing client commitments, and maintained insurance to safeguard against potential claims. Oversaw the delegation of application processes and tracked expiration dates, ensuring sustained business protection.

o Business Development: Led a robust sales and marketing division, focusing on client acquisition, contract negotiations, and deal finalizations. Leveraged diverse marketing channels, from direct mail and digital platforms to networking and public relations, aligning all endeavors with strategic goals to optimize client acquisition.

o Project Execution & Quality Control: Emphasized customer satisfaction as pivotal to business growth. Ensured accurate project estimations, timely permit acquisitions, and resource allocation, guaranteeing on-time and within-budget delivery. Supervised on-site construction, upholding safety protocols and maintaining exceptional quality standards.

o Financial Oversight: Implemented prudent financial management strategies, setting payment schedules that ensured operational cost coverage. Maintained meticulous expense and revenue records for each project, ensuring profitability and sustainable bid pricing. Strategically controlled expenses to preserve desired profit margins.

– **EDUCATION**

2017- Present	Master of Science in Industrial Engineering, Abdullah Gul University, Kayseri, TURKEY
2022-2023	Master of Science in Civil Engineering, Purdue University, West Lafayette, U.S.A.
1996-2000	Bachelor of Science in Civil Engineering, Middle East Technical University, Ankara, TURKEY

– **AWARDS & RECOGNITIONS**

o Academic Excellence: Achieved the 43rd rank in the 1996 University Acceptance Test of Turkey, standing out among 2 million participants.

o Business Growth & Leadership: Under my leadership, Form Construction Company was recognized as:

o The 25th Fastest Growing Company in Turkey (2012-2017).

o The 99th Fastest Growing Company in Turkey (2013-2018).

o Infrastructure Achievements: Showcased engineering and design prowess by:

o Designing and constructing Turkey's largest single-span steel pedestrian bridge, spanning 84 meters, located in Antalya.

o Successfully designing and erecting a total of 180 steel pedestrian bridges.

o International Project Management: Demonstrated global competence by completing over 500 construction projects spanning diverse regions including the US, Turkey, Libya, Kazakhstan, and Turkmenistan.

– **ACTIVITIES**

o Vice-President, ASKON-USA: Actively involved in the Turkish American Business Association, fostering trade, investment, and mutual understanding between Turkish and American businesses.

o Family Commitment: Proud father of two sons, emphasizing the importance of family, community, and work-life balance.

o Scuba Diving Instructor: Demonstrates a commitment to safety, training, and environmental awareness, qualities that are essential in overseeing construction projects.

o Moto-Cross Enthusiast: Engaging in moto-cross highlights adaptability, resilience, and an adventurous spirit, traits beneficial in navigating the challenges of a leadership role.

o Chess Player: Playing chess showcases strategic thinking, problem-solving, and foresight

o Guitar Enthusiast: Playing the guitar reflects creativity and an appreciation for cultural arts, suggesting a well-rounded personality that values diverse experiences and perspectives.

APPENDIX

1. Base Model OpenStudio Results

OpenStudio Results

Model Summary

Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	914,776 kBtu
Total Building Area	9,531 ft^2
Total Site EUI	95.98 kBtu/ft^2
OpenStudio Standards Building Type	n/a

Weather Summary

	Value
Weather File	ANKARA - TUR IWEC Data WMO#=171280
Latitude	40.12
Longitude	32.98
Elevation	3114 ft
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Sizing Period Design Days

	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
ANKARA ANN CLG .4% CONDNS DB=>MWB	91.4	27.72	63.68	Wetbulb [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS DP=>MDB	74.48	27.72	59.36	Dewpoint [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS ENTH=>MDB	84.38	27.72	25.37	Enthalpy [Btu/lb]	8.95	230.0
ANKARA ANN CLG .4% CONDNS WB=>MDB	84.92	27.72	66.56	Wetbulb [F]	8.95	230.0
ANKARA ANN HTG 99.6% CONDNS DB	3.74	0.0	3.74	Wetbulb [F]	1.12	100.0
ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB	38.12	0.0	38.12	Wetbulb [F]	22.59	100.0
ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB	5.36	0.0	-0.94	Dewpoint [F]	1.12	100.0

Unmet Hours Summary

Time Setpoint Not Met	Time (hr)
During Heating	664.67
During Cooling	0.0

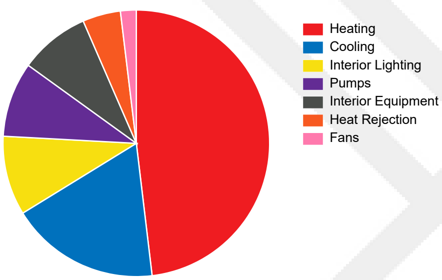
During Occupied Heating	655.17
During Occupied Cooling	0.0

Unmet Hours Tolerance

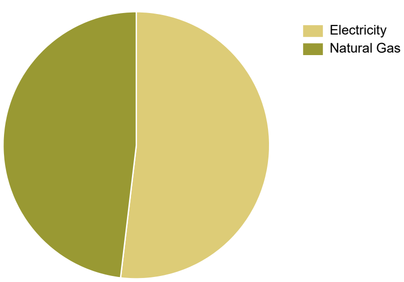
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Overview

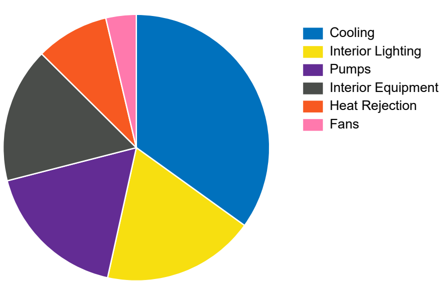
End Use - view table



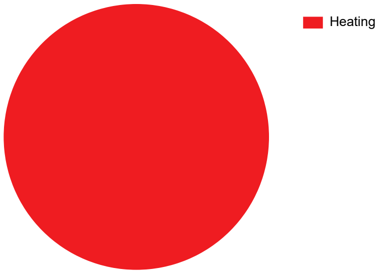
Energy Use - view table



EUI - Electricity - view table

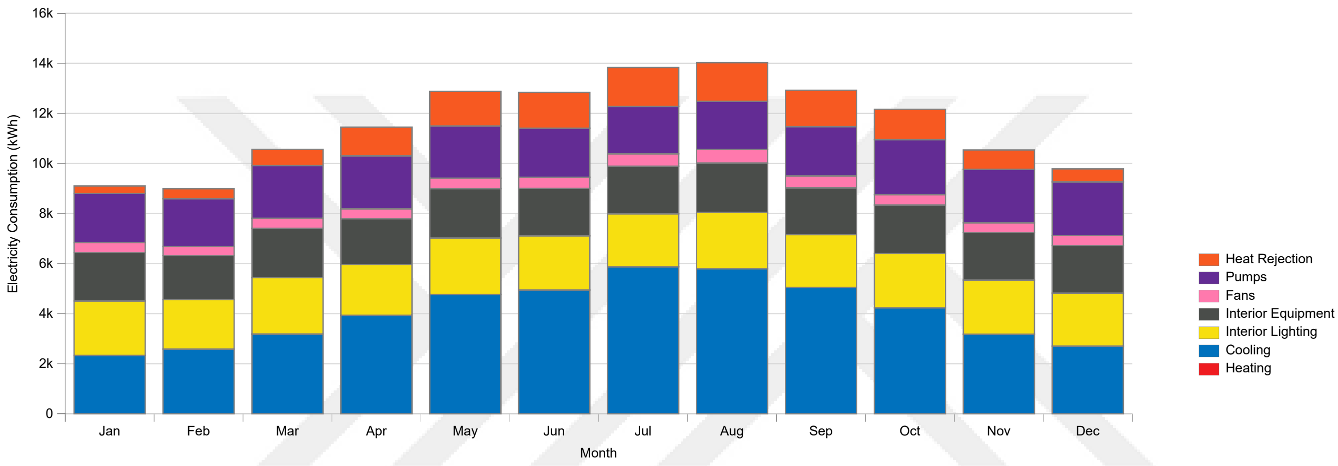


EUI - Gas - view table

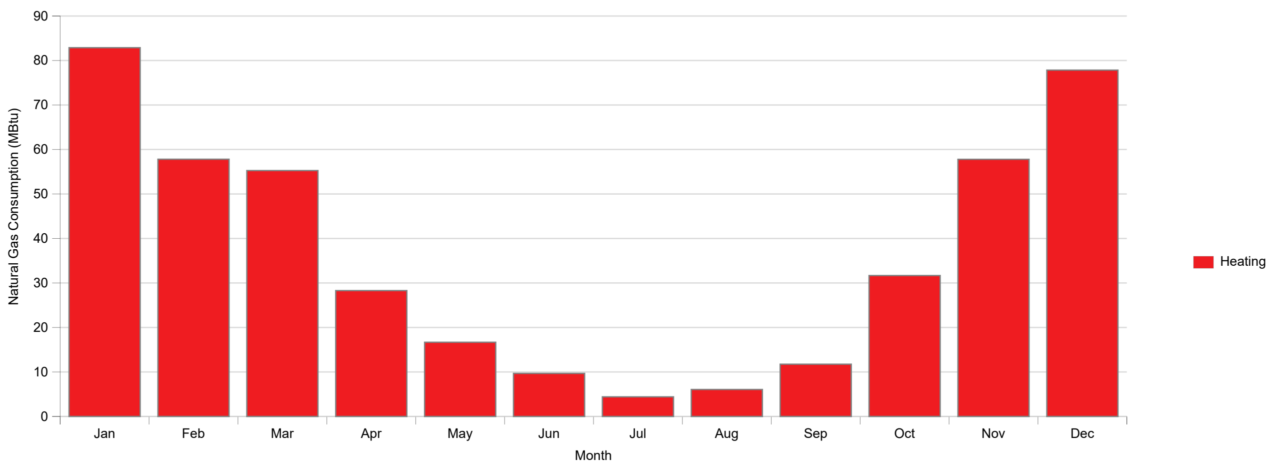


Monthly Overview

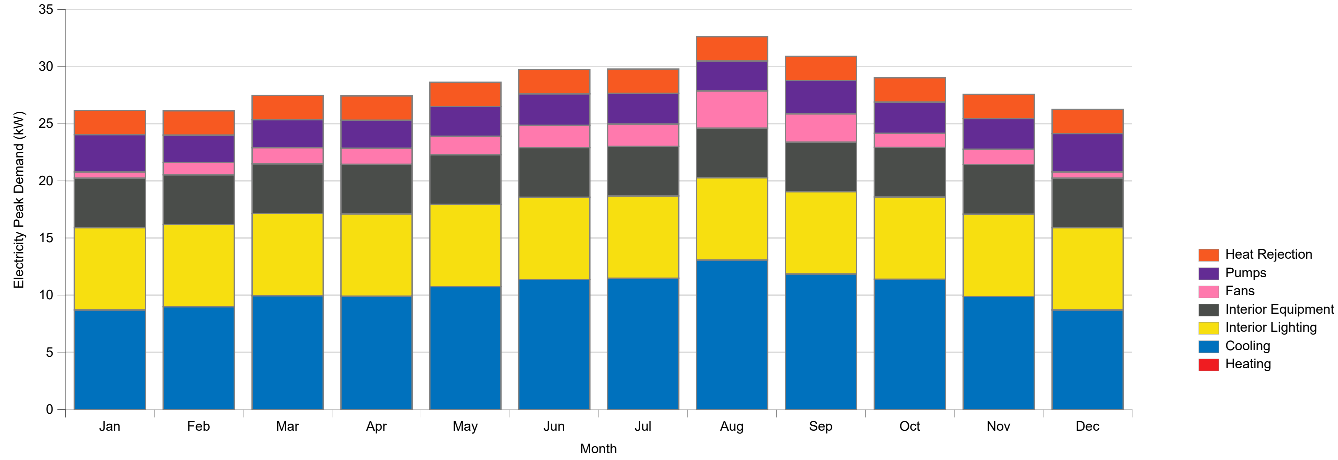
Electricity Consumption (kWh) - view table



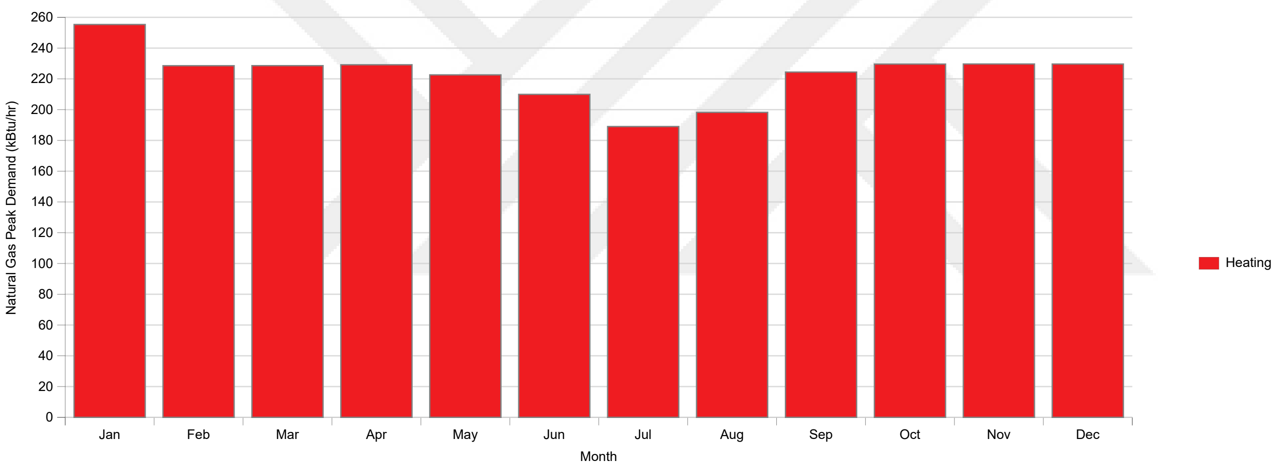
Natural Gas Consumption (MBtu) - view table



Electricity Peak Demand (kW) - view table



Natural Gas Peak Demand (kBtu/hr) - view table



Utility Bills/Rates

No Data to Show for Utility Bills/Rates

Envelope Summary

Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8	3,321	8	34.42
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8	4,090	51	15.84

Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT

ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8	7,363	37	0.35	0.45	0.45

Sub Surface Construction Details (Material Layers)

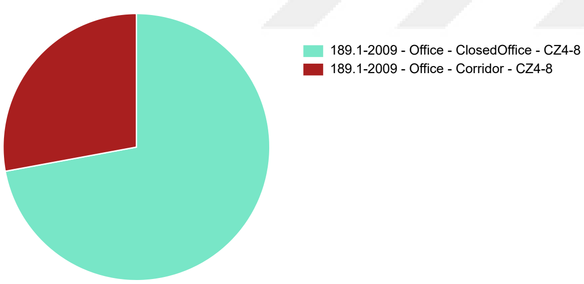
Material Name
(Material Layers in Construction 'ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8':)
Theoretical Glass [221]

Window-to-Wall and Skylight-to-Roof area Ratios

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	64.29	40.0	57.67	80.0	80.0
Gross Window-Wall Ratio (Conditioned)	64.29	40.0	57.67	80.0	80.0
Skylight-Roof Ratio	0.0				

Space Type Breakdown

Space Type Breakdown - view table



Space Type Summary

189.1-2009 - Office - ClosedOffice - CZ4-8
(16 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
189.1-2009 - Office - ClosedOffice - CZ4-8 People Definition	0.0048	people/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.6400	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	0.9900	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - ClosedOffice - CZ4-8 Ventilation (outdoor air method Sum)	20.0000	cfm/person	

189.1-2009 - Office - Corridor - CZ4-8
(11 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier

189.1-2009 - Office - Corridor - CZ4-8 People Definition	0.0010	people/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.1600	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	0.4500	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - Corridor - CZ4-8 Ventilation (outdoor air method Sum)	0.0500	cfm/ floor area ft^2	

Interior Lighting Summary

Zone Lighting

Lights	Zone	Lighting Power Density (W/ft^2)	Total Power (W)	Schedule Name	Scheduled Hours/Week (hr)	Actual Load Hours/Week (hr)	Return Air Fraction	Annual Consumption (kWh)
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 1		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 10		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 11		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 12		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 13		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 14		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 15		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 16		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 2		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 3		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 4		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 5		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 6		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 7		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 8		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89

189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 9		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 1		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 10		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 11		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 2		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 3		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 4		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 5		0.13	354.2	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1141.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 6		0.09	245.22	OFFICE BLDG LIGHT	61.85	61.85	0.0000	791.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 7		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 8		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 9		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78

Space Lighting Details

Load Name	Definition Name	Load Type	Load (units)	Multiplier	Total Load (W)
(Space Name: 'Space 101', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 102', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 203', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 305', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 103', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 201', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 401', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 105', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 402', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 104', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 202', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 204', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 205', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 301', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 302', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 304', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 303', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 403', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 404', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 405', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 406', Area: 787 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	354
(Space Name: 'Space 407', Area: 545 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	245
(Space Name: 'Space 409', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 412', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 410', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 411', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 501', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109

Lighting Controls Details

Space Name	Control Name	Zone Controlled (type, fraction)	Illuminance Setpoint (fc)

Plug Loads Summary

Electric Plug Load Consumption

	Electricity Annual Value (kWh)
InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20830.55
General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20830.55
InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

Space-level Electric Plug Loads

Equipment Name	Definition	Load (units)	Inheritance Level	Multiplier	Total Load (W)
(Space Name: Space 101, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 102, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 103, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 104, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 105, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 201, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 202, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 203, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 204, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 205, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 301, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 302, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 303, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357

(Space Name: Space 304, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 305, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 401, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 402, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 403, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 404, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 405, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 406, Area: 787 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	126
(Space Name: Space 407, Area: 545 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	87
(Space Name: Space 409, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 410, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 411, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 412, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 501, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39

Exterior Lighting

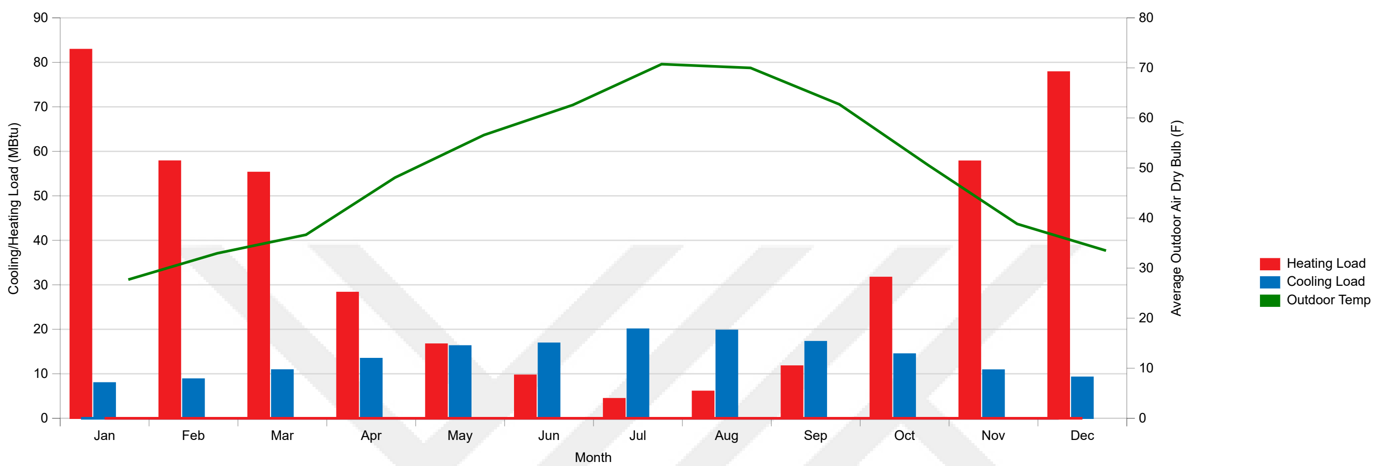
No Data to Show for Exterior Lighting

Water Use Equipment

No Data to Show for Water Use Equipment

HVAC Load Profiles

Monthly Load Profiles - view table



Zone Conditions

Temperature (Table values represent hours spent in each temperature range)

Zone	Unmet Htg (hr)	Unmet Htg - Occ (hr)	< 56 (F)	56-61 (F)	61-66 (F)	66-68 (F)	68-70 (F)	70-72 (F)	72-74 (F)	74-76 (F)	76-78 (F)	78-83 (F)	83-88 (F)	>= 88 (F)	Unmet Clg (hr)	Unmet Clg - Occ (hr)	Mean Temp (F)
THERMAL ZONE 1	173	173	0	2580	797	412	1091	2074	359	1368	66	13	0	0	0	0	67.1 (F)
THERMAL ZONE 2	665	655	0	2270	1080	758	1527	1643	423	917	137	5	0	0	0	0	66.8 (F)

Humidity (Table values represent hours spent in each Humidity range)

Zone	< 30 (%)	30-35 (%)	35-40 (%)	40-45 (%)	45-50 (%)	50-55 (%)	55-60 (%)	60-65 (%)	65-70 (%)	70-75 (%)	75-80 (%)	>= 80 (%)	Mean Relative Humidity (%)
THERMAL ZONE 1	3190	968	1010	1034	972	561	450	274	166	97	34	4	36.8 (%)
THERMAL ZONE 2	3193	986	1003	1054	997	646	451	233	115	74	8	0	36.4 (%)

Zone Overview

Zone Summary

	Area (ft^2)	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume (ft^3)	Multiplier	Above Ground Gross Wall Area (ft^2)	Underground Gross Wall Area (ft^2)	Window Glass Area (ft^2)	Lighting (W/ft^2)	People (ft^2/person)	Plug and Process (W/ft^2)
THERMAL ZONE 1	6871.68	Yes	Yes	90179.54	1.00	7543.35	0.0	6034.68	0.99	210.54	0.64
THERMAL ZONE 2	2659.22	Yes	Yes	34897.95	1.00	3909.45	0.0	1327.84	0.45	999.97	0.16
Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Conditioned Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Unconditioned Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Not Part of Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0

Zone Sensible Cooling and Heating Sensible Sizing

	Heating/Cooling	Calculated Design Load	Design Load With Sizing Factor	Calculated Design Air Flow (ft^3/min)	Design Air Flow With Sizing Factor (ft^3/min)	Date/Time Of Peak	Outdoor Temperature at Peak Load (F)	Outdoor Humidity Ratio at Peak Load (lbWater/lbAir)
THERMAL ZONE 1	Cooling	16.93 (ton)	19.47 (ton)	11499.16	13223.93	8/21 15:10:00	91.13	0.01
THERMAL ZONE 1	Heating	137.07 (kBtu/h)	171.34 (kBtu/h)	4087.32	5108.62	1/21 24:00:00	3.74	0.0
THERMAL ZONE 2	Cooling	3.45 (ton)	3.97 (ton)	2343.48	2695.22	8/21 15:20:00	90.84	0.01
THERMAL ZONE 2	Heating	54.41 (kBtu/h)	68.01 (kBtu/h)	1620.94	2027.77	1/21 24:00:00	3.74	0.0

Zone Equipment Detail

No Data to Show for Zone Equipment Detail

Air Loops Detail

VAV with Reheat

Object	Description	Value	Sizing	Count
(supply)				
AirLoopHVAC:OutdoorAirSystem	Minimum Outdoor Air Flow Rate	0 cfm	Hard Sized	
	Maximum Outdoor Air Flow Rate	15,921 cfm	Autosized	
Coil:Cooling:Water	Air Flow Rate	15,921 cfm	Autosized	
	Water Flow Rate	96.83 gal/min	Autosized	
	Plant Loop	Chilled Water Loop		
Coil:Heating:Water	Heating Capacity	236,755.1 Btu/hr	Autosized	
	Water Flow Rate	24.30 gal/min	Autosized	
	Plant Loop	Hot Water Loop		
Fan:VariableVolume	Air Flow Rate	15,921 cfm	Autosized	

	Fan Efficiency	60.5 %		
	Pressure Rise	2.01 in w.g.		
	Motor Efficiency	93.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	55.0 to 55.0 F		
(demand)				
Thermal Zones	Total Floor Area	9,531 ft^2		2
Thermal Zones	Cooling Setpoint Range	75.2 to 80.1 F		
Thermal Zones	Heating Setpoint Range	60.1 to 69.8 F		
Terminal Types Used	AirTerminal:SingleDuct:VAV:Reheat			2
(controls)				
HVAC Operation Schedule		Always On Discrete		
Night Cycle Setting		StayOff		
Economizer Setting		NoEconomizer		
Demand Controlled Ventilation Status		Off		
Central Heating Design Supply Air Temperature		55.0 F		
Central Cooling Design Supply Air Temperature		55.0 F		
Load to Size On		Sensible		

Plant Loops Detail

Chilled Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	96.83 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Chiller:Electric:EIR	Cooling Capacity	48.6 ton	Autosized	
	Water Flow Rate	96.83 gal/min	Autosized	
	Reference COP	5.5		
	Fraction of Compressor Electric Consumption Rejected by Condenser	1.0		
SetpointManager:Scheduled	Control Variable - Temperature	44.1 to 44.1 F		
(demand)				
Coil:Cooling:Water	Air Loop	VAV with Reheat		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	96.83 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		45.0 F		
Loop Design Temperature Difference		12.0 R		
Equipment Loading/Staging		Optimal		

Condenser Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	136.89 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
CoolingTower:SingleSpeed	Air Flow Rate	13,260 cfm	Autosized	
	Water Flow Rate	136.89 gal/min	Autosized	
SetpointManager:FollowOutdoorAirTemperature	Reference Temperature Type	OutdoorAirWetBulb		
(demand)				
Chiller:Electric:EIR	Plant Loop	Chilled Water Loop		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	136.89 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		84.9 F		
Loop Design Temperature Difference		10.1 R		
Equipment Loading/Staging		Optimal		

Hot Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	59.44 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Boiler:HotWater	Heating Capacity	579,177.5 Btu/hr	Autosized	
	Water Flow Rate	59.44 gal/min	Autosized	
	Nominal Thermal Efficiency	80.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	152.6 to 152.6 F		
(demand)				
Coil:Heating:Water	Air Loop	VAV with Reheat		
Air Terminal Connections				2
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	59.44 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		179.6 F		
Loop Design Temperature Difference		19.8 R		
Equipment Loading/Staging		Optimal		

Outdoor Air

Average and Minimum Outdoor Air During Occupied Hours

	Average Number of Occupants	Nominal Number of Occupants	Zone Volume (ft^3)	Avg. Mechanical Ventilation (ach)	Min. Mechanical Ventilation (ach)	Avg. Infiltration (ach)	Min. Infiltration (ach)	Avg. Simple Ventilation (ach)	Min. Simple Ventilation (ach)
THERMAL ZONE 1	1.08	32.64	90180	0.441	0.421	0.092	0.001	0.0	0.0
THERMAL ZONE 2	0.13	2.66	34898	0.225	0.137	0.142	0.002	0.0	0.0

Cash Flow

No Data to Show for Cash Flow

Site and Source Summary

Site and Source Energy

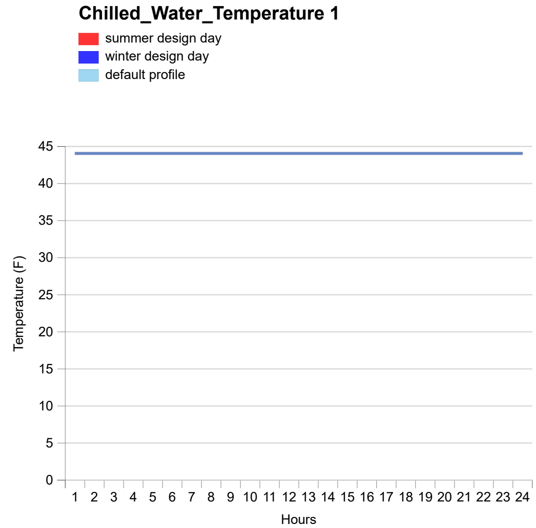
	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)	Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy	914776.2	96.0	96.0
Net Site Energy	914776.2	96.0	96.0
Total Source Energy	1980388.0	207.8	207.8
Net Source Energy	1980388.0	207.8	207.8

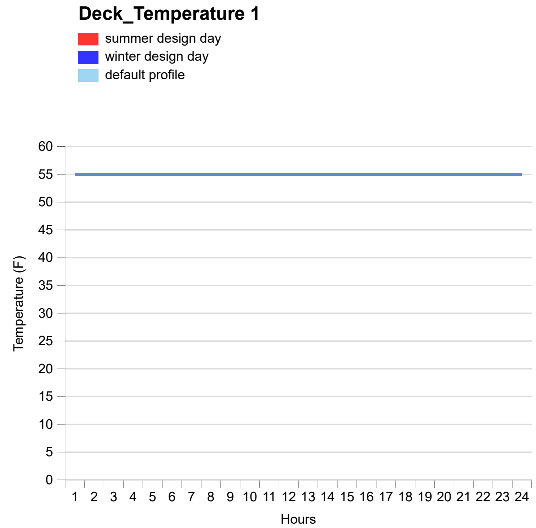
Site to Source Energy Conversion Factors

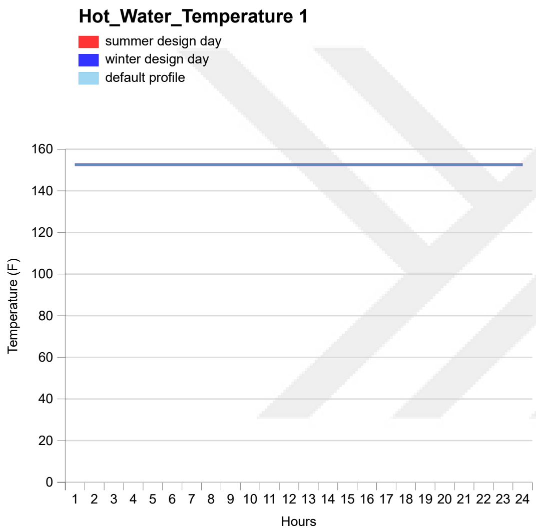
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613

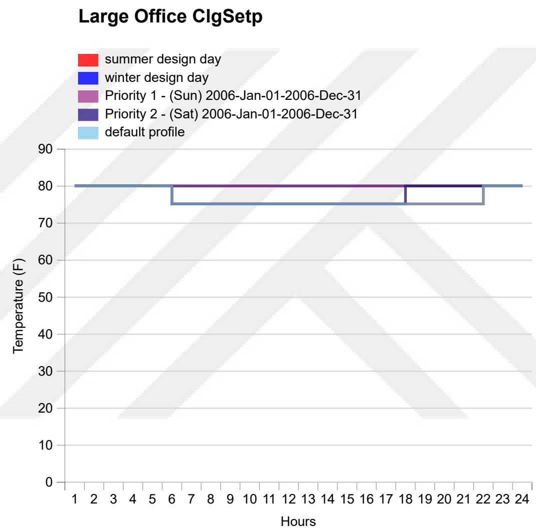
Schedule Overview

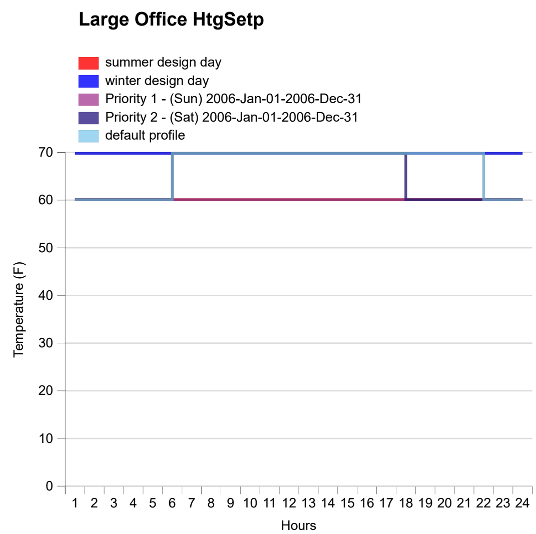
Schedule Overview - view table

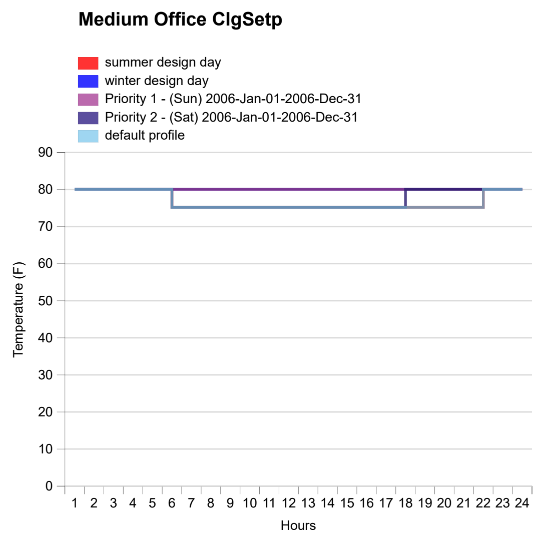

Chilled_Water_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours

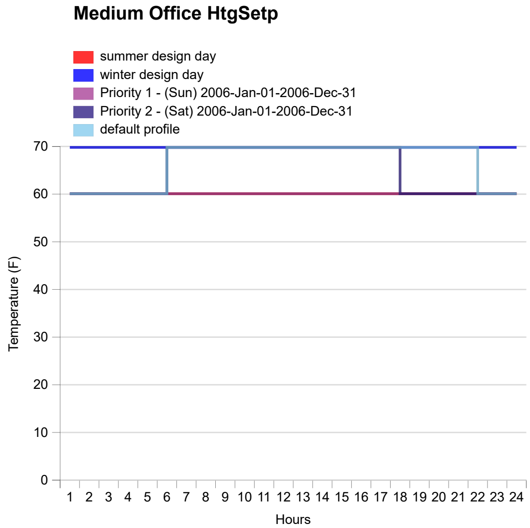

Deck_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours

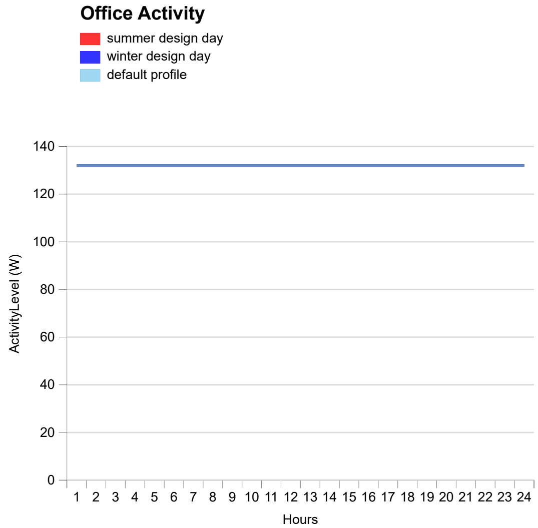

Hot_Water_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours

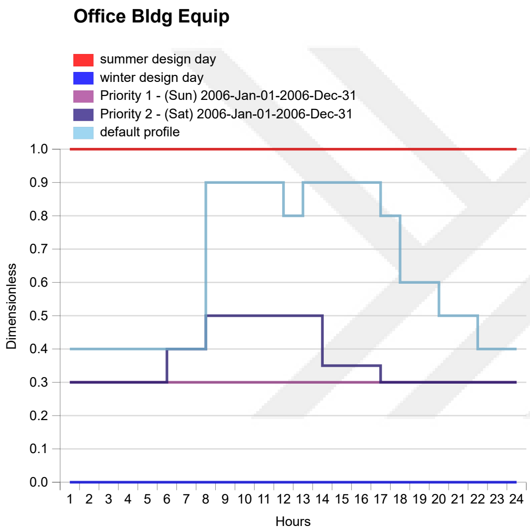

Large Office ClgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours

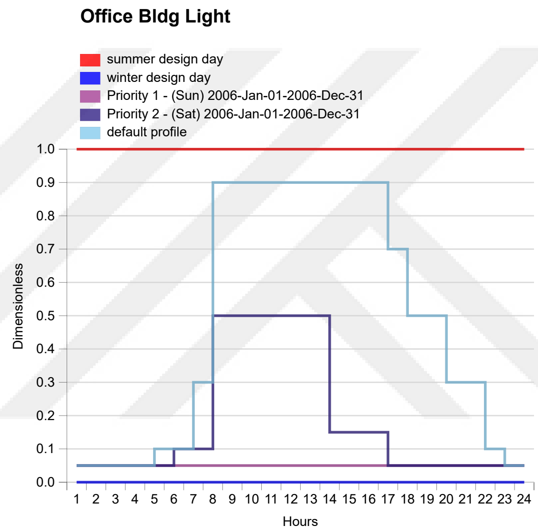

Large Office HtgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours

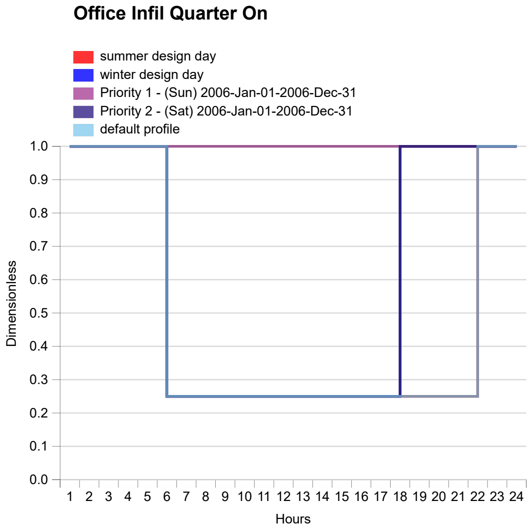

Medium Office ClgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours

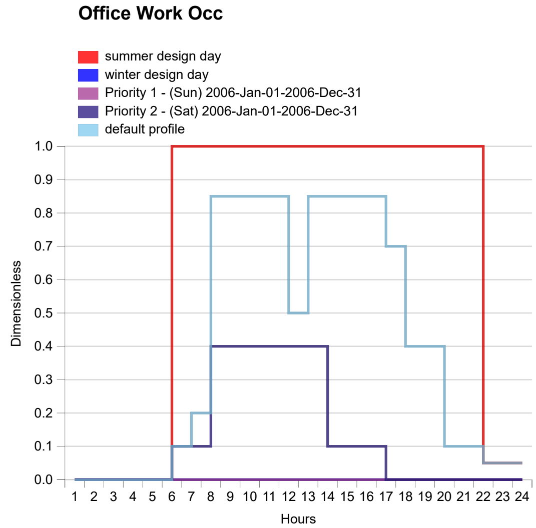

Medium Office HtgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours

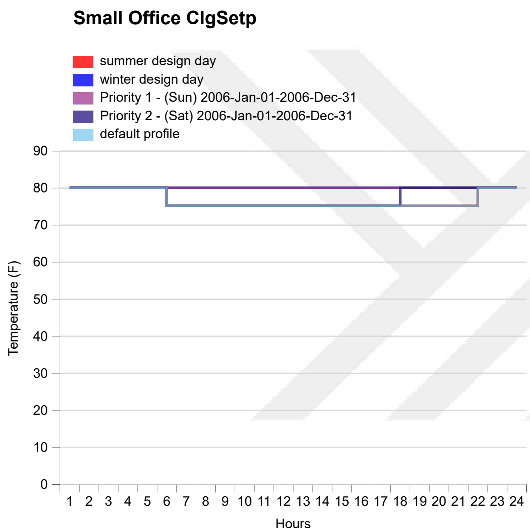

Office Activity
summer design day
winter design day
default profile
ActivityLevel (W)
Hours

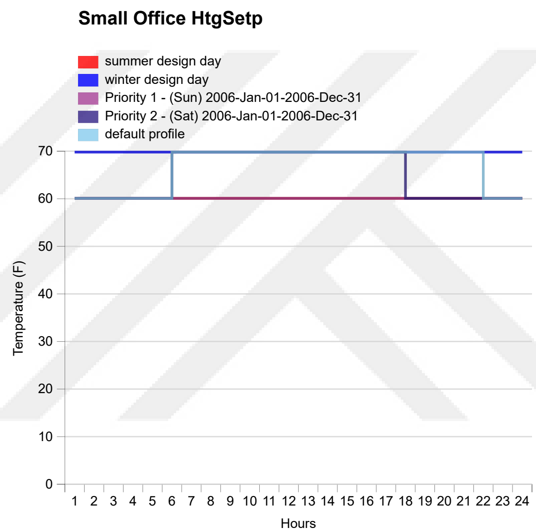

Office Bldg Equip
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Dimensionless
Hours


Office Bldg Light
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Dimensionless
Hours









Measure Warnings

Measure Warning Summary

Description	Count
Number of measures in workflow	2
Number of measures with warnings	0
Total number of warnings	0

2.Scenario #1 OpenStudio Results

OpenStudio Results

Model Summary

Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	746,738 kBtu
Total Building Area	9,531 ft^2
Total Site EUI	78.35 kBtu/ft^2
OpenStudio Standards Building Type	n/a

Weather Summary

	Value
Weather File	ANKARA - TUR IWEC Data WMO#=171280
Latitude	40.12
Longitude	32.98
Elevation	3114 ft
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Sizing Period Design Days

	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
ANKARA ANN CLG .4% CONDNS DB=>MWB	91.4	27.72	63.68	Wetbulb [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS DP=>MDB	74.48	27.72	59.36	Dewpoint [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS ENTH=>MDB	84.38	27.72	25.37	Enthalpy [Btu/lb]	8.95	230.0
ANKARA ANN CLG .4% CONDNS WB=>MDB	84.92	27.72	66.56	Wetbulb [F]	8.95	230.0
ANKARA ANN HTG 99.6% CONDNS DB	3.74	0.0	3.74	Wetbulb [F]	1.12	100.0
ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB	38.12	0.0	38.12	Wetbulb [F]	22.59	100.0
ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB	5.36	0.0	-0.94	Dewpoint [F]	1.12	100.0

Unmet Hours Summary

Time Setpoint Not Met	Time (hr)
During Heating	1764.0
During Cooling	0.0

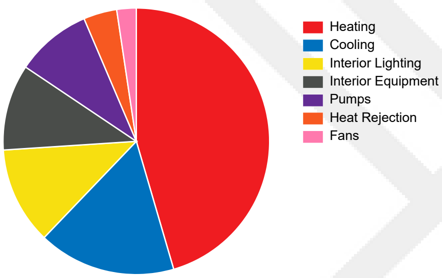
During Occupied Heating	882.67
During Occupied Cooling	0.0

Unmet Hours Tolerance

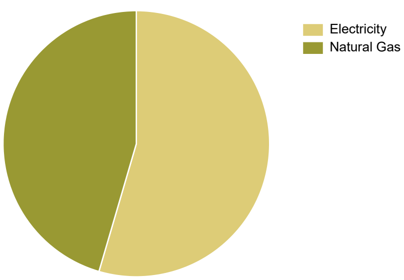
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Overview

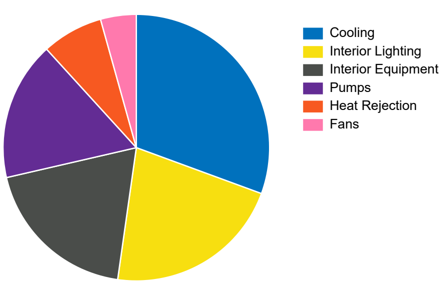
End Use - view table



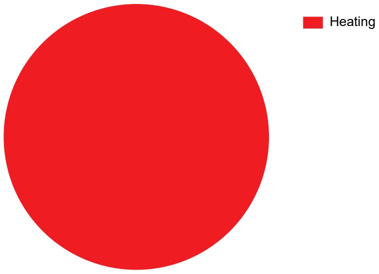
Energy Use - view table



EUI - Electricity - view table

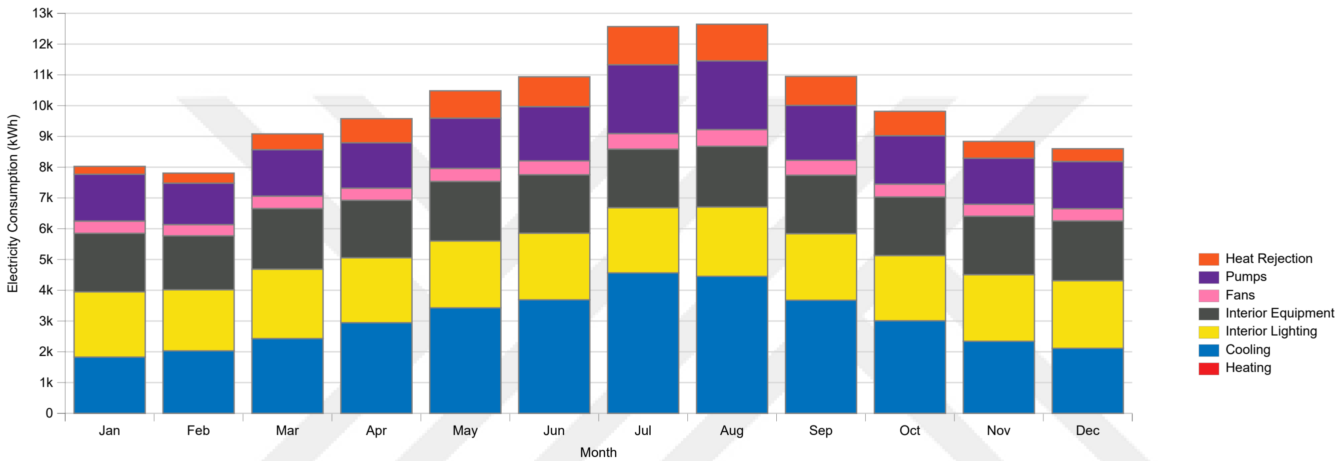


EUI - Gas - view table

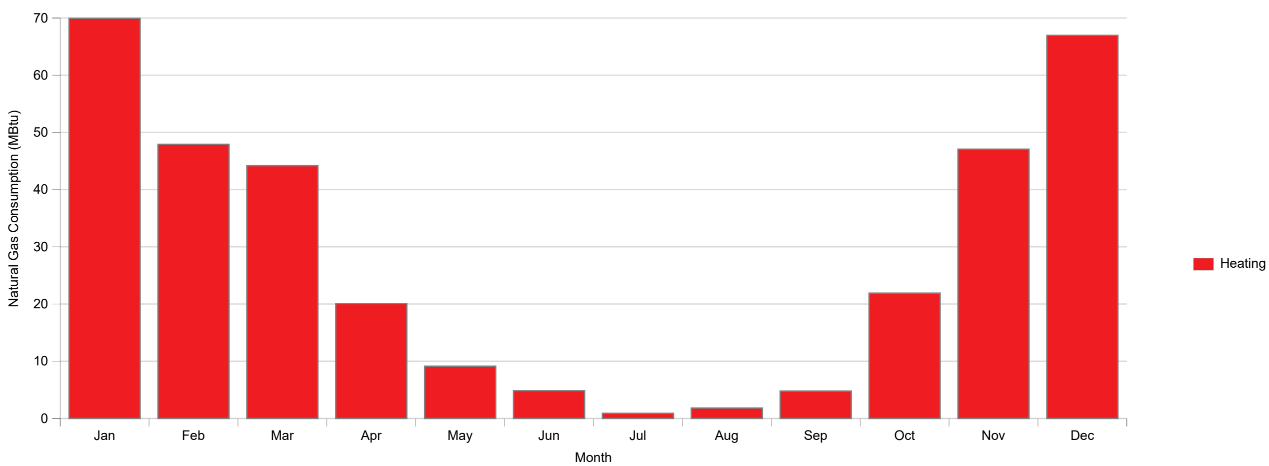


Monthly Overview

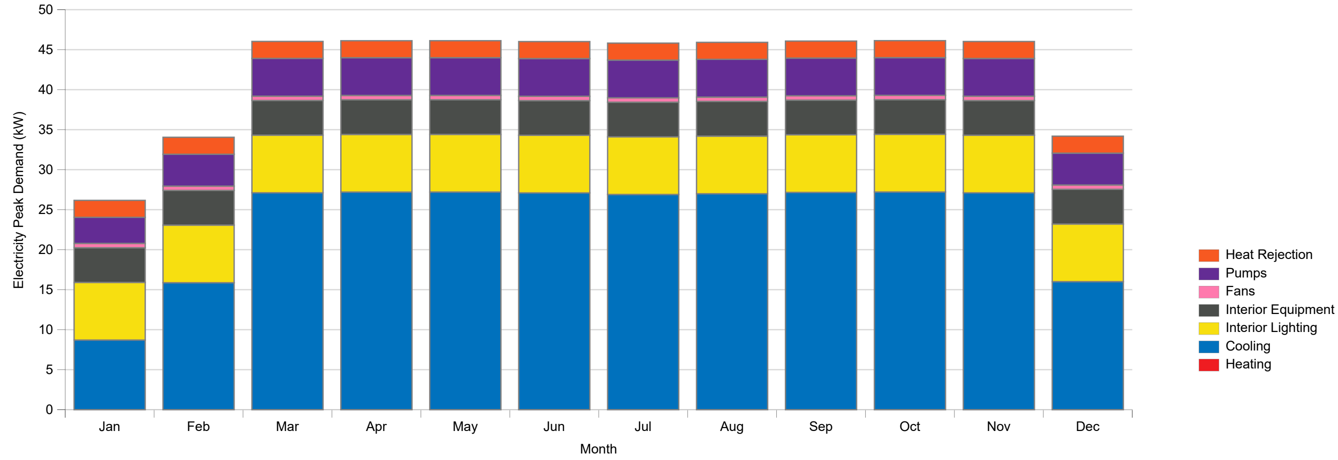
Electricity Consumption (kWh) - view table



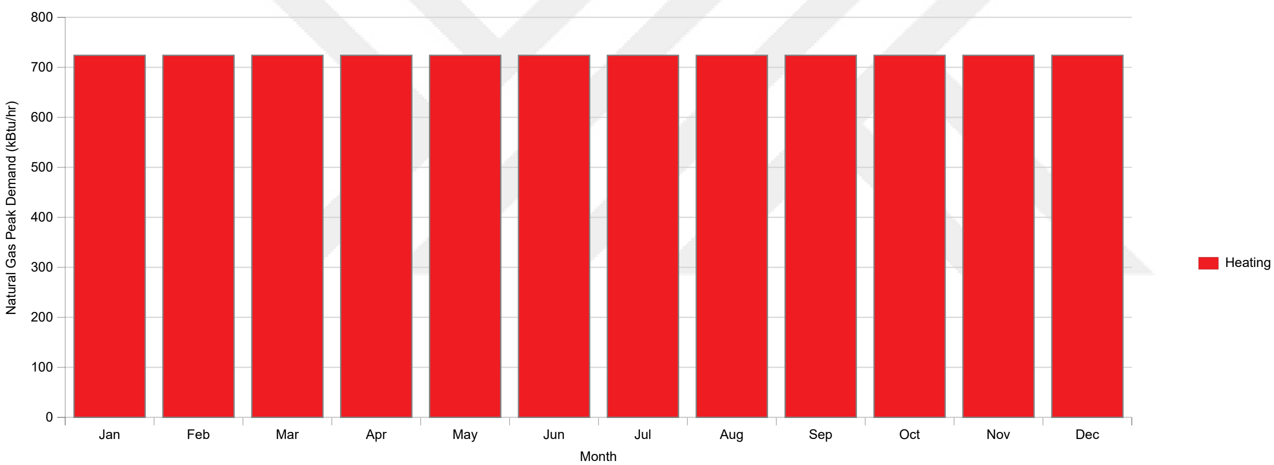
Natural Gas Consumption (MBtu) - view table



Electricity Peak Demand (kW) - view table



Natural Gas Peak Demand (kBtu/hr) - view table



Utility Bills/Rates

No Data to Show for Utility Bills/Rates

Envelope Summary

Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8	3,321	8	34.42
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8	4,090	51	15.84

Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT

ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8	7,363	37	0.35	0.45	0.45

Sub Surface Construction Details (Material Layers)

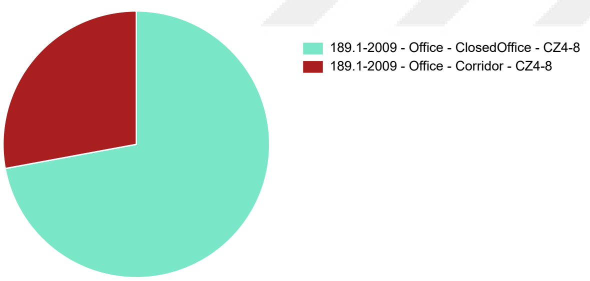
Material Name
(Material Layers in Construction 'ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8':)
Theoretical Glass [221]

Window-to-Wall and Skylight-to-Roof area Ratios

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	64.29	40.0	57.67	80.0	80.0
Gross Window-Wall Ratio (Conditioned)	64.29	40.0	57.67	80.0	80.0
Skylight-Roof Ratio	0.0				

Space Type Breakdown

Space Type Breakdown - view table



Space Type Summary

189.1-2009 - Office - ClosedOffice - CZ4-8
(16 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
189.1-2009 - Office - ClosedOffice - CZ4-8 People Definition	0.0048	people/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.6400	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	0.9900	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - ClosedOffice - CZ4-8 Ventilation (outdoor air method Sum)	20.0000	cfm/person	

189.1-2009 - Office - Corridor - CZ4-8
(11 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier

189.1-2009 - Office - Corridor - CZ4-8 People Definition	0.0010	people/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.1600	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	0.4500	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - Corridor - CZ4-8 Ventilation (outdoor air method Sum)	0.0500	cfm/ floor area ft^2	

Interior Lighting Summary

Zone Lighting

Lights	Zone	Lighting Power Density (W/ft^2)	Total Power (W)	Schedule Name	Scheduled Hours/Week (hr)	Actual Load Hours/Week (hr)	Return Air Fraction	Annual Consumption (kWh)
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 1		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 10		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 11		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 12		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 13		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 14		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 15		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 16		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 2		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 3		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 4		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 5		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 6		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 7		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 8		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89

189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 9	0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 1	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 10	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 11	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 2	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 3	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 4	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 5	0.13	354.2	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1144.44
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 6	0.09	245.22	OFFICE BLDG LIGHT	61.91	61.91	0.0000	791.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 7	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 8	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 9	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78

Space Lighting Details

Load Name	**Definition Name**	**Load Type**	**Load (units)**	**Multiplier**	**Total Load (W)**
(Space Name: 'Space 101', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 102', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 203', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 305', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 103', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 201', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 401', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 105', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 402', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 104', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 202', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 204', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 205', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 301', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 302', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 304', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 303', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 403', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 404', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 405', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 406', Area: 787 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	354
(Space Name: 'Space 407', Area: 545 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	245
(Space Name: 'Space 409', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 412', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 410', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 411', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 501', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109

Lighting Controls Details

Space Name	**Control Name**	**Zone Controlled (type, fraction)**	**Illuminance Setpoint (fc)**

Plug Loads Summary

Electric Plug Load Consumption

	Electricity Annual Value (kWh)
InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20838.89
General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20838.89
InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

Space-level Electric Plug Loads

Equipment Name	**Definition**	**Load (units)**	**Inheritance Level**	**Multiplier**	**Total Load (W)**
(Space Name: Space 101, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 102, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 103, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 104, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 105, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 201, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 202, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 203, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 204, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 205, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 301, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 302, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 303, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357

(Space Name: Space 304, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 305, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 401, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 402, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 403, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 404, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 405, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 406, Area: 787 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	126
(Space Name: Space 407, Area: 545 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	87
(Space Name: Space 409, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 410, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 411, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 412, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 501, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39

Exterior Lighting

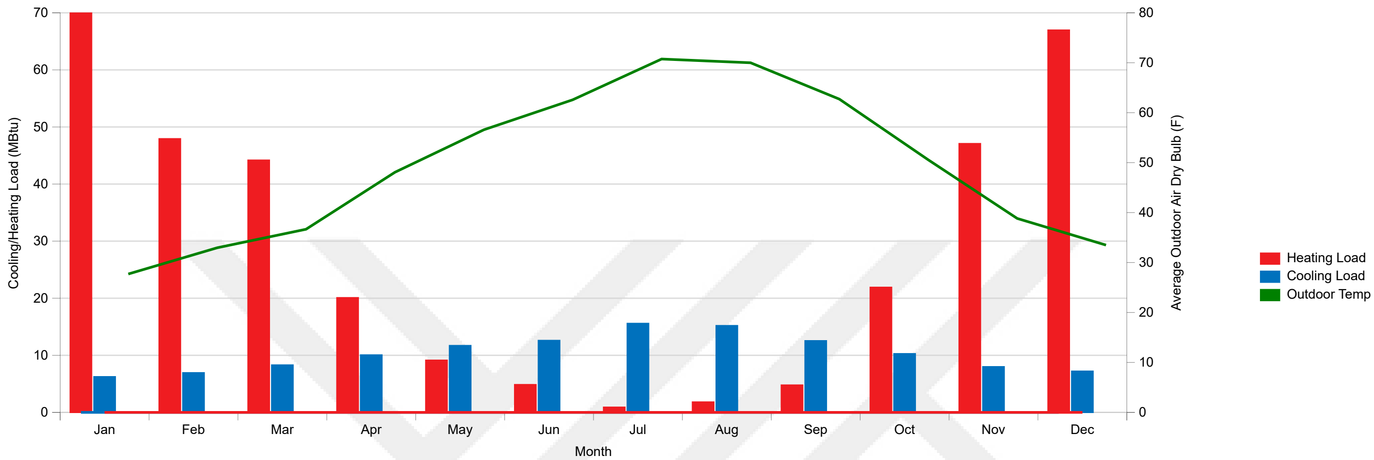
No Data to Show for Exterior Lighting

Water Use Equipment

No Data to Show for Water Use Equipment

HVAC Load Profiles

Monthly Load Profiles - view table



Zone Conditions

Temperature (Table values represent hours spent in each temperature range)

Zone	Unmet Htg (hr)	Unmet Htg - Occ (hr)	< 56 (F)	56-61 (F)	61-66 (F)	66-68 (F)	68-70 (F)	70-72 (F)	72-74 (F)	74-76 (F)	76-78 (F)	78-83 (F)	83-88 (F)	>= 88 (F)	Unmet Clg (hr)	Unmet Clg - Occ (hr)	Mean Temp (F)
THERMAL ZONE 1	1229	511	129	1739	856	1094	1065	1882	475	1416	84	20	0	0	0	0	67.4 (F)
THERMAL ZONE 2	1763	882	181	1837	938	1122	1540	1564	476	916	177	9	0	0	0	0	66.8 (F)

Humidity (Table values represent hours spent in each Humidity range)

Zone	< 30 (%)	30-35 (%)	35-40 (%)	40-45 (%)	45-50 (%)	50-55 (%)	55-60 (%)	60-65 (%)	65-70 (%)	70-75 (%)	75-80 (%)	>= 80 (%)	Mean Relative Humidity (%)
THERMAL ZONE 1	3136	1057	1101	1252	1169	622	286	105	26	4	2	0	35.7 (%)
THERMAL ZONE 2	3091	1062	1073	1255	1151	649	316	124	32	7	0	0	35.9 (%)

Zone Overview

Zone Summary

	Area (ft^2)	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume (ft^3)	Multiplier	Above Ground Gross Wall Area (ft^2)	Underground Gross Wall Area (ft^2)	Window Glass Area (ft^2)	Lighting (W/ft^2)	People (ft^2/person)	Plug and Process (W/ft^2)
THERMAL ZONE 1	6871.68	Yes	Yes	90179.54	1.00	7543.35	0.0	6034.68	0.99	210.54	0.64
THERMAL ZONE 2	2659.22	Yes	Yes	34897.95	1.00	3909.45	0.0	1327.84	0.45	999.97	0.16
Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Conditioned Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Unconditioned Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Not Part of Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0

Zone Sensible Cooling and Heating Sensible Sizing

	Heating/Cooling	Calculated Design Load	Design Load With Sizing Factor	Calculated Design Air Flow (ft^3/min)	Design Air Flow With Sizing Factor (ft^3/min)	Date/Time Of Peak	Outdoor Temperature at Peak Load (F)	Outdoor Humidity Ratio at Peak Load (lbWater/lbAir)
THERMAL ZONE 1	Cooling	16.93 (ton)	19.47 (ton)	11499.16	13223.93	8/21 15:10:00	91.13	0.01
THERMAL ZONE 1	Heating	137.07 (kBtu/h)	171.34 (kBtu/h)	4087.32	5108.62	1/21 24:00:00	3.74	0.0
THERMAL ZONE 2	Cooling	3.45 (ton)	3.97 (ton)	2343.48	2695.22	8/21 15:20:00	90.84	0.01
THERMAL ZONE 2	Heating	54.4 (kBtu/h)	68.01 (kBtu/h)	1620.94	2027.77	1/21 24:00:00	3.74	0.0

Zone Equipment Detail

No Data to Show for Zone Equipment Detail

Air Loops Detail

VAV with Reheat

Object	Description	Value	Sizing	Count
(supply)				
AirLoopHVAC:OutdoorAirSystem	Minimum Outdoor Air Flow Rate	0 cfm	Hard Sized	
	Maximum Outdoor Air Flow Rate	15,921 cfm	Autosized	
Coil:Cooling:Water	Air Flow Rate	15,921 cfm	Autosized	
	Water Flow Rate	96.83 gal/min	Autosized	
	Plant Loop	Chilled Water Loop		
Coil:Heating:Water	Heating Capacity	236,755.7 Btu/hr	Autosized	
	Water Flow Rate	24.30 gal/min	Autosized	
	Plant Loop	Hot Water Loop		
Fan:VariableVolume	Air Flow Rate	15,921 cfm	Autosized	

	Fan Efficiency	60.5 %		
	Pressure Rise	2.01 in w.g.		
	Motor Efficiency	93.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	55.0 to 64.4 F		
(demand)				
Thermal Zones	Total Floor Area	9,531 ft^2		2
Thermal Zones	Cooling Setpoint Range	75.2 to 80.1 F		
Thermal Zones	Heating Setpoint Range	60.1 to 69.8 F		
Terminal Types Used	AirTerminal:SingleDuct:VAV:Reheat			2
(controls)				
HVAC Operation Schedule		Always On Discrete		
Night Cycle Setting		StayOff		
Economizer Setting		NoEconomizer		
Demand Controlled Ventilation Status		Off		
Central Heating Design Supply Air Temperature		55.0 F		
Central Cooling Design Supply Air Temperature		55.0 F		
Load to Size On		Sensible		

Plant Loops Detail

Chilled Water Loop

Object	**Description**	**Value**	**Sizing**	**Count**
(supply)				
Pump:VariableSpeed	Water Flow Rate	96.83 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Chiller:Electric:EIR	Cooling Capacity	48.6 ton	Autosized	
	Water Flow Rate	96.83 gal/min	Autosized	
	Reference COP	5.5		
	Fraction of Compressor Electric Consumption Rejected by Condenser	1.0		
SetpointManager:Scheduled	Control Variable - Temperature	44.1 to 64.4 F		
(demand)				
Coil:Cooling:Water	Air Loop	VAV with Reheat		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	96.83 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		45.0 F		
Loop Design Temperature Difference		12.0 R		
Equipment Loading/Staging		Optimal		

Condenser Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	136.89 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
CoolingTower:SingleSpeed	Air Flow Rate	13,260 cfm	Autosized	
	Water Flow Rate	136.89 gal/min	Autosized	
SetpointManager:FollowOutdoorAirTemperature	Reference Temperature Type	OutdoorAirWetBulb		
(demand)				
Chiller:Electric:EIR	Plant Loop	Chilled Water Loop		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	136.89 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		84.9 F		
Loop Design Temperature Difference		10.1 R		
Equipment Loading/Staging		Optimal		

Hot Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	59.44 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Boiler:HotWater	Heating Capacity	579,172.2 Btu/hr	Autosized	
	Water Flow Rate	59.44 gal/min	Autosized	
	Nominal Thermal Efficiency	80.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	77.0 to 152.6 F		
(demand)				
Coil:Heating:Water	Air Loop	VAV with Reheat		
Air Terminal Connections				2
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	59.44 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		179.6 F		
Loop Design Temperature Difference		19.8 R		
Equipment Loading/Staging		Optimal		

Outdoor Air

Average and Minimum Outdoor Air During Occupied Hours

	Average Number of Occupants	Nominal Number of Occupants	Zone Volume (ft^3)	Avg. Mechanical Ventilation (ach)	Min. Mechanical Ventilation (ach)	Avg. Infiltration (ach)	Min. Infiltration (ach)	Avg. Simple Ventilation (ach)	Min. Simple Ventilation (ach)
THERMAL ZONE 1	1.09	32.64	90180	0.441	0.415	0.092	0.001	0.0	0.0
THERMAL ZONE 2	0.13	2.66	34898	0.225	0.108	0.142	0.002	0.0	0.0

Cash Flow

No Data to Show for Cash Flow

Site and Source Summary

Site and Source Energy

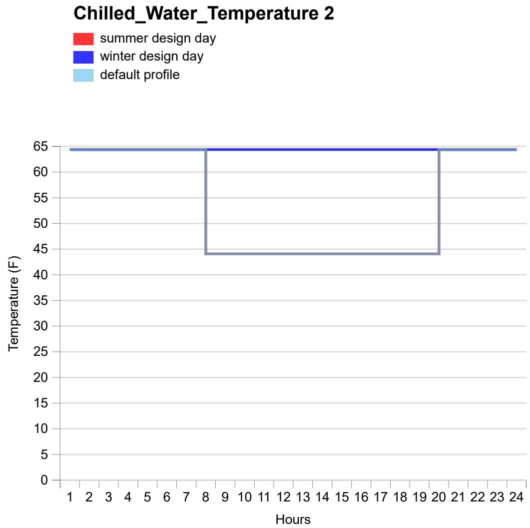
	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)	Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy	746737.7	78.3	78.3
Net Site Energy	746737.7	78.3	78.3
Total Source Energy	1657589.9	173.9	173.9
Net Source Energy	1657589.9	173.9	173.9

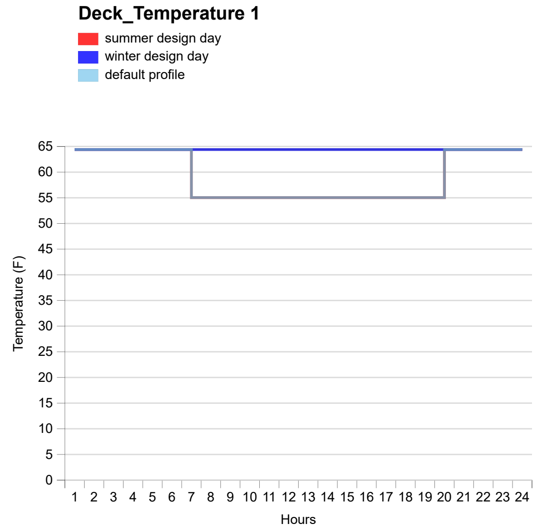
Site to Source Energy Conversion Factors

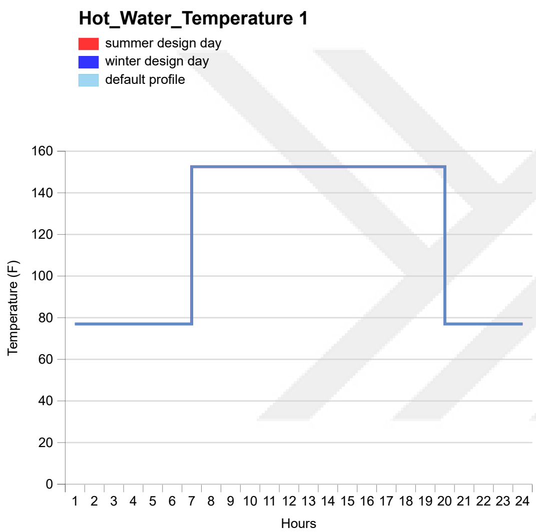
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613

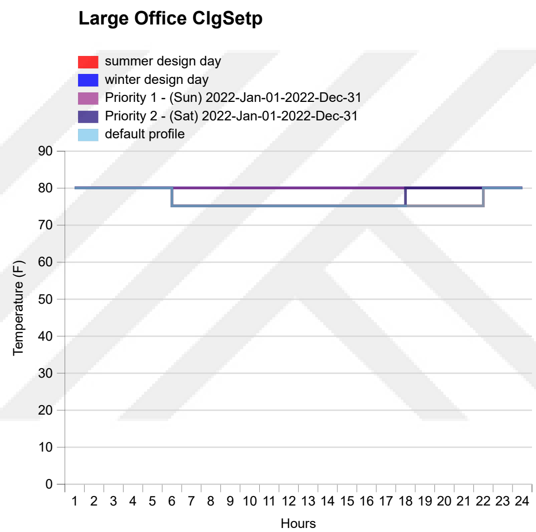
Schedule Overview

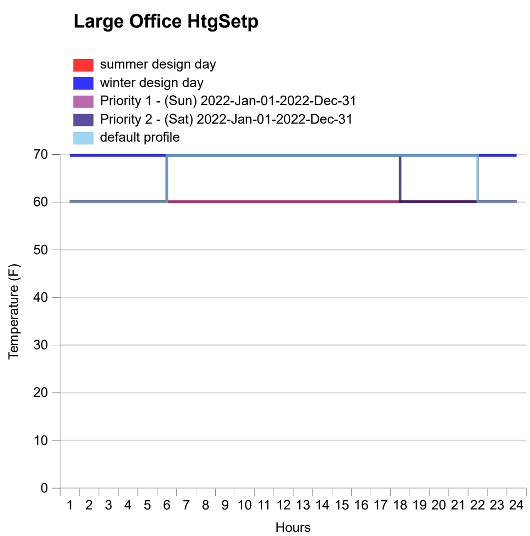
Schedule Overview - view table

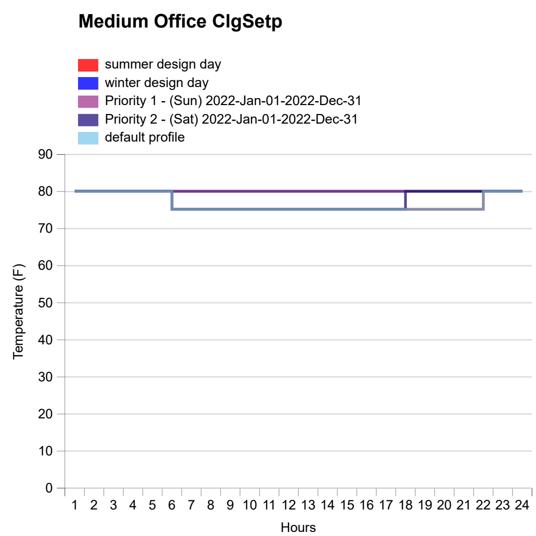

Chilled_Water_Temperature 2
summer design day
winter design day
default profile
Temperature (F)
Hours

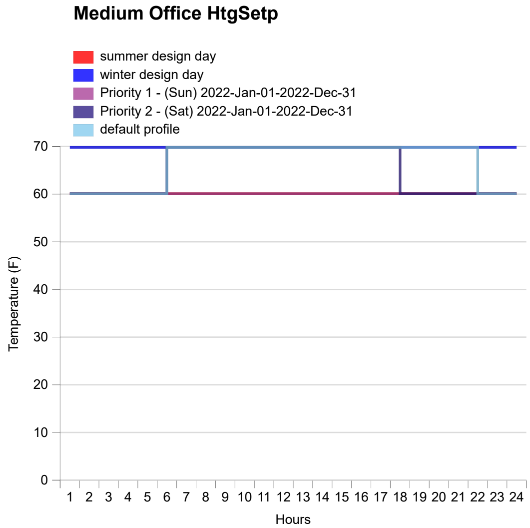

Deck_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours

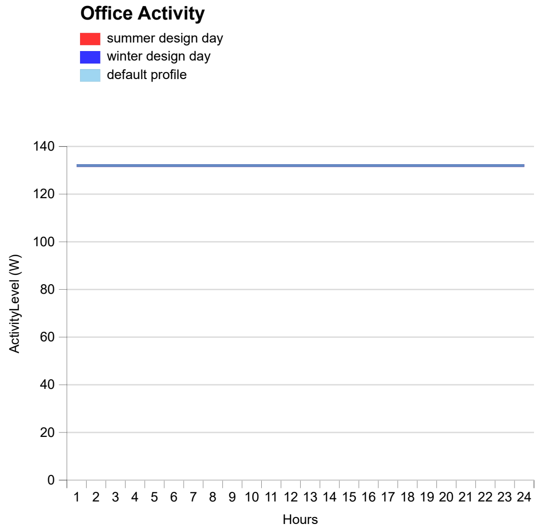

Hot_Water_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours

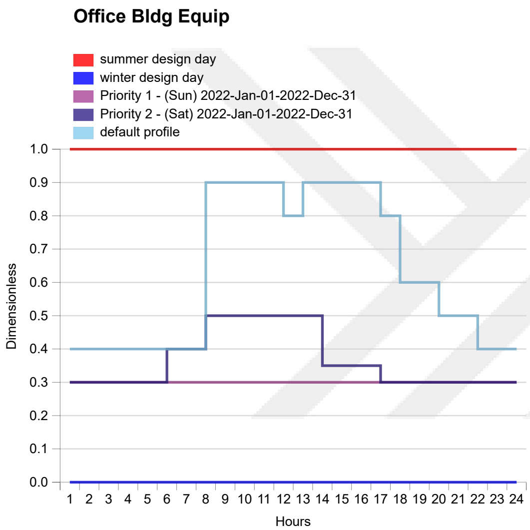

Large Office ClgSetp
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Temperature (F)
Hours

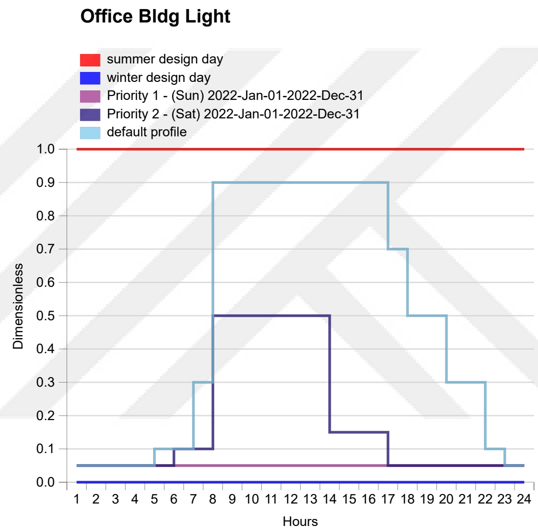

Large Office HtgSetp
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Temperature (F)
Hours

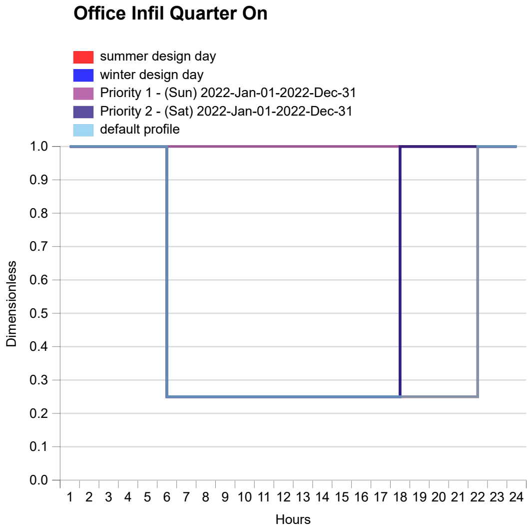

Medium Office ClgSetp
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Temperature (F)
Hours

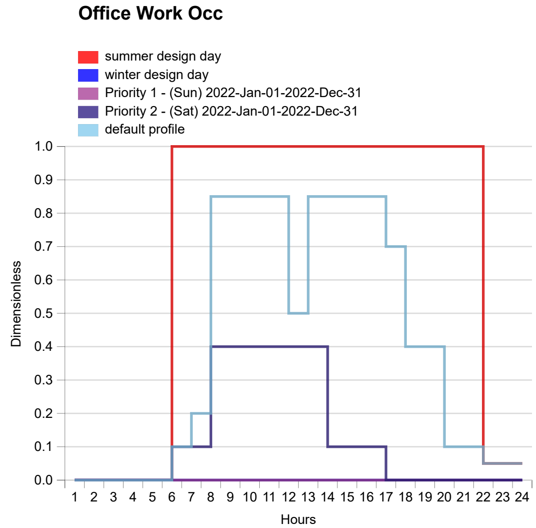

Medium Office HtgSetp
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Temperature (F)
Hours

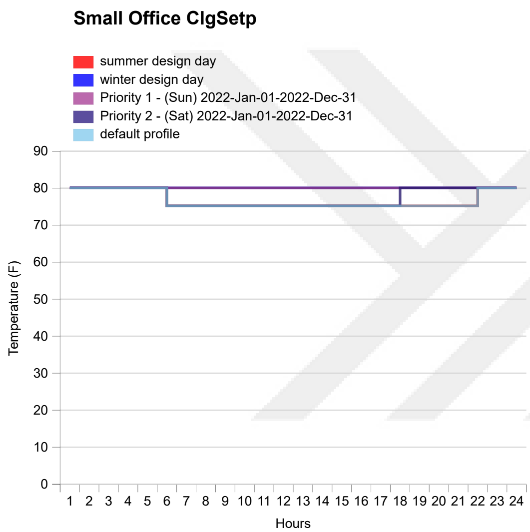

Office Activity
summer design day
winter design day
default profile
ActivityLevel (W)
Hours

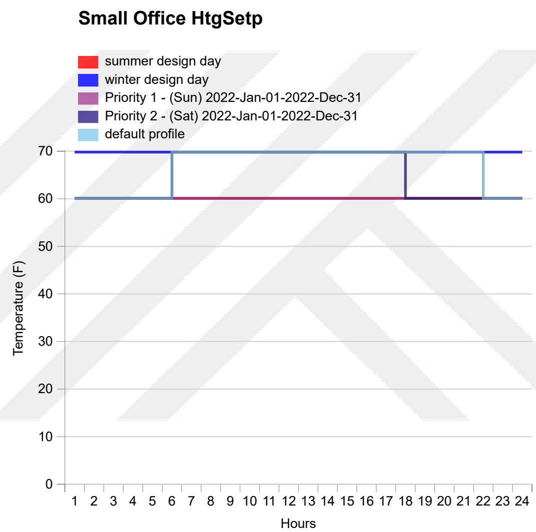

Office Bldg Equip
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Dimensionless
Hours


Office Bldg Light
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Dimensionless
Hours









Measure Warnings

Measure Warning Summary

Description	Count
Number of measures in workflow	2
Number of measures with warnings	0
Total number of warnings	0

3.Scenario #2 OpenStudio Results

OpenStudio Results

Model Summary

Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	732,938 kBtu
Total Building Area	9,531 ft^2
Total Site EUI	76.90 kBtu/ft^2
OpenStudio Standards Building Type	n/a

Weather Summary

	Value
Weather File	ANKARA - TUR IWEC Data WMO#=171280
Latitude	40.12
Longitude	32.98
Elevation	3114 ft
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Sizing Period Design Days

	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
ANKARA ANN CLG .4% CONDNS DB=>MWB	91.4	27.72	63.68	Wetbulb [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS DP=>MDB	74.48	27.72	59.36	Dewpoint [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS ENTH=>MDB	84.38	27.72	25.37	Enthalpy [Btu/lb]	8.95	230.0
ANKARA ANN CLG .4% CONDNS WB=>MDB	84.92	27.72	66.56	Wetbulb [F]	8.95	230.0
ANKARA ANN HTG 99.6% CONDNS DB	3.74	0.0	3.74	Wetbulb [F]	1.12	100.0
ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB	38.12	0.0	38.12	Wetbulb [F]	22.59	100.0
ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB	5.36	0.0	-0.94	Dewpoint [F]	1.12	100.0

Unmet Hours Summary

Time Setpoint Not Met	Time (hr)
During Heating	1329.17
During Cooling	0.0

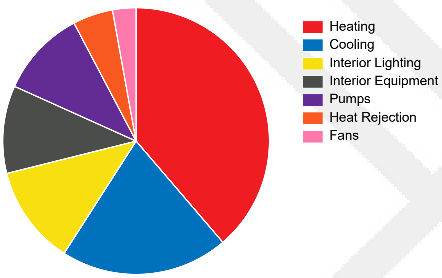
During Occupied Heating	632.5
During Occupied Cooling	0.0

Unmet Hours Tolerance

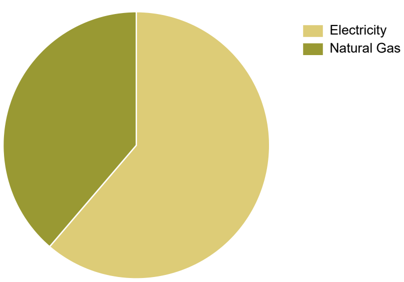
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Overview

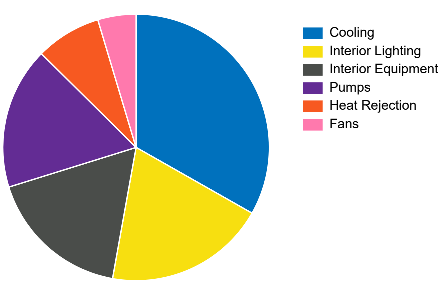
End Use - view table



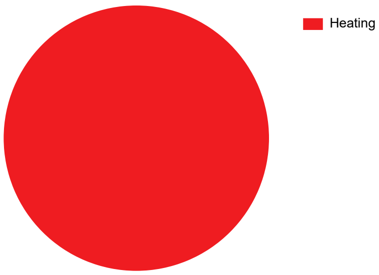
Energy Use - view table



EUI - Electricity - view table

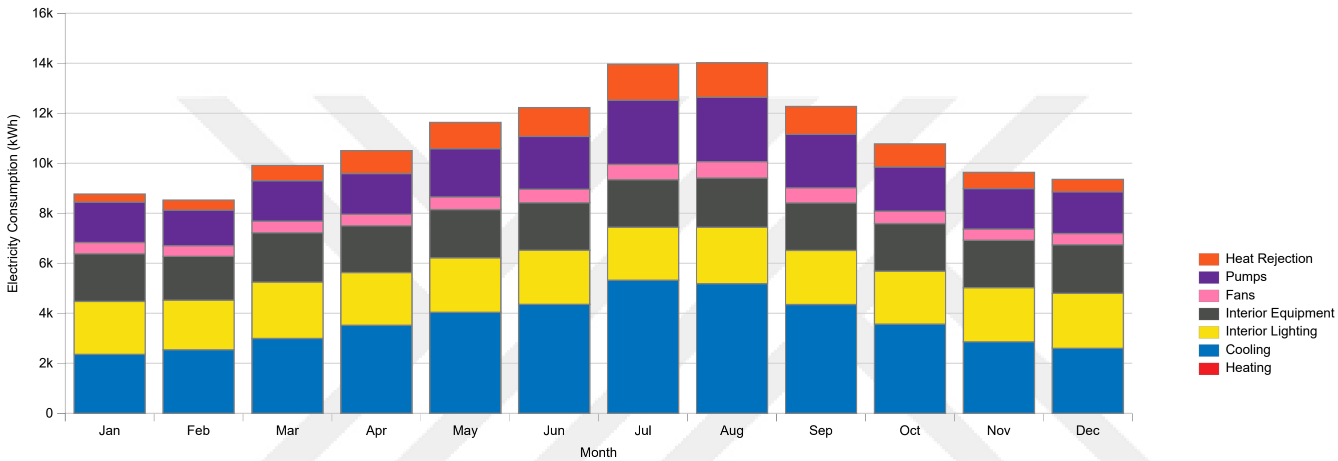


EUI - Gas - view table

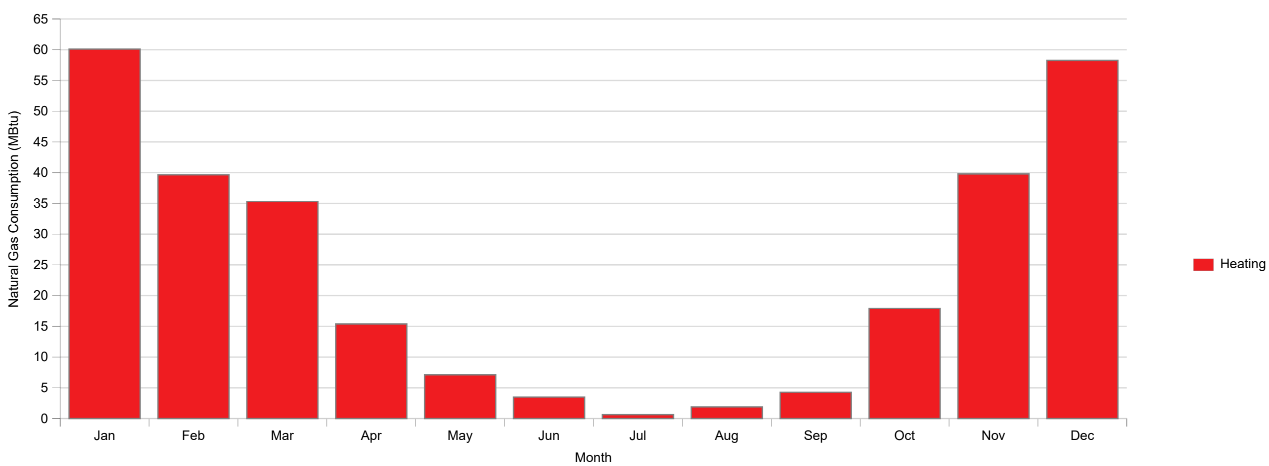


Monthly Overview

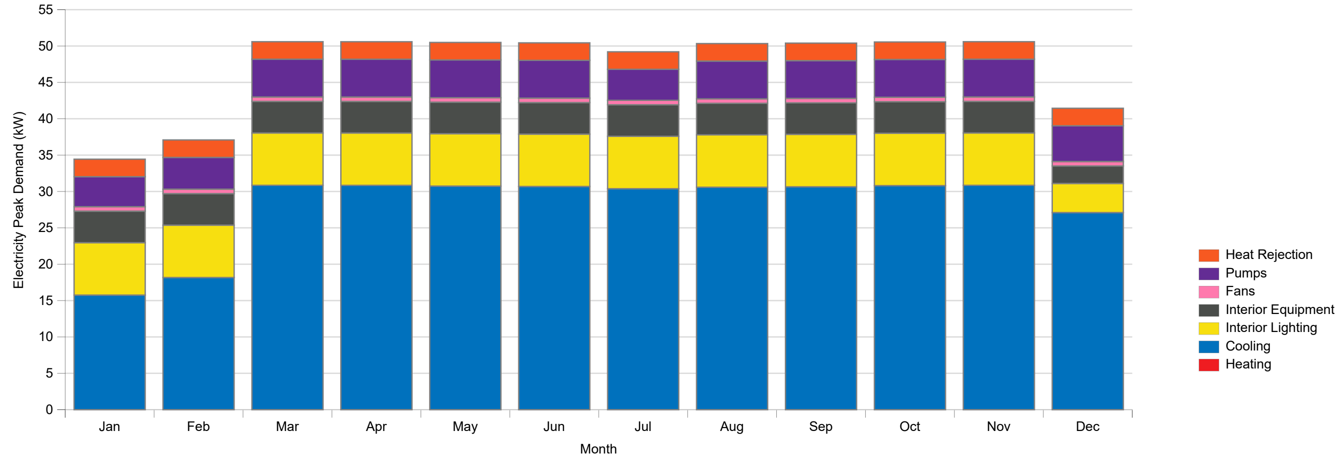
Electricity Consumption (kWh) - view table



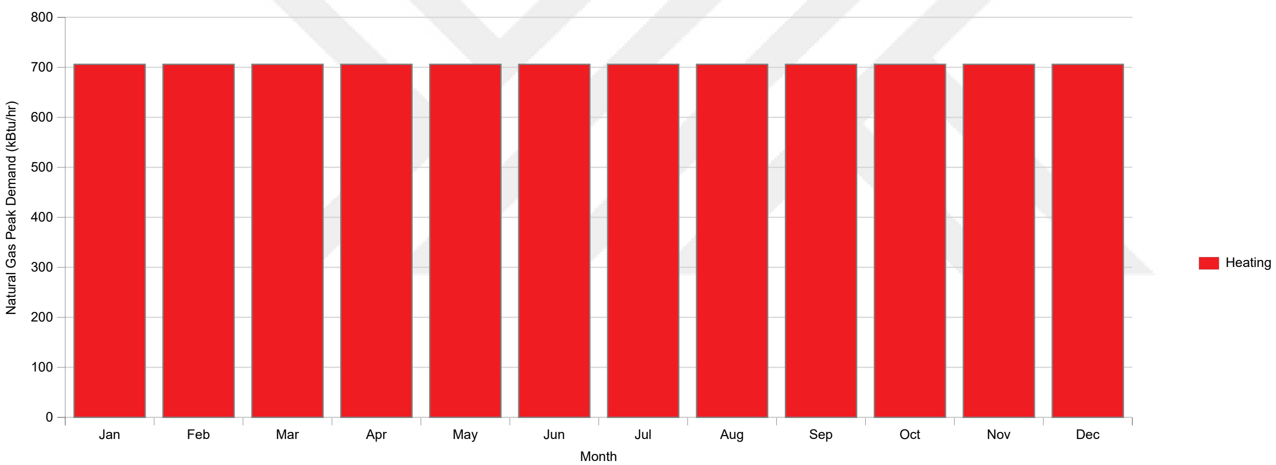
Natural Gas Consumption (MBtu) - view table



Electricity Peak Demand (kW) - view table



Natural Gas Peak Demand (kBtu/hr) - view table



Utility Bills/Rates

No Data to Show for Utility Bills/Rates

Envelope Summary

Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8	3,321	8	34.42
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8	4,090	51	15.84

Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT

ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8	7,363	37	0.25	0.40	0.31

Sub Surface Construction Details (Material Layers)

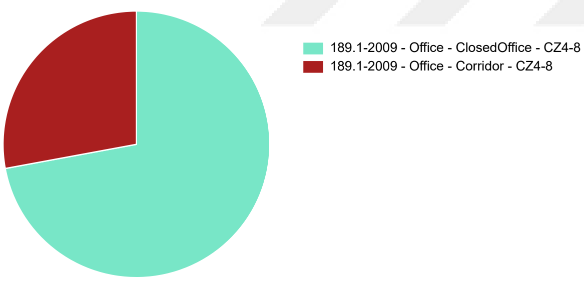
Material Name
(Material Layers in Construction 'ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8':)
ANKARA CAM

Window-to-Wall and Skylight-to-Roof area Ratios

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	64.29	40.0	57.67	80.0	80.0
Gross Window-Wall Ratio (Conditioned)	64.29	40.0	57.67	80.0	80.0
Skylight-Roof Ratio	0.0				

Space Type Breakdown

Space Type Breakdown - view table



Space Type Summary

189.1-2009 - Office - ClosedOffice - CZ4-8 (16 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
189.1-2009 - Office - ClosedOffice - CZ4-8 People Definition	0.0048	people/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.6400	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	0.9900	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - ClosedOffice - CZ4-8 Ventilation (outdoor air method Sum)	20.0000	cfm/person	

189.1-2009 - Office - Corridor - CZ4-8 (11 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier

189.1-2009 - Office - Corridor - CZ4-8 People Definition	0.0010	people/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.1600	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	0.4500	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - Corridor - CZ4-8 Ventilation (outdoor air method Sum)	0.0500	cfm/ floor area ft^2	

Interior Lighting Summary

Zone Lighting

Lights	Zone	Lighting Power Density (W/ft^2)	Total Power (W)	Schedule Name	Scheduled Hours/Week (hr)	Actual Load Hours/Week (hr)	Return Air Fraction	Annual Consumption (kWh)
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 1		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 10		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 11		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 12		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 13		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 14		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 15		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 16		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 2		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 3		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 4		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 5		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 6		0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 7		0.08	551.99	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1783.33
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 8		0.04	283.46	OFFICE BLDG LIGHT	61.91	61.91	0.0000	913.89

189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 9	0.06	432.64	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1397.22
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 1	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 10	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 11	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 2	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 3	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 4	0.0	13.08	OFFICE BLDG LIGHT	61.91	61.91	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 5	0.13	354.2	OFFICE BLDG LIGHT	61.91	61.91	0.0000	1144.44
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 6	0.09	245.22	OFFICE BLDG LIGHT	61.91	61.91	0.0000	791.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 7	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 8	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 9	0.04	108.98	OFFICE BLDG LIGHT	61.91	61.91	0.0000	352.78

Space Lighting Details

Load Name	Definition Name	Load Type	Load (units)	Multiplier	Total Load (W)
(Space Name: 'Space 101', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 102', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 203', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 305', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 103', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 201', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 401', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 105', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 402', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 104', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 202', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 204', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 205', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 301', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 302', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 304', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 303', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 403', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 404', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 405', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 406', Area: 787 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	354
(Space Name: 'Space 407', Area: 545 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	245
(Space Name: 'Space 409', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 412', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 410', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 411', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 501', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109

Lighting Controls Details

Space Name	**Control Name**	**Zone Controlled (type, fraction)**	**Illuminance Setpoint (fc)**

Plug Loads Summary

Electric Plug Load Consumption

	Electricity Annual Value (kWh)
InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20838.89
General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20838.89
InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

Space-level Electric Plug Loads

Equipment Name	Definition	Load (units)	Inheritance Level	Multiplier	Total Load (W)
(Space Name: Space 101, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 102, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 103, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 104, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 105, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 201, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 202, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 203, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 204, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 205, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 301, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 302, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 303, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357

(Space Name: Space 304, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 305, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 401, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 402, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 403, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 404, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 405, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 406, Area: 787 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	126
(Space Name: Space 407, Area: 545 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	87
(Space Name: Space 409, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 410, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 411, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 412, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 501, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39

Exterior Lighting

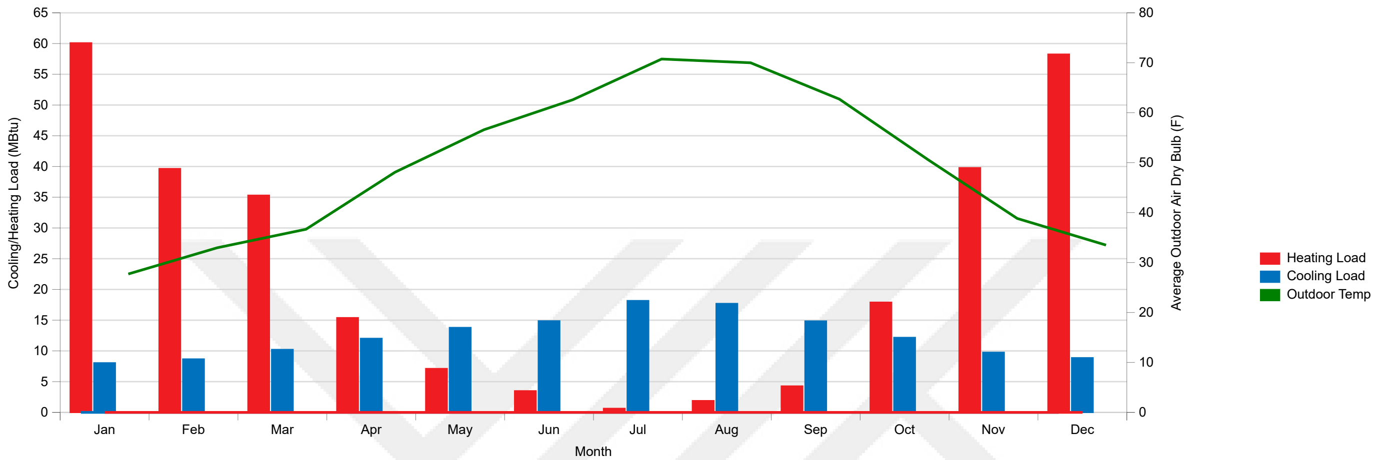
No Data to Show for Exterior Lighting

Water Use Equipment

No Data to Show for Water Use Equipment

HVAC Load Profiles

Monthly Load Profiles - view table



Zone Conditions

Temperature (Table values represent hours spent in each temperature range)

Zone	Unmet Htg (hr)	Unmet Htg - Occ (hr)	< 56 (F)	56-61 (F)	61-66 (F)	66-68 (F)	68-70 (F)	70-72 (F)	72-74 (F)	74-76 (F)	76-78 (F)	78-83 (F)	83-88 (F)	>= 88 (F)	Unmet Clg (hr)	Unmet Clg - Occ (hr)	Mean Temp (F)
THERMAL ZONE 1	854	397	22	1525	899	1238	974	1800	435	1669	148	50	0	0	0	0	68.0 (F)
THERMAL ZONE 2	1329	632	49	1714	982	1123	1424	1657	477	1020	294	20	0	0	0	0	67.3 (F)

Humidity (Table values represent hours spent in each Humidity range)

Zone	< 30 (%)	30-35 (%)	35-40 (%)	40-45 (%)	45-50 (%)	50-55 (%)	55-60 (%)	60-65 (%)	65-70 (%)	70-75 (%)	75-80 (%)	>= 80 (%)	Mean Relative Humidity (%)
THERMAL ZONE 1	3264	1076	1149	1212	1131	576	239	93	14	5	1	0	35.0 (%)
THERMAL ZONE 2	3202	1048	1112	1211	1166	607	277	109	22	6	0	0	35.4 (%)

Zone Overview

Zone Summary

	Area (ft^2)	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume (ft^3)	Multiplier	Above Ground Gross Wall Area (ft^2)	Underground Gross Wall Area (ft^2)	Window Glass Area (ft^2)	Lighting (W/ft^2)	People (ft^2/person)	Plug and Process (W/ft^2)
THERMAL ZONE 1	6871.68	Yes	Yes	90179.54	1.00	7543.35	0.0	6034.68	0.99	210.54	0.64
THERMAL ZONE 2	2659.22	Yes	Yes	34897.95	1.00	3909.45	0.0	1327.84	0.45	999.97	0.16
Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Conditioned Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Unconditioned Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Not Part of Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0

Zone Sensible Cooling and Heating Sensible Sizing

	Heating/Cooling	Calculated Design Load	Design Load With Sizing Factor	Calculated Design Air Flow (ft^3/min)	Design Air Flow With Sizing Factor (ft^3/min)	Date/Time Of Peak	Outdoor Temperature at Peak Load (F)	Outdoor Humidity Ratio at Peak Load (lbWater/lbAir)
THERMAL ZONE 1	Cooling	19.25 (ton)	22.13 (ton)	13075.61	15035.57	8/21 15:10:00	91.13	0.01
THERMAL ZONE 1	Heating	114.96 (kBtu/h)	143.71 (kBtu/h)	3428.35	4284.38	1/21 24:00:00	3.74	0.0
THERMAL ZONE 2	Cooling	3.83 (ton)	4.4 (ton)	2599.87	2989.74	8/21 15:10:00	91.13	0.01
THERMAL ZONE 2	Heating	49.15 (kBtu/h)	61.44 (kBtu/h)	1466.26	1830.71	1/21 24:00:00	3.74	0.0

Zone Equipment Detail

No Data to Show for Zone Equipment Detail

Air Loops Detail

VAV with Reheat

Object	Description	Value	Sizing	Count
(supply)				
AirLoopHVAC:OutdoorAirSystem	Minimum Outdoor Air Flow Rate	0 cfm	Hard Sized	
	Maximum Outdoor Air Flow Rate	18,026 cfm	Autosized	
Coil:Cooling:Water	Air Flow Rate	18,026 cfm	Autosized	
	Water Flow Rate	109.77 gal/min	Autosized	
	Plant Loop	Chilled Water Loop		
Coil:Heating:Water	Heating Capacity	268,056.7 Btu/hr	Autosized	
	Water Flow Rate	27.51 gal/min	Autosized	
	Plant Loop	Hot Water Loop		
Fan:VariableVolume	Air Flow Rate	18,026 cfm	Autosized	

	Fan Efficiency	60.5 %		
	Pressure Rise	2.01 in w.g.		
	Motor Efficiency	93.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	55.0 to 64.4 F		
(demand)				
Thermal Zones	Total Floor Area	9,531 ft^2		2
Thermal Zones	Cooling Setpoint Range	75.2 to 80.1 F		
Thermal Zones	Heating Setpoint Range	60.1 to 69.8 F		
Terminal Types Used	AirTerminal:SingleDuct:VAV:Reheat			2
(controls)				
HVAC Operation Schedule		Always On Discrete		
Night Cycle Setting		StayOff		
Economizer Setting		NoEconomizer		
Demand Controlled Ventilation Status		Off		
Central Heating Design Supply Air Temperature		55.0 F		
Central Cooling Design Supply Air Temperature		55.0 F		
Load to Size On		Sensible		

Plant Loops Detail

Chilled Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	109.77 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Chiller:Electric:EIR	Cooling Capacity	55.1 ton	Autosized	
	Water Flow Rate	109.77 gal/min	Autosized	
	Reference COP	5.5		
	Fraction of Compressor Electric Consumption Rejected by Condenser	1.0		
SetpointManager:Scheduled	Control Variable - Temperature	44.1 to 64.4 F		
(demand)				
Coil:Cooling:Water	Air Loop	VAV with Reheat		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	109.77 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		45.0 F		
Loop Design Temperature Difference		12.0 R		
Equipment Loading/Staging		Optimal		

Condenser Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	155.18 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
CoolingTower:SingleSpeed	Air Flow Rate	15,032 cfm	Autosized	
	Water Flow Rate	155.18 gal/min	Autosized	
SetpointManager:FollowOutdoorAirTemperature	Reference Temperature Type	OutdoorAirWetBulb		
(demand)				
Chiller:Electric:EIR	Plant Loop	Chilled Water Loop		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	155.18 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		84.9 F		
Loop Design Temperature Difference		10.1 R		
Equipment Loading/Staging		Optimal		

Hot Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	57.97 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Boiler:HotWater	Heating Capacity	564,791.2 Btu/hr	Autosized	
	Water Flow Rate	57.97 gal/min	Autosized	
	Nominal Thermal Efficiency	80.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	77.0 to 152.6 F		
(demand)				
Coil:Heating:Water	Air Loop	VAV with Reheat		
Air Terminal Connections				2
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	57.97 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		179.6 F		
Loop Design Temperature Difference		19.8 R		
Equipment Loading/Staging		Optimal		

Outdoor Air

Average and Minimum Outdoor Air During Occupied Hours

	Average Number of Occupants	Nominal Number of Occupants	Zone Volume (ft^3)	Avg. Mechanical Ventilation (ach)	Min. Mechanical Ventilation (ach)	Avg. Infiltration (ach)	Min. Infiltration (ach)	Avg. Simple Ventilation (ach)	Min. Simple Ventilation (ach)
THERMAL ZONE 1	1.08	32.64	90180	0.444	0.419	0.093	0.001	0.0	0.0
THERMAL ZONE 2	0.13	2.66	34898	0.218	0.105	0.142	0.002	0.0	0.0

Cash Flow

No Data to Show for Cash Flow

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)	Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy	732937.5	76.9	76.9
Net Site Energy	732937.5	76.9	76.9
Total Source Energy	1730003.2	181.5	181.5
Net Source Energy	1730003.2	181.5	181.5

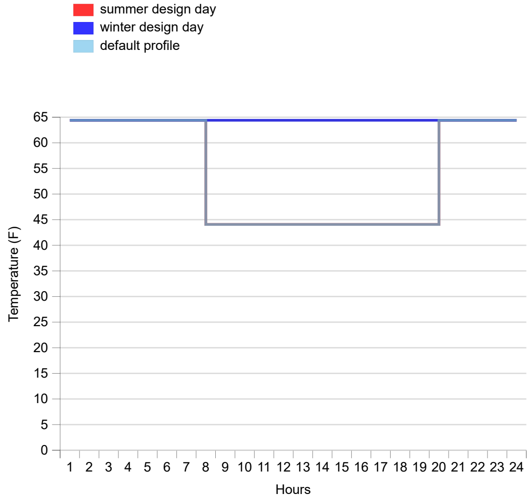
Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613

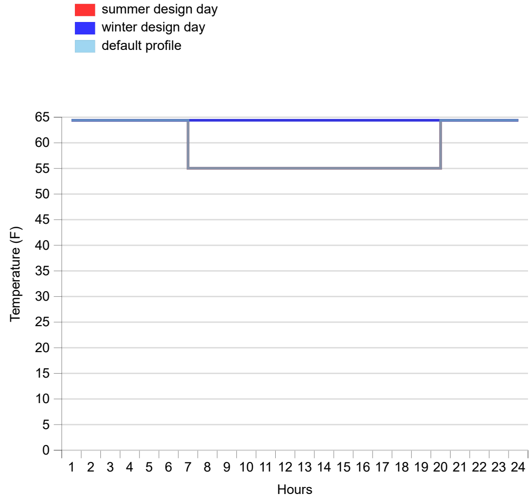
Schedule Overview

Schedule Overview - view table

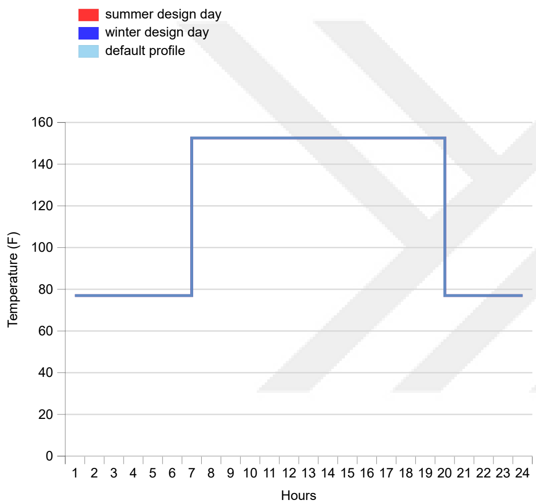
Chilled_Water_Temperature 2



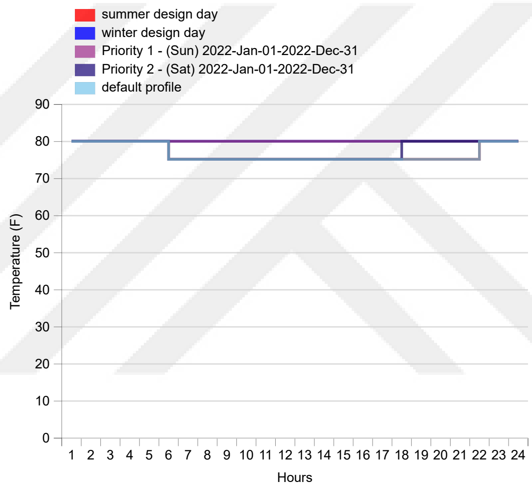
Deck_Temperature 1



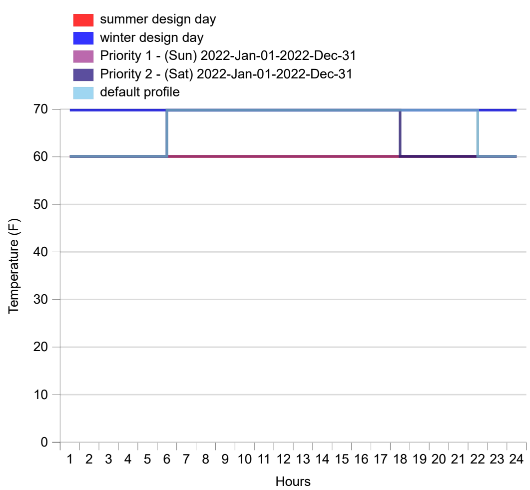
Hot_Water_Temperature 1



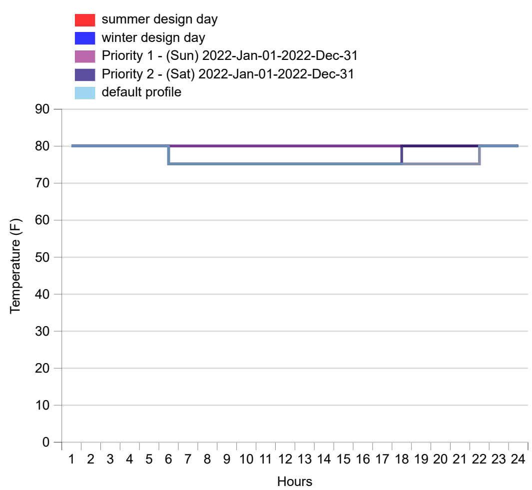
Large Office ClgSetp

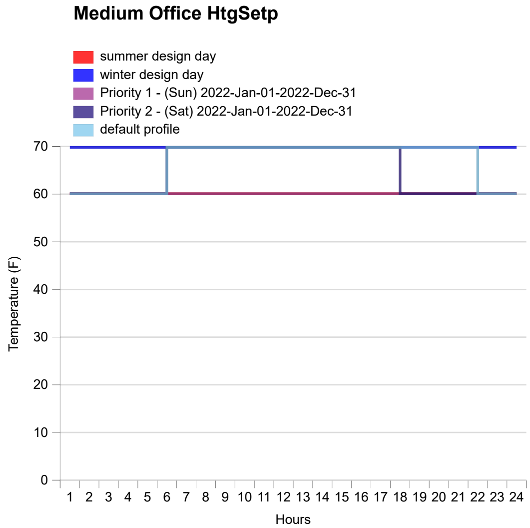


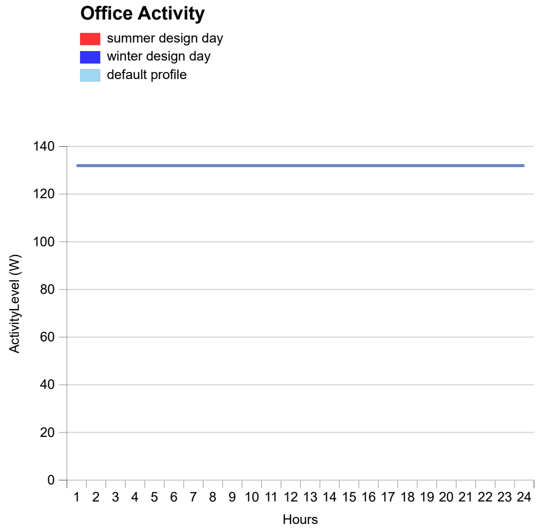
Large Office HtgSetp

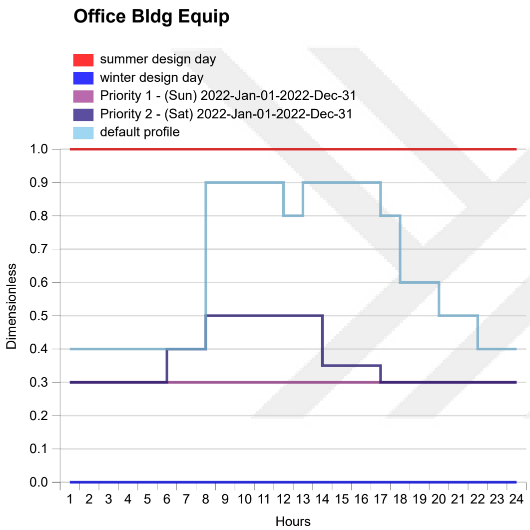


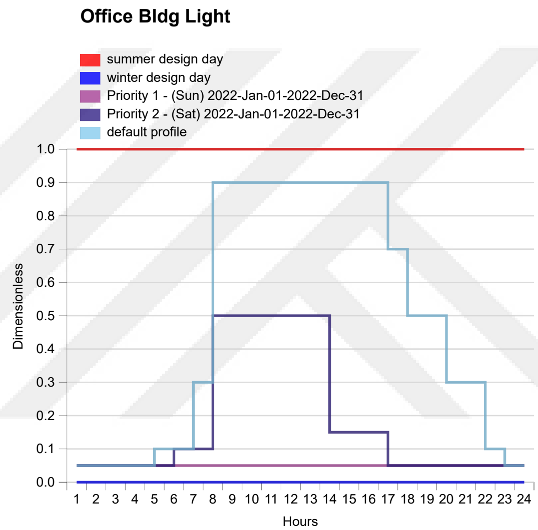
Medium Office ClgSetp



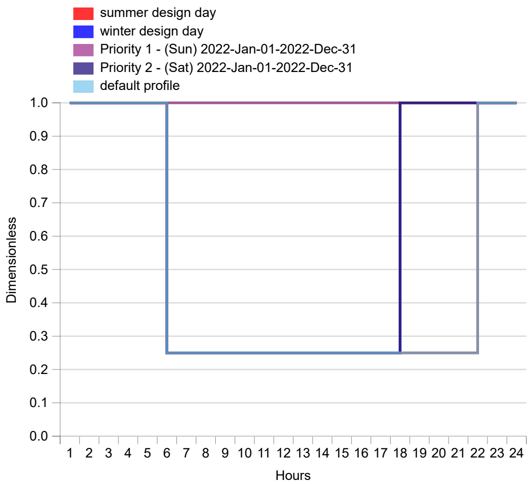

Medium Office HtgSetp
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Temperature (F)
Hours


Office Activity
summer design day
winter design day
default profile
ActivityLevel (W)
Hours

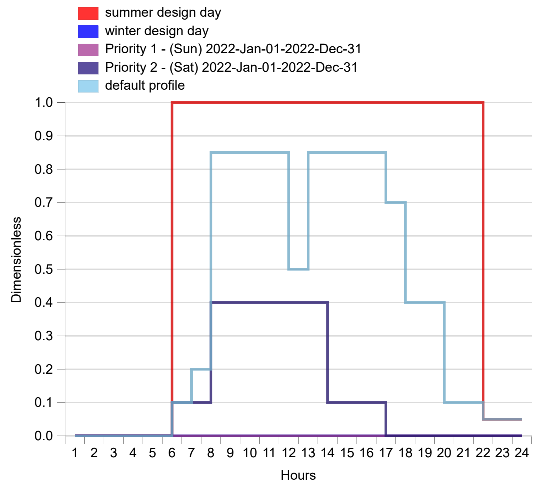

Office Bldg Equip
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Dimensionless
Hours


Office Bldg Light
summer design day
winter design day
Priority 1 - (Sun) 2022-Jan-01-2022-Dec-31
Priority 2 - (Sat) 2022-Jan-01-2022-Dec-31
default profile
Dimensionless
Hours

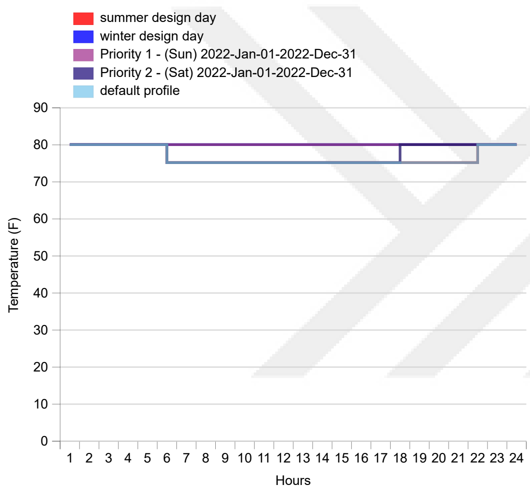
Office Infil Quarter On



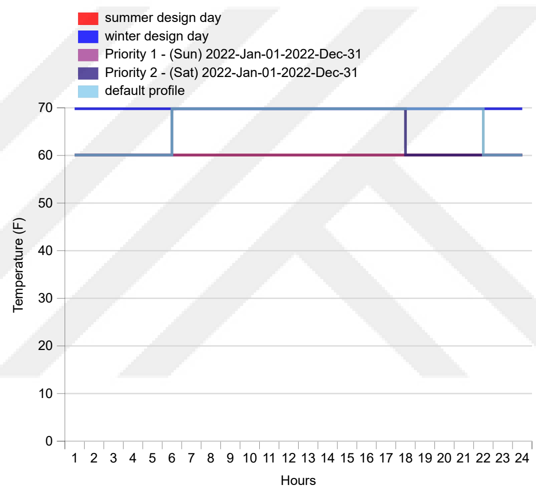
Office Work Occ



Small Office ClgSetp



Small Office HtgSetp



Measure Warnings

Measure Warning Summary

Description	Count
Number of measures in workflow	2
Number of measures with warnings	0
Total number of warnings	0

4.Scenario #3 OpenStudio Results

OpenStudio Results

Model Summary

Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	571,069 kBtu
Total Building Area	9,531 ft^2
Total Site EUI	59.92 kBtu/ft^2
OpenStudio Standards Building Type	n/a

Weather Summary

	Value
Weather File	ANKARA - TUR IWEC Data WMO#=171280
Latitude	40.12
Longitude	32.98
Elevation	3114 ft
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Sizing Period Design Days

	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
ANKARA ANN CLG .4% CONDNS DB=>MWB	91.4	27.72	63.68	Wetbulb [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS DP=>MDB	74.48	27.72	59.36	Dewpoint [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS ENTH=>MDB	84.38	27.72	25.37	Enthalpy [Btu/lb]	8.95	230.0
ANKARA ANN CLG .4% CONDNS WB=>MDB	84.92	27.72	66.56	Wetbulb [F]	8.95	230.0
ANKARA ANN HTG 99.6% CONDNS DB	3.74	0.0	3.74	Wetbulb [F]	1.12	100.0
ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB	38.12	0.0	38.12	Wetbulb [F]	22.59	100.0
ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB	5.36	0.0	-0.94	Dewpoint [F]	1.12	100.0

Unmet Hours Summary

Time Setpoint Not Met	Time (hr)
During Heating	1374.83
During Cooling	0.0

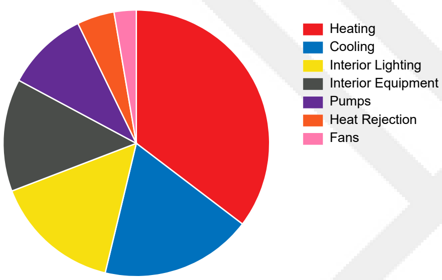
During Occupied Heating	708.0
During Occupied Cooling	0.0

Unmet Hours Tolerance

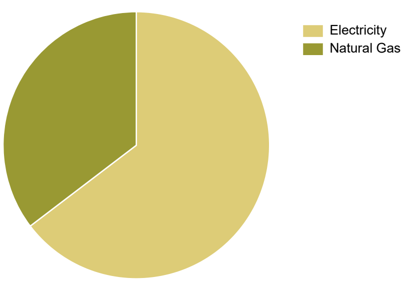
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Overview

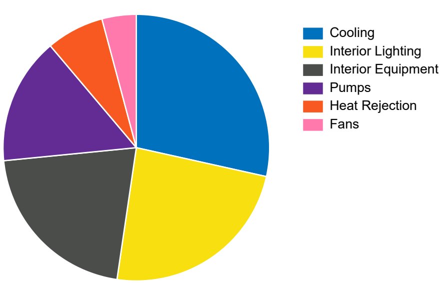
End Use - view table



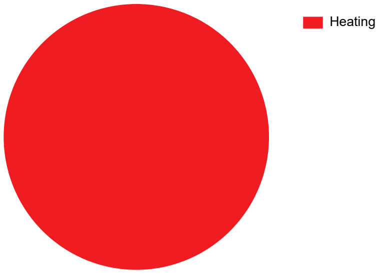
Energy Use - view table



EUI - Electricity - view table

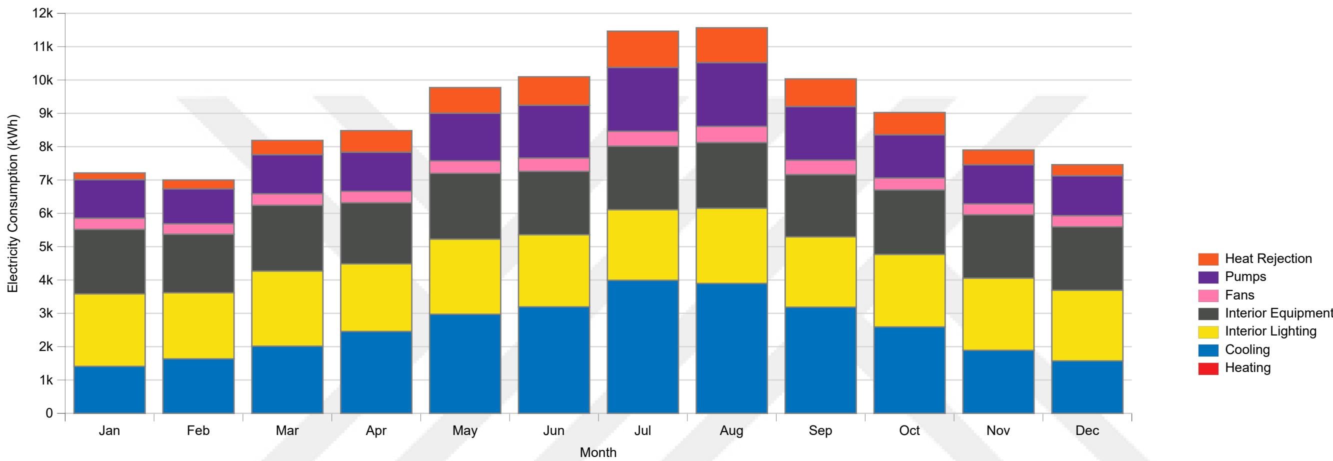


EUI - Gas - view table

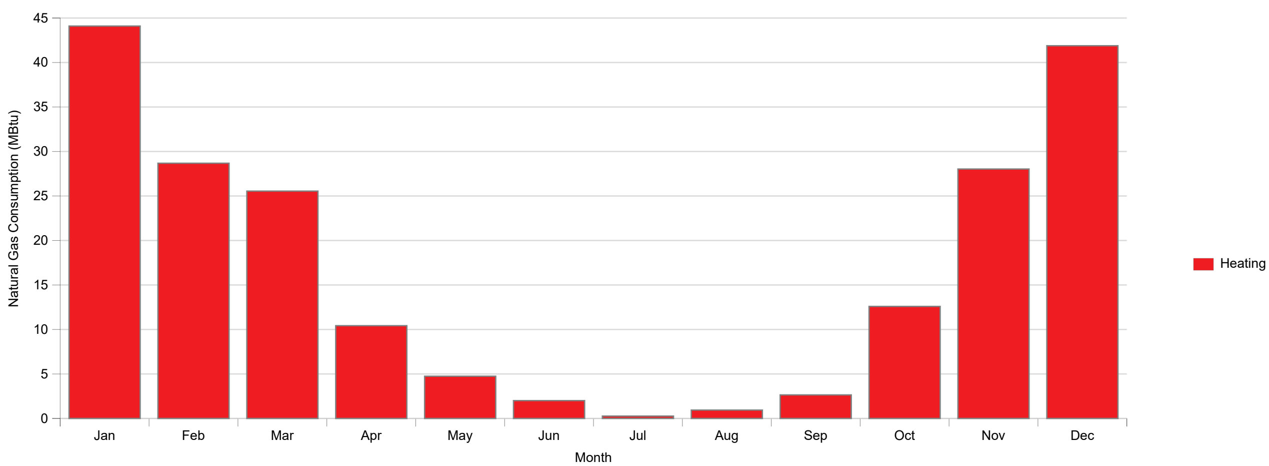


Monthly Overview

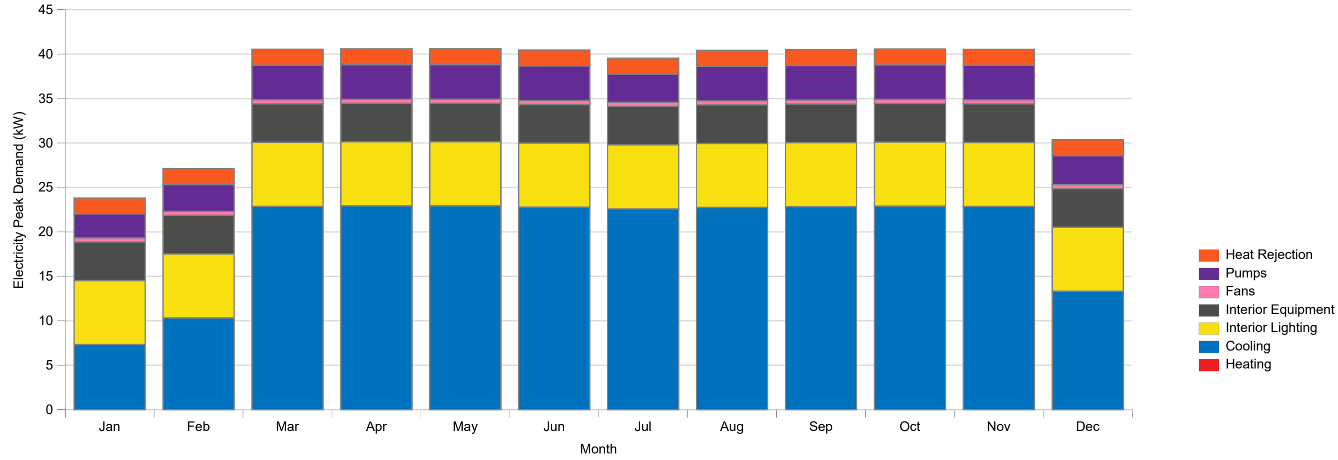
Electricity Consumption (kWh) - view table



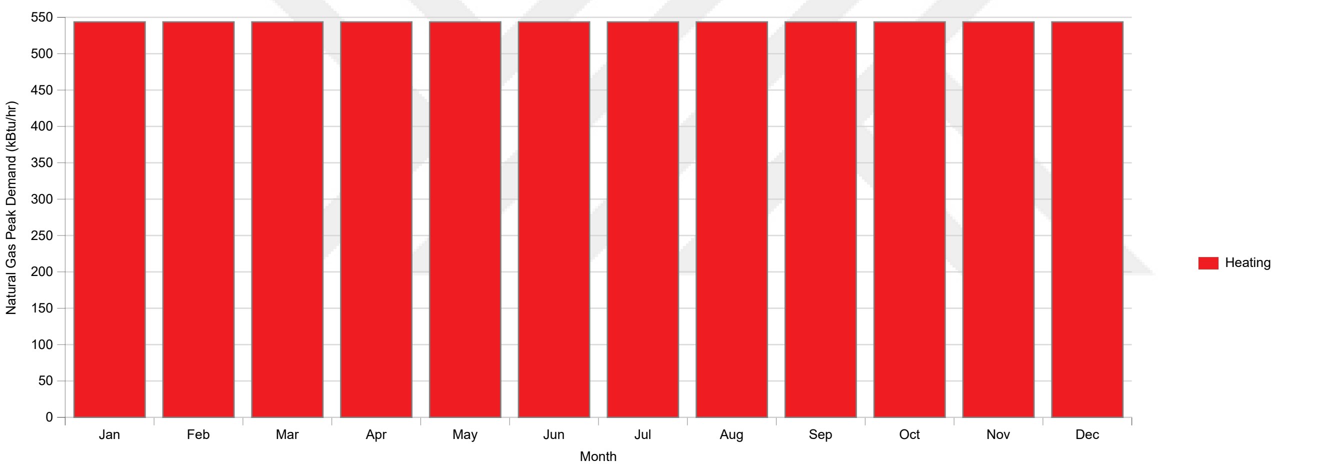
Natural Gas Consumption (MBtu) - view table



Electricity Peak Demand (kW) - view table



Natural Gas Peak Demand (kBtu/hr) - view table



Utility Bills/Rates

No Data to Show for Utility Bills/Rates

Envelope Summary

Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8	3,321	8	34.42
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8	4,090	51	15.84

Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT

ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8	7,363	37	0.14	0.30	0.31

Sub Surface Construction Details (Material Layers)

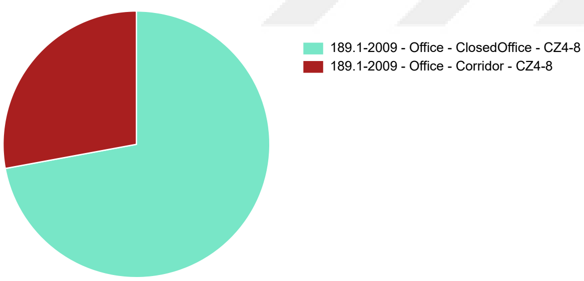
Material Name
(Material Layers in Construction 'ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8':)
ANKARA CAM 12 mm

Window-to-Wall and Skylight-to-Roof area Ratios

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	64.29	40.0	57.67	80.0	80.0
Gross Window-Wall Ratio (Conditioned)	64.29	40.0	57.67	80.0	80.0
Skylight-Roof Ratio	0.0				

Space Type Breakdown

Space Type Breakdown - view table



Space Type Summary

189.1-2009 - Office - ClosedOffice - CZ4-8
(16 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
189.1-2009 - Office - ClosedOffice - CZ4-8 People Definition	0.0048	people/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.6400	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	0.9900	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - ClosedOffice - CZ4-8 Ventilation (outdoor air method Sum)	20.0000	cfm/person	

189.1-2009 - Office - Corridor - CZ4-8
(11 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier

189.1-2009 - Office - Corridor - CZ4-8 People Definition	0.0010	people/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.1600	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	0.4500	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - Corridor - CZ4-8 Ventilation (outdoor air method Sum)	0.0500	cfm/ floor area ft^2	

Interior Lighting Summary

Zone Lighting

Lights	Zone	Lighting Power Density (W/ft^2)	Total Power (W)	Schedule Name	Scheduled Hours/Week (hr)	Actual Load Hours/Week (hr)	Return Air Fraction	Annual Consumption (kWh)
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 1		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 10		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 11		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 12		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 13		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 14		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 15		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 16		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 2		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 3		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 4		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 5		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 6		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 7		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 8		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89

189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 9	0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 1	0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 10	0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 11	0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 2	0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 3	0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 4	0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 5	0.13	354.2	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1141.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 6	0.09	245.22	OFFICE BLDG LIGHT	61.85	61.85	0.0000	791.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 7	0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 8	0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 9	0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78

Space Lighting Details

Load Name	Definition Name	Load Type	Load (units)	Multiplier	Total Load (W)
(Space Name: 'Space 101', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 102', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 203', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 305', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 103', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 201', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 401', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 105', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 402', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 104', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 202', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 204', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 205', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 301', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 302', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 304', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 303', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 403', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 404', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 405', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 406', Area: 787 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	354
(Space Name: 'Space 407', Area: 545 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	245
(Space Name: 'Space 409', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 412', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 410', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 411', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 501', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109

Lighting Controls Details

Space Name	Control Name	Zone Controlled (type, fraction)	Illuminance Setpoint (fc)

Plug Loads Summary

Electric Plug Load Consumption

	Electricity Annual Value (kWh)
InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20830.55
General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20830.55
InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

Space-level Electric Plug Loads

Equipment Name	Definition	Load (units)	Inheritance Level	Multiplier	Total Load (W)
(Space Name: Space 101, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 102, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 103, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 104, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 105, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 201, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 202, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 203, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 204, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 205, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 301, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 302, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 303, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357

(Space Name: Space 304, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 305, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 401, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 402, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 403, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 404, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 405, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 406, Area: 787 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	126
(Space Name: Space 407, Area: 545 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	87
(Space Name: Space 409, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 410, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 411, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 412, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 501, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39

Exterior Lighting

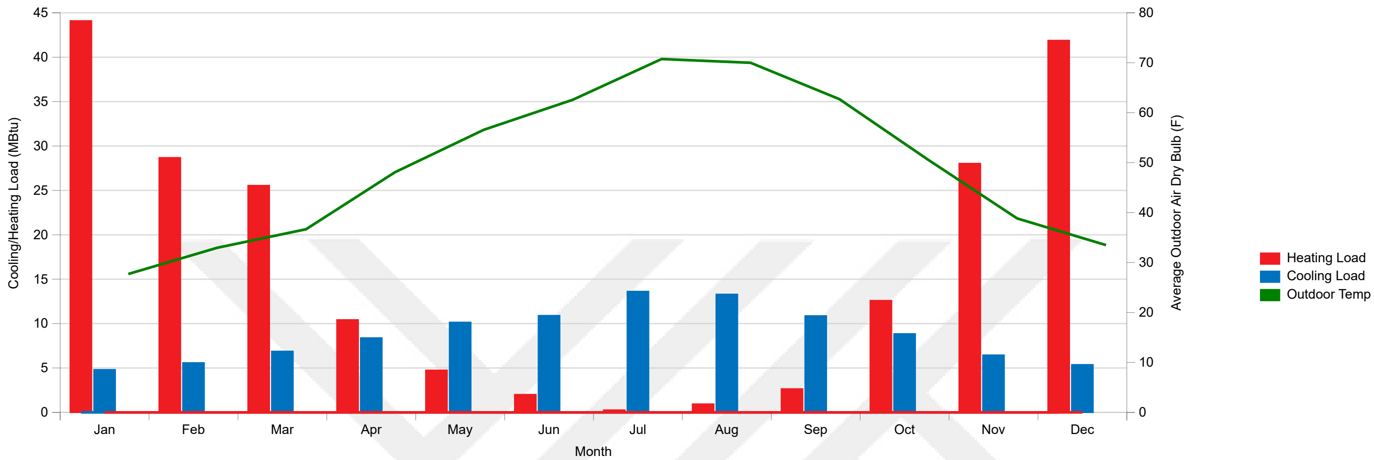
No Data to Show for Exterior Lighting

Water Use Equipment

No Data to Show for Water Use Equipment

HVAC Load Profiles

Monthly Load Profiles - view table



Zone Conditions

Temperature (Table values represent hours spent in each temperature range)

Zone	Unmet Htg (hr)	Unmet Htg - Occ (hr)	< 56 (F)	56-61 (F)	61-66 (F)	66-68 (F)	68-70 (F)	70-72 (F)	72-74 (F)	74-76 (F)	76-78 (F)	78-83 (F)	83-88 (F)	>= 88 (F)	Unmet Clg (hr)	Unmet Clg - Occ (hr)	Mean Temp (F)
THERMAL ZONE 1	728	377	8	1327	842	1243	1063	1874	546	1734	104	19	0	0	0	0	68.4 (F)
THERMAL ZONE 2	1375	708	36	1627	949	1206	1526	1622	570	1029	192	3	0	0	0	0	67.4 (F)

Humidity (Table values represent hours spent in each Humidity range)

Zone	< 30 (%)	30-35 (%)	35-40 (%)	40-45 (%)	45-50 (%)	50-55 (%)	55-60 (%)	60-65 (%)	65-70 (%)	70-75 (%)	75-80 (%)	>= 80 (%)	Mean Relative Humidity (%)
THERMAL ZONE 1	3323	1096	1197	1232	1166	478	193	64	6	5	0	0	34.5 (%)
THERMAL ZONE 2	3219	1071	1167	1213	1151	598	230	97	9	5	0	0	35.1 (%)

Zone Overview

Zone Summary

	Area (ft^2)	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume (ft^3)	Multiplier	Above Ground Gross Wall Area (ft^2)	Underground Gross Wall Area (ft^2)	Window Glass Area (ft^2)	Lighting (W/ft^2)	People (ft^2/person)	Plug and Process (W/ft^2)
THERMAL ZONE 1	6871.68	Yes	Yes	90179.54	1.00	7543.35	0.0	6034.68	0.99	210.54	0.64
THERMAL ZONE 2	2659.22	Yes	Yes	34897.95	1.00	3909.45	0.0	1327.84	0.45	999.97	0.16
Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Conditioned Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Unconditioned Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Not Part of Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0

Zone Sensible Cooling and Heating Sensible Sizing

	Heating/Cooling	Calculated Design Load	Design Load With Sizing Factor	Calculated Design Air Flow (ft^3/min)	Design Air Flow With Sizing Factor (ft^3/min)	Date/Time Of Peak	Outdoor Temperature at Peak Load (F)	Outdoor Humidity Ratio at Peak Load (lbWater/lbAir)
THERMAL ZONE 1	Cooling	14.5 (ton)	16.67 (ton)	9848.55	11325.41	8/21 15:10:00	91.13	0.01
THERMAL ZONE 1	Heating	87.96 (kBtu/h)	109.95 (kBtu/h)	2623.17	3277.91	1/21 24:00:00	3.74	0.0
THERMAL ZONE 2	Cooling	2.66 (ton)	3.06 (ton)	1809.52	2080.74	8/21 15:20:00	90.84	0.01
THERMAL ZONE 2	Heating	42.84 (kBtu/h)	53.55 (kBtu/h)	1277.68	1595.52	1/21 24:00:00	3.74	0.0

Zone Equipment Detail

No Data to Show for Zone Equipment Detail

Air Loops Detail

VAV with Reheat

Object	Description	Value	Sizing	Count
(supply)				
AirLoopHVAC:OutdoorAirSystem	Minimum Outdoor Air Flow Rate	0 cfm	Hard Sized	
	Maximum Outdoor Air Flow Rate	13,407 cfm	Autosized	
Coil:Cooling:Water	Air Flow Rate	13,407 cfm	Autosized	
	Water Flow Rate	81.55 gal/min	Autosized	
	Plant Loop	Chilled Water Loop		
Coil:Heating:Water	Heating Capacity	199,377.7 Btu/hr	Autosized	
	Water Flow Rate	20.46 gal/min	Autosized	
	Plant Loop	Hot Water Loop		
Fan:VariableVolume	Air Flow Rate	13,407 cfm	Autosized	

	Fan Efficiency	60.5 %		
	Pressure Rise	2.01 in w.g.		
	Motor Efficiency	93.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	55.0 to 64.4 F		
(demand)				
Thermal Zones	Total Floor Area	9,531 ft^2		2
Thermal Zones	Cooling Setpoint Range	75.2 to 80.1 F		
Thermal Zones	Heating Setpoint Range	60.1 to 69.8 F		
Terminal Types Used	AirTerminal:SingleDuct:VAV:Reheat			2
(controls)				
HVAC Operation Schedule		Always On Discrete		
Night Cycle Setting		StayOff		
Economizer Setting		NoEconomizer		
Demand Controlled Ventilation Status		Off		
Central Heating Design Supply Air Temperature		55.0 F		
Central Cooling Design Supply Air Temperature		55.0 F		
Load to Size On		Sensible		

Plant Loops Detail

Chilled Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	81.55 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Chiller:Electric:EIR	Cooling Capacity	41.0 ton	Autosized	
	Water Flow Rate	81.55 gal/min	Autosized	
	Reference COP	5.5		
	Fraction of Compressor Electric Consumption Rejected by Condenser	1.0		
SetpointManager:Scheduled	Control Variable - Temperature	44.1 to 64.4 F		
(demand)				
Coil:Cooling:Water	Air Loop	VAV with Reheat		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	81.55 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		45.0 F		
Loop Design Temperature Difference		12.0 R		
Equipment Loading/Staging		Optimal		

Condenser Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	115.29 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
CoolingTower:SingleSpeed	Air Flow Rate	11,168 cfm	Autosized	
	Water Flow Rate	115.29 gal/min	Autosized	
SetpointManager:FollowOutdoorAirTemperature	Reference Temperature Type	OutdoorAirWetBulb		
(demand)				
Chiller:Electric:EIR	Plant Loop	Chilled Water Loop		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	115.29 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		84.9 F		
Loop Design Temperature Difference		10.1 R		
Equipment Loading/Staging		Optimal		

Hot Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	44.64 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Boiler:HotWater	Heating Capacity	434,970.4 Btu/hr	Autosized	
	Water Flow Rate	44.64 gal/min	Autosized	
	Nominal Thermal Efficiency	80.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	77.0 to 152.6 F		
(demand)				
Coil:Heating:Water	Air Loop	VAV with Reheat		
Air Terminal Connections				2
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	44.64 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		179.6 F		
Loop Design Temperature Difference		19.8 R		
Equipment Loading/Staging		Optimal		

Outdoor Air

Average and Minimum Outdoor Air During Occupied Hours

	Average Number of Occupants	Nominal Number of Occupants	Zone Volume (ft^3)	Avg. Mechanical Ventilation (ach)	Min. Mechanical Ventilation (ach)	Avg. Infiltration (ach)	Min. Infiltration (ach)	Avg. Simple Ventilation (ach)	Min. Simple Ventilation (ach)
THERMAL ZONE 1	1.09	32.64	90180	0.45	0.425	0.093	0.001	0.0	0.0
THERMAL ZONE 2	0.13	2.66	34898	0.203	0.098	0.142	0.002	0.0	0.0

Cash Flow

No Data to Show for Cash Flow

Site and Source Summary

Site and Source Energy

	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)	Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy	571069.3	59.9	59.9
Net Site Energy	571069.3	59.9	59.9
Total Source Energy	1388106.6	145.6	145.6
Net Source Energy	1388106.6	145.6	145.6

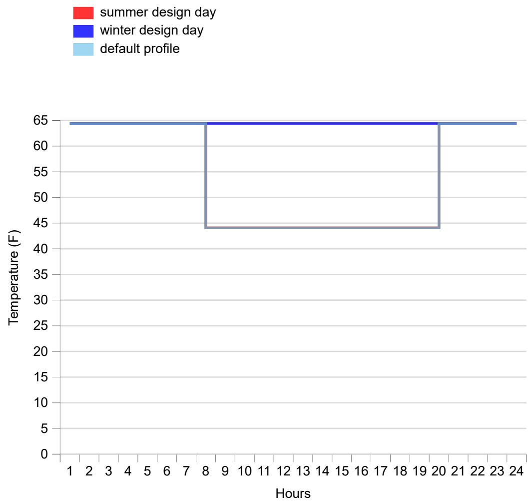
Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613

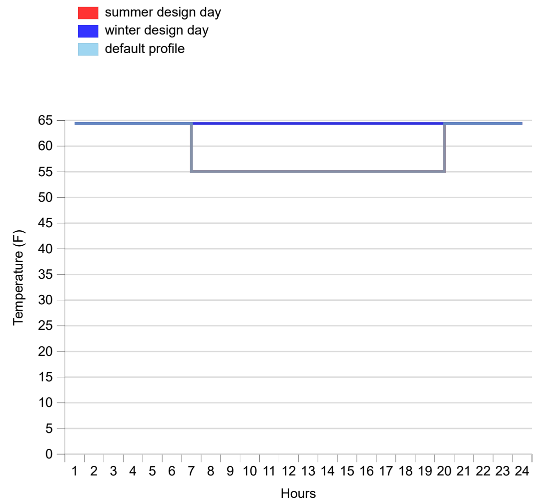
Schedule Overview

Schedule Overview - view table

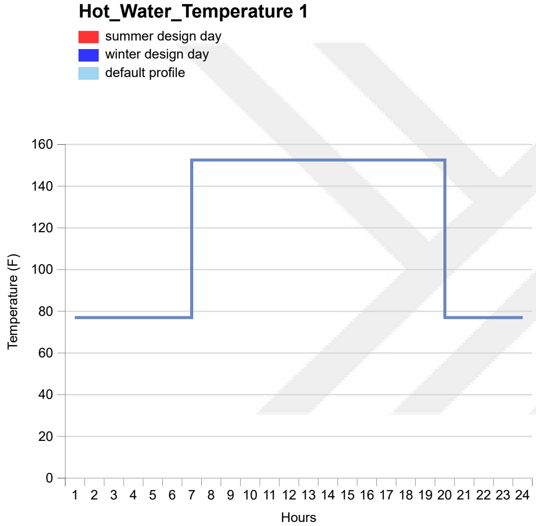
Chilled_Water_Temperature 2



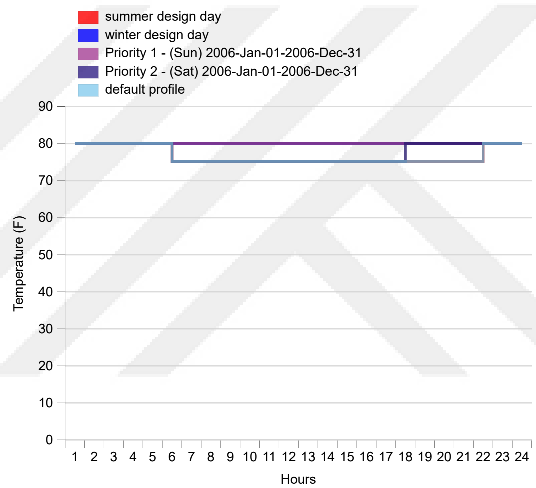
Deck_Temperature 1



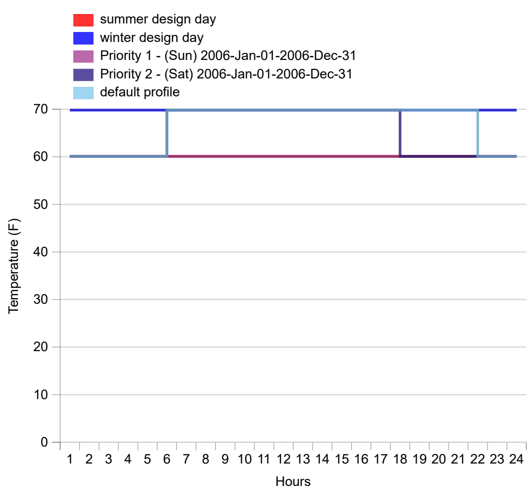
Hot_Water_Temperature 1



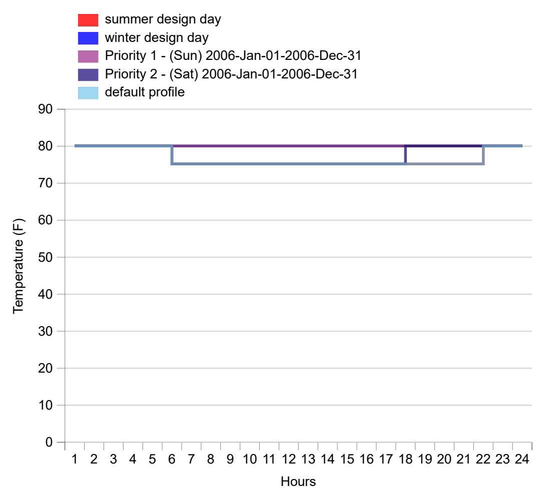
Large Office ClgSetp



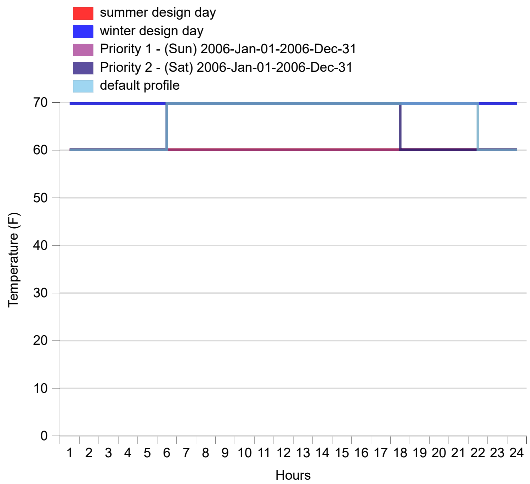
Large Office HtgSetp



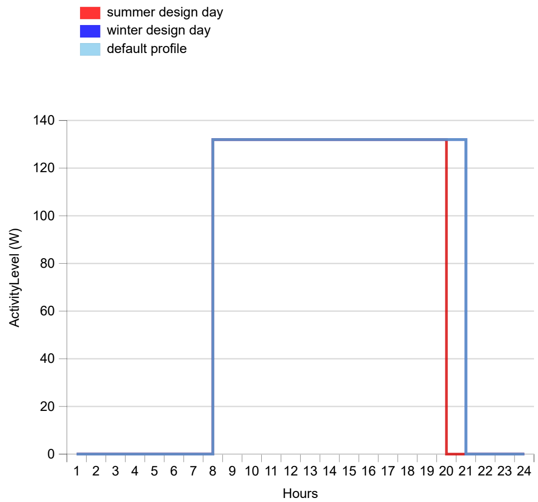
Medium Office ClgSetp



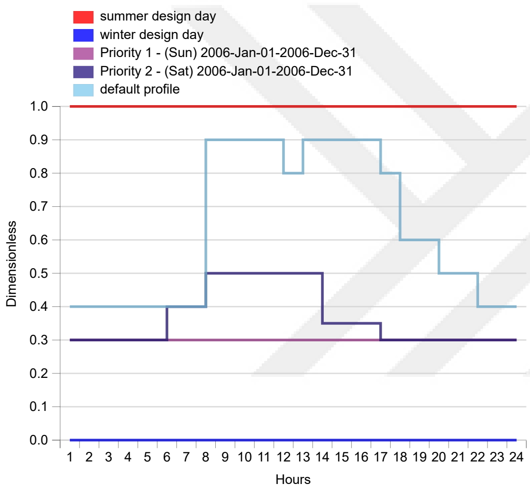
Medium Office HtgSetp



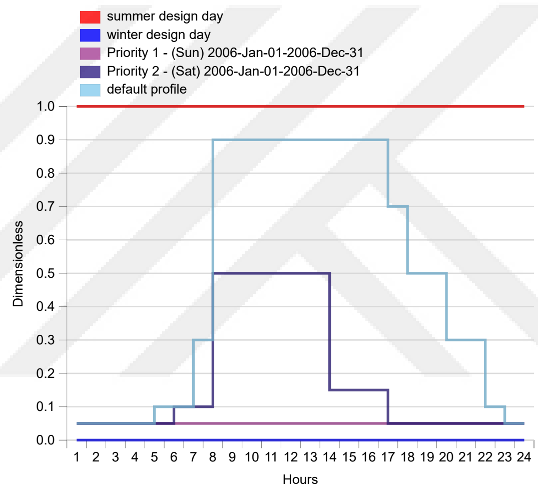
Office Activity

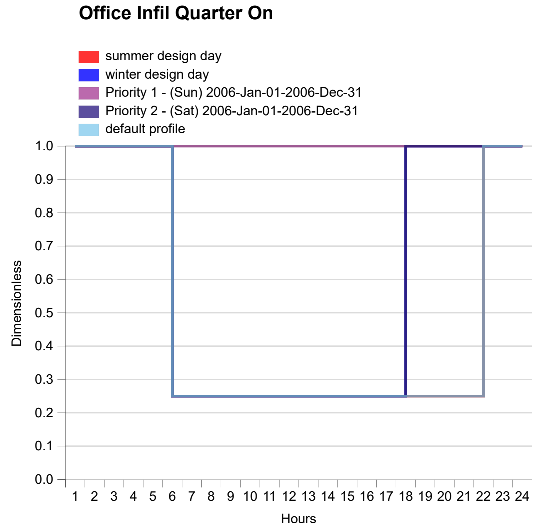


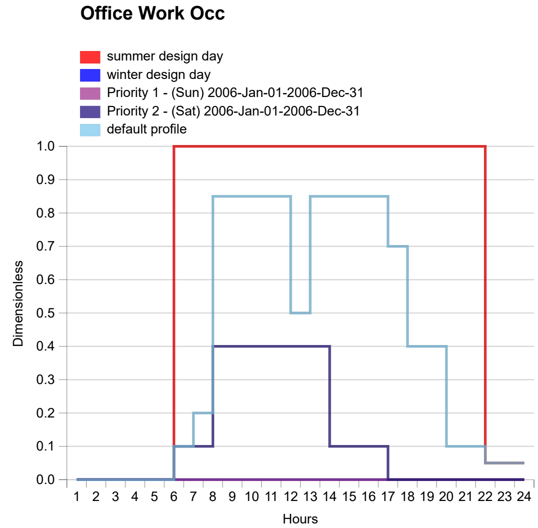
Office Bldg Equip

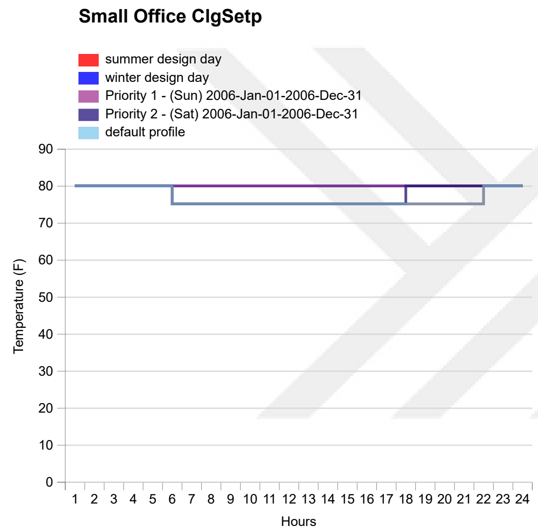


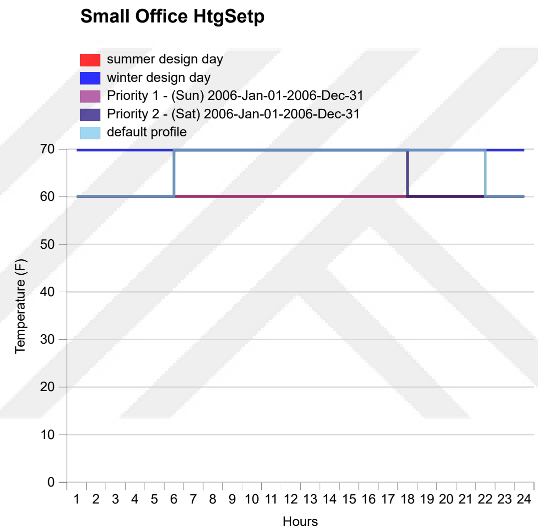
Office Bldg Light











Measure Warnings

Measure Warning Summary

Description	Count
Number of measures in workflow	2
Number of measures with warnings	0
Total number of warnings	0

5.Scenario #4 OpenStudio Results

OpenStudio Results

Model Summary

Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	735,402 kBtu
Total Building Area	9,531 ft^2
Total Site EUI	77.16 kBtu/ft^2
OpenStudio Standards Building Type	n/a

Weather Summary

	Value
Weather File	ANKARA - TUR IWEC Data WMO#=171280
Latitude	40.12
Longitude	32.98
Elevation	3114 ft
Time Zone	2.00
North Axis Angle	0.00
ASHRAE Climate Zone	

Sizing Period Design Days

	Maximum Dry Bulb (F)	Daily Temperature Range (R)	Humidity Value	Humidity Type	Wind Speed (mph)	Wind Direction
ANKARA ANN CLG .4% CONDNS DB=>MWB	91.4	27.72	63.68	Wetbulb [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS DP=>MDB	74.48	27.72	59.36	Dewpoint [F]	8.95	230.0
ANKARA ANN CLG .4% CONDNS ENTH=>MDB	84.38	27.72	25.37	Enthalpy [Btu/lb]	8.95	230.0
ANKARA ANN CLG .4% CONDNS WB=>MDB	84.92	27.72	66.56	Wetbulb [F]	8.95	230.0
ANKARA ANN HTG 99.6% CONDNS DB	3.74	0.0	3.74	Wetbulb [F]	1.12	100.0
ANKARA ANN HTG WIND 99.6% CONDNS WS=>MCDB	38.12	0.0	38.12	Wetbulb [F]	22.59	100.0
ANKARA ANN HUM_N 99.6% CONDNS DP=>MCDB	5.36	0.0	-0.94	Dewpoint [F]	1.12	100.0

Unmet Hours Summary

Time Setpoint Not Met	Time (hr)
During Heating	1331.83
During Cooling	0.0

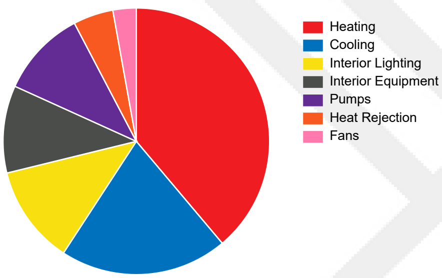
During Occupied Heating	628.33
During Occupied Cooling	0.0

Unmet Hours Tolerance

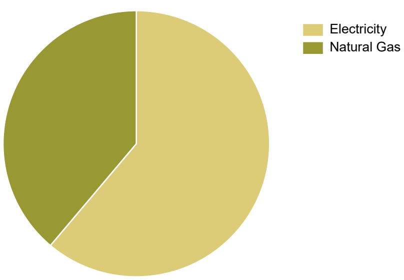
Tolerance for Time Setpoint Not Met	Temperature (F)
Heating	0.36
Cooling	0.36

Annual Overview

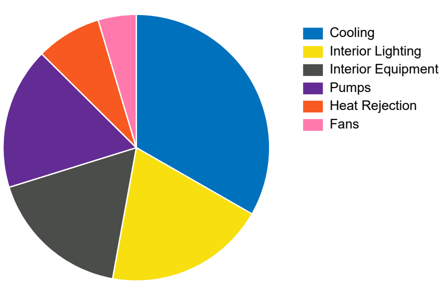
End Use - view table



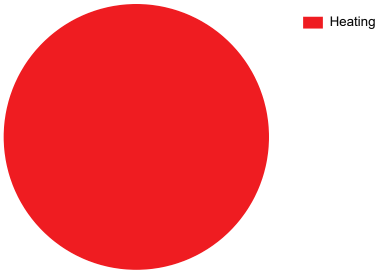
Energy Use - view table



EUI - Electricity - view table

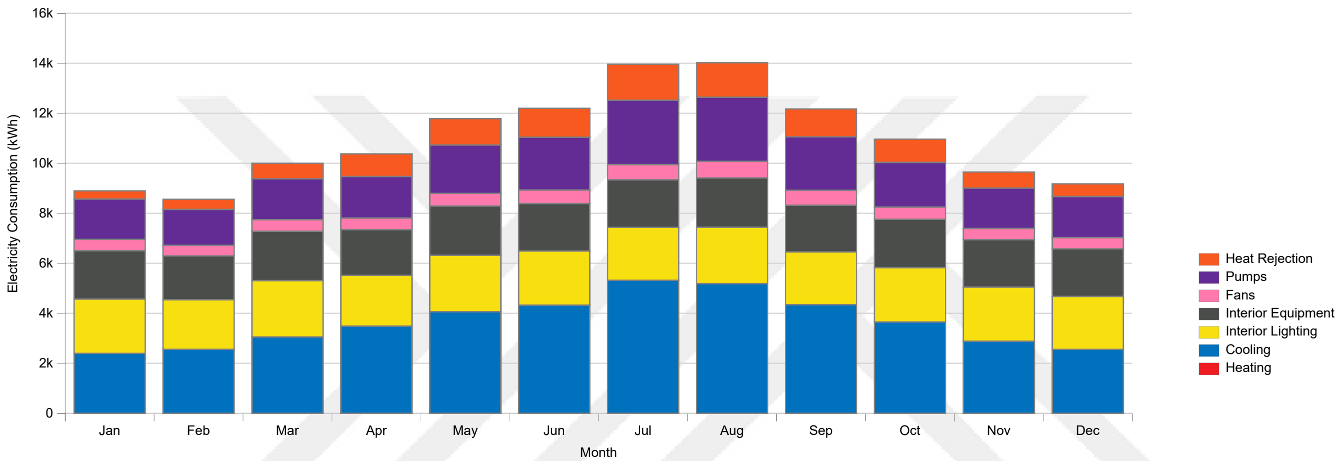


EUI - Gas - view table

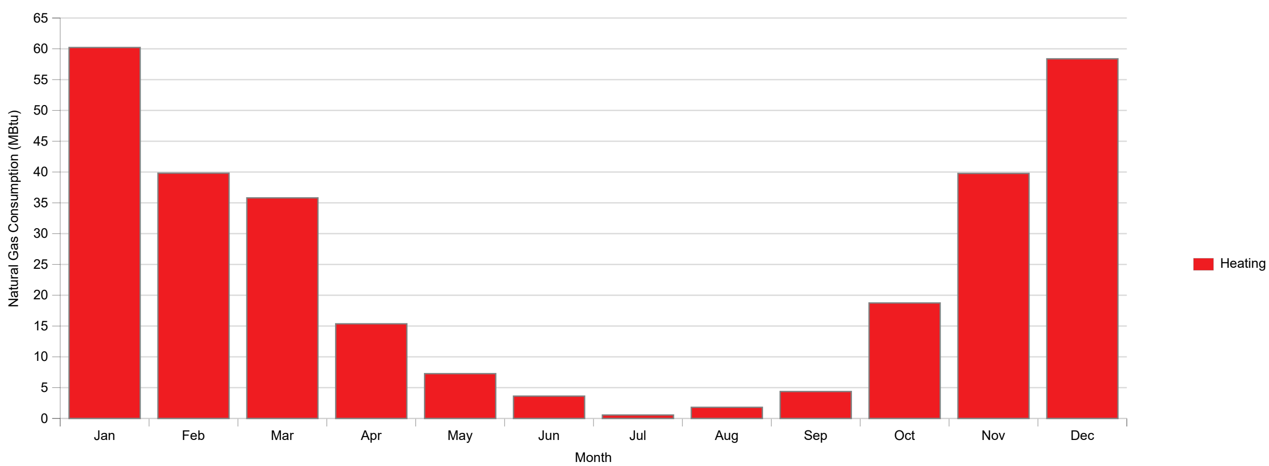


Monthly Overview

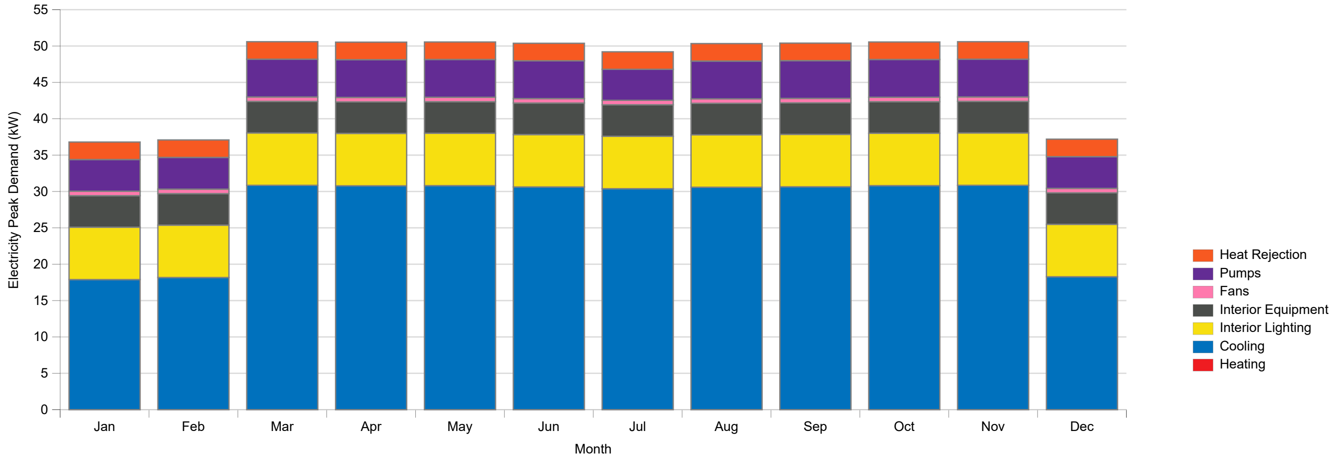
Electricity Consumption (kWh) - view table



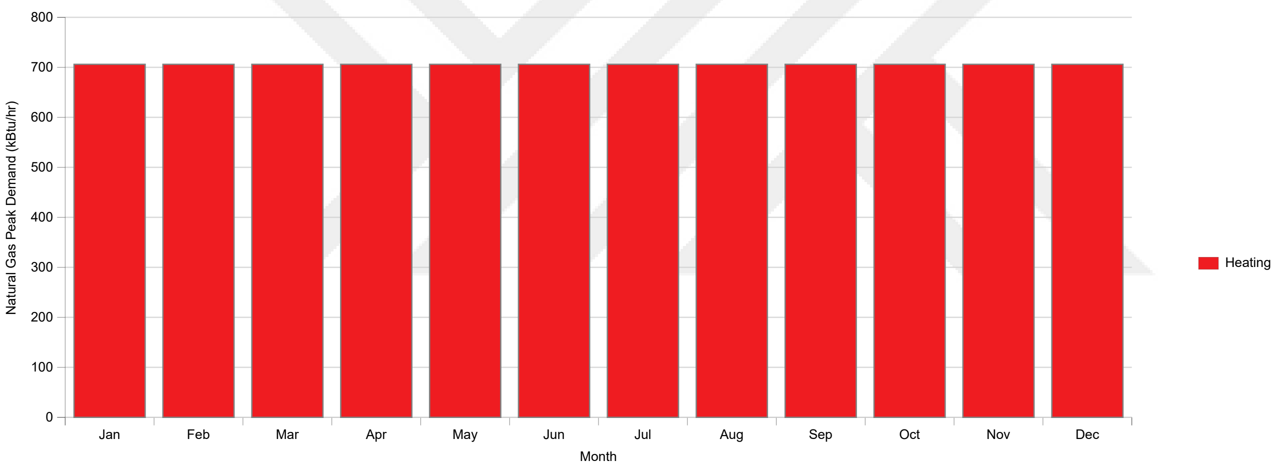
Natural Gas Consumption (MBtu) - view table



Electricity Peak Demand (kW) - view table



Natural Gas Peak Demand (kBtu/hr) - view table



Utility Bills/Rates

No Data to Show for Utility Bills/Rates

Envelope Summary

Base Surface Constructions

Construction	Net Area (ft^2)	Surface Count	R Value (ft^2*h*R/Btu)
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8	3,321	8	34.42
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8	4,090	51	15.84

Sub Surface Constructions

Construction	Net Area (ft^2)	Surface Count	U-factor (Btu/ft^2*h*R)	SHGC	VLT

ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8	7,363	37	0.25	0.40	0.31

Sub Surface Construction Details (Material Layers)

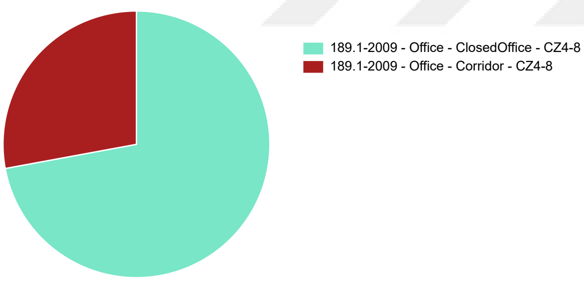
Material Name
(Material Layers in Construction 'ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8':)
ANKARA CAM

Window-to-Wall and Skylight-to-Roof area Ratios

Description	Total (%)	North (%)	East (%)	South (%)	West (%)
Gross Window-Wall Ratio	64.29	40.0	57.67	80.0	80.0
Gross Window-Wall Ratio (Conditioned)	64.29	40.0	57.67	80.0	80.0
Skylight-Roof Ratio	0.0				

Space Type Breakdown

Space Type Breakdown - view table



Space Type Summary

189.1-2009 - Office - ClosedOffice - CZ4-8 (16 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier
189.1-2009 - Office - ClosedOffice - CZ4-8 People Definition	0.0048	people/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.6400	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	0.9900	W/ft^2	1.0
189.1-2009 - Office - ClosedOffice - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - ClosedOffice - CZ4-8 Ventilation (outdoor air method Sum)	20.0000	cfm/person	

189.1-2009 - Office - Corridor - CZ4-8 (11 spaces and 1 thermal zones)

Definition	Value	Unit	Inst. Multiplier

189.1-2009 - Office - Corridor - CZ4-8 People Definition	0.0010	people/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.1600	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	0.4500	W/ft^2	1.0
189.1-2009 - Office - Corridor - CZ4-8 Infiltration	0.0446	cfm/ext surf area ft^2	
189.1-2009 - Office - Corridor - CZ4-8 Ventilation (outdoor air method Sum)	0.0500	cfm/ floor area ft^2	

Interior Lighting Summary

Zone Lighting

Lights	Zone	Lighting Power Density (W/ft^2)	Total Power (W)	Schedule Name	Scheduled Hours/Week (hr)	Actual Load Hours/Week (hr)	Return Air Fraction	Annual Consumption (kWh)
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 1		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 10		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 11		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 12		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 13		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 14		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 15		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 16		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 2		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 3		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 4		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 5		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 6		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 7		0.08	551.99	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1780.56
189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 8		0.04	283.46	OFFICE BLDG LIGHT	61.85	61.85	0.0000	913.89

189.1-2009 - OFFICE - CLOSEDOFFICE - CZ4-8 LIGHTS 9		0.06	432.64	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1394.44
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 1		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 10		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 11		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 2		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 3		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 4		0.0	13.08	OFFICE BLDG LIGHT	61.85	61.85	0.0000	41.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 5		0.13	354.2	OFFICE BLDG LIGHT	61.85	61.85	0.0000	1141.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 6		0.09	245.22	OFFICE BLDG LIGHT	61.85	61.85	0.0000	791.67
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 7		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 8		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78
189.1-2009 - OFFICE - CORRIDOR - CZ4-8 LIGHTS 9		0.04	108.98	OFFICE BLDG LIGHT	61.85	61.85	0.0000	352.78

Space Lighting Details

Load Name	Definition Name	Load Type	Load (units)	Multiplier	Total Load (W)
(Space Name: 'Space 101', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 102', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 203', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 305', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 103', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 201', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 401', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 105', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 402', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 104', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 202', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 204', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 205', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 301', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 302', Area: 437 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	433
(Space Name: 'Space 304', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 303', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 403', Area: 558 ft^2, Total LPD: 0.99 W/ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	552
(Space Name: 'Space 404', Area: 286 ft^2, Total LPD: 0.99 W/ft^2)					

189.1-2009 - Office - ClosedOffice - CZ4-8 Lights	189.1-2009 - Office - ClosedOffice - CZ4-8 Lights Definition	Spacetype	0.99 (W/ft^2)	1	283
(Space Name: 'Space 405', Area: 29 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	13
(Space Name: 'Space 406', Area: 787 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	354
(Space Name: 'Space 407', Area: 545 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	245
(Space Name: 'Space 409', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 412', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 410', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 411', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109
(Space Name: 'Space 501', Area: 242 ft^2, Total LPD: 0.45 W/ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Lights	189.1-2009 - Office - Corridor - CZ4-8 Lights Definition	Spacetype	0.45 (W/ft^2)	1	109

Lighting Controls Details

Space Name	Control Name	Zone Controlled (type, fraction)	Illuminance Setpoint (fc)

Plug Loads Summary

Electric Plug Load Consumption

	Electricity Annual Value (kWh)
InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20830.55
General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 1	20830.55
InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

General:InteriorEquipment:Electricity:Zone:THERMAL ZONE 2	2016.67

Space-level Electric Plug Loads

Equipment Name	Definition	Load (units)	Inheritance Level	Multiplier	Total Load (W)
(Space Name: Space 101, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 102, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 103, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 104, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 105, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 201, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 202, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 203, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 204, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 205, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 301, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 302, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 303, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357

(Space Name: Space 304, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 305, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 401, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 402, Area: 437 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	280
(Space Name: Space 403, Area: 558 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	357
(Space Name: Space 404, Area: 286 ft^2)					
189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment	189.1-2009 - Office - ClosedOffice - CZ4-8 Electric Equipment Definition	0.64 (W/ft^2)	spacetype	1.0	183
(Space Name: Space 405, Area: 29 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	5
(Space Name: Space 406, Area: 787 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	126
(Space Name: Space 407, Area: 545 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	87
(Space Name: Space 409, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 410, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 411, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 412, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39
(Space Name: Space 501, Area: 242 ft^2)					
189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment	189.1-2009 - Office - Corridor - CZ4-8 Electric Equipment Definition	0.16 (W/ft^2)	spacetype	1.0	39

Exterior Lighting

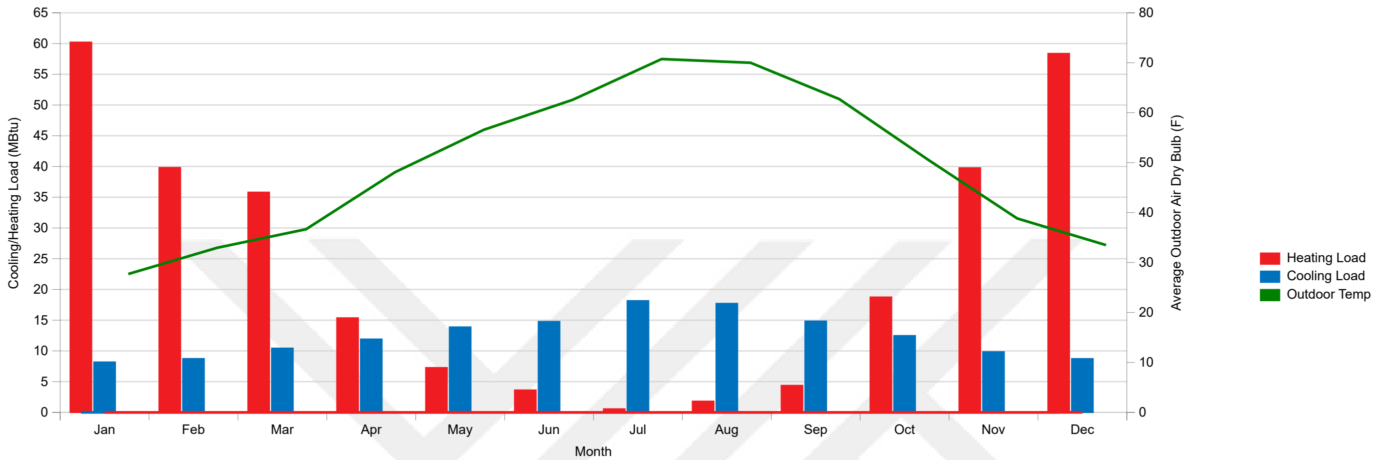
No Data to Show for Exterior Lighting

Water Use Equipment

No Data to Show for Water Use Equipment

HVAC Load Profiles

Monthly Load Profiles - view table



Zone Conditions

Temperature (Table values represent hours spent in each temperature range)

Zone	Unmet Htg (hr)	Unmet Htg - Occ (hr)	< 56 (F)	56-61 (F)	61-66 (F)	66-68 (F)	68-70 (F)	70-72 (F)	72-74 (F)	74-76 (F)	76-78 (F)	78-83 (F)	83-88 (F)	>= 88 (F)	Unmet Clg (hr)	Unmet Clg - Occ (hr)	Mean Temp (F)
THERMAL ZONE 1	864	395	21	1498	903	1226	1007	1862	389	1669	138	47	0	0	0	0	68.1 (F)
THERMAL ZONE 2	1331	628	57	1686	976	1123	1492	1632	454	1033	287	20	0	0	0	0	67.4 (F)

Humidity (Table values represent hours spent in each Humidity range)

Zone	< 30 (%)	30-35 (%)	35-40 (%)	40-45 (%)	45-50 (%)	50-55 (%)	55-60 (%)	60-65 (%)	65-70 (%)	70-75 (%)	75-80 (%)	>= 80 (%)	Mean Relative Humidity (%)
THERMAL ZONE 1	3247	1105	1145	1201	1137	574	237	91	16	7	0	0	35.0 (%)
THERMAL ZONE 2	3195	1079	1097	1207	1142	631	268	111	24	6	0	0	35.4 (%)

Zone Overview

Zone Summary

	Area (ft^2)	Conditioned (Y/N)	Part of Total Floor Area (Y/N)	Volume (ft^3)	Multiplier	Above Ground Gross Wall Area (ft^2)	Underground Gross Wall Area (ft^2)	Window Glass Area (ft^2)	Lighting (W/ft^2)	People (ft^2/person)	Plug and Process (W/ft^2)
THERMAL ZONE 1	6871.68	Yes	Yes	90179.54	1.00	7543.35	0.0	6034.68	0.99	210.54	0.64
THERMAL ZONE 2	2659.22	Yes	Yes	34897.95	1.00	3909.45	0.0	1327.84	0.45	999.97	0.16
Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Conditioned Total	9530.9			125077.49		11452.8	0.0	7362.51	0.84	269.96	0.51
Unconditioned Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0
Not Part of Total	0.0			0.0		0.0	0.0	0.0	0.0	0.0	0.0

Zone Sensible Cooling and Heating Sensible Sizing

	Heating/Cooling	Calculated Design Load	Design Load With Sizing Factor	Calculated Design Air Flow (ft^3/min)	Design Air Flow With Sizing Factor (ft^3/min)	Date/Time Of Peak	Outdoor Temperature at Peak Load (F)	Outdoor Humidity Ratio at Peak Load (lbWater/lbAir)
THERMAL ZONE 1	Cooling	19.25 (ton)	22.13 (ton)	13075.61	15035.57	8/21 15:10:00	91.13	0.01
THERMAL ZONE 1	Heating	114.96 (kBtu/h)	143.71 (kBtu/h)	3428.35	4284.38	1/21 24:00:00	3.74	0.0
THERMAL ZONE 2	Cooling	3.83 (ton)	4.4 (ton)	2599.87	2989.74	8/21 15:10:00	91.13	0.01
THERMAL ZONE 2	Heating	49.15 (kBtu/h)	61.44 (kBtu/h)	1466.26	1830.71	1/21 24:00:00	3.74	0.0

Zone Equipment Detail

No Data to Show for Zone Equipment Detail

Air Loops Detail

VAV with Reheat

Object	Description	Value	Sizing	Count
(supply)				
AirLoopHVAC:OutdoorAirSystem	Minimum Outdoor Air Flow Rate	0 cfm	Hard Sized	
	Maximum Outdoor Air Flow Rate	18,026 cfm	Autosized	
Coil:Cooling:Water	Air Flow Rate	18,026 cfm	Autosized	
	Water Flow Rate	109.77 gal/min	Autosized	
	Plant Loop	Chilled Water Loop		
Coil:Heating:Water	Heating Capacity	268,055.2 Btu/hr	Autosized	
	Water Flow Rate	27.51 gal/min	Autosized	
	Plant Loop	Hot Water Loop		
Fan:VariableVolume	Air Flow Rate	18,026 cfm	Autosized	

	Fan Efficiency	60.5 %		
	Pressure Rise	2.01 in w.g.		
	Motor Efficiency	93.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	55.0 to 64.4 F		
(demand)				
Thermal Zones	Total Floor Area	9,531 ft^2		2
Thermal Zones	Cooling Setpoint Range	75.2 to 80.1 F		
Thermal Zones	Heating Setpoint Range	60.1 to 69.8 F		
Terminal Types Used	AirTerminal:SingleDuct:VAV:Reheat			2
(controls)				
HVAC Operation Schedule		Always On Discrete		
Night Cycle Setting		StayOff		
Economizer Setting		NoEconomizer		
Demand Controlled Ventilation Status		Off		
Central Heating Design Supply Air Temperature		55.0 F		
Central Cooling Design Supply Air Temperature		55.0 F		
Load to Size On		Sensible		

Plant Loops Detail

Chilled Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	109.77 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Chiller:Electric:EIR	Cooling Capacity	55.1 ton	Autosized	
	Water Flow Rate	109.77 gal/min	Autosized	
	Reference COP	5.5		
	Fraction of Compressor Electric Consumption Rejected by Condenser	1.0		
SetpointManager:Scheduled	Control Variable - Temperature	44.1 to 64.4 F		
(demand)				
Coil:Cooling:Water	Air Loop	VAV with Reheat		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	109.77 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		45.0 F		
Loop Design Temperature Difference		12.0 R		
Equipment Loading/Staging		Optimal		

Condenser Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	155.18 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
CoolingTower:SingleSpeed	Air Flow Rate	15,032 cfm	Autosized	
	Water Flow Rate	155.18 gal/min	Autosized	
SetpointManager:FollowOutdoorAirTemperature	Reference Temperature Type	OutdoorAirWetBulb		
(demand)				
Chiller:Electric:EIR	Plant Loop	Chilled Water Loop		
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	155.18 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		84.9 F		
Loop Design Temperature Difference		10.1 R		
Equipment Loading/Staging		Optimal		

Hot Water Loop

Object	Description	Value	Sizing	Count
(supply)				
Pump:VariableSpeed	Water Flow Rate	57.97 gal/min	Autosized	
	Rated Pump Head	60.0 ft H2O		
	Motor Efficiency	90.0 %		
Boiler:HotWater	Heating Capacity	564,795.4 Btu/hr	Autosized	
	Water Flow Rate	57.97 gal/min	Autosized	
	Nominal Thermal Efficiency	80.0 %		
SetpointManager:Scheduled	Control Variable - Temperature	77.0 to 152.6 F		
(demand)				
Coil:Heating:Water	Air Loop	VAV with Reheat		
Air Terminal Connections				2
(controls)				
Loop Flow Rate Range	Minimum Loop Flow Rate	0.00 gal/min	Hard Sized	
Loop Flow Rate Range	Maximum Loop Flow Rate	57.97 gal/min	Autosized	
Loop Temperature Range		32.0 to 212.0 F		
Loop Design Exit Temperature		179.6 F		
Loop Design Temperature Difference		19.8 R		
Equipment Loading/Staging		Optimal		

Outdoor Air

Average and Minimum Outdoor Air During Occupied Hours

	Average Number of Occupants	Nominal Number of Occupants	Zone Volume (ft^3)	Avg. Mechanical Ventilation (ach)	Min. Mechanical Ventilation (ach)	Avg. Infiltration (ach)	Min. Infiltration (ach)	Avg. Simple Ventilation (ach)	Min. Simple Ventilation (ach)
THERMAL ZONE 1	1.08	32.64	90180	0.444	0.419	0.093	0.001	0.0	0.0
THERMAL ZONE 2	0.13	2.66	34898	0.218	0.105	0.142	0.002	0.0	0.0

Cash Flow

No Data to Show for Cash Flow

Site and Source Summary

Site and Source Energy

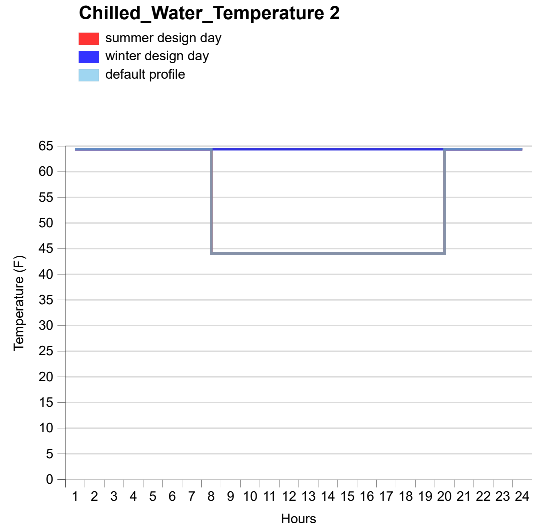
	Total Energy (kBtu)	Energy Per Total Building Area (kBtu/ft^2)	Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy	735401.8	77.2	77.2
Net Site Energy	735401.8	77.2	77.2
Total Source Energy	1733860.8	181.9	181.9
Net Source Energy	1733860.8	181.9	181.9

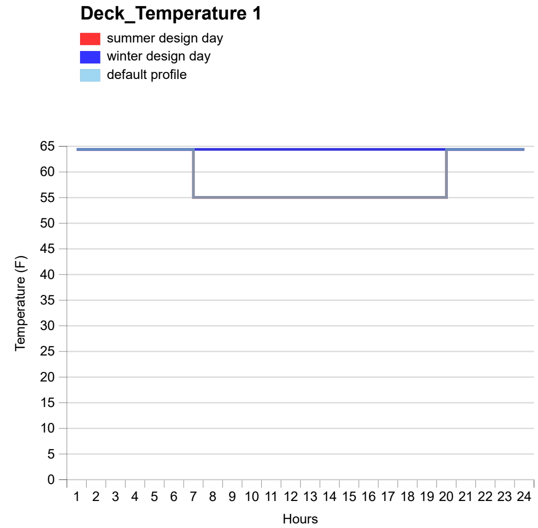
Site to Source Energy Conversion Factors

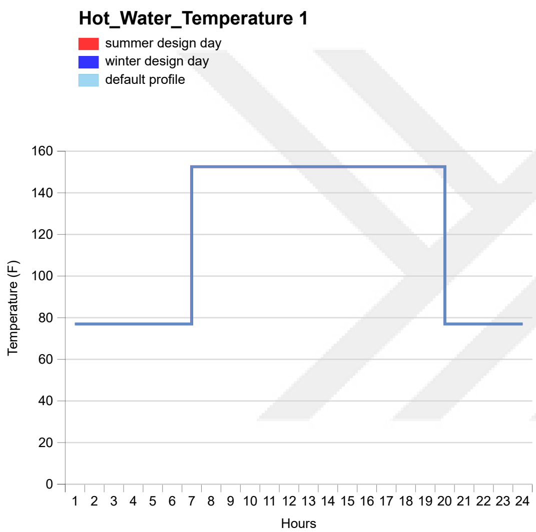
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613

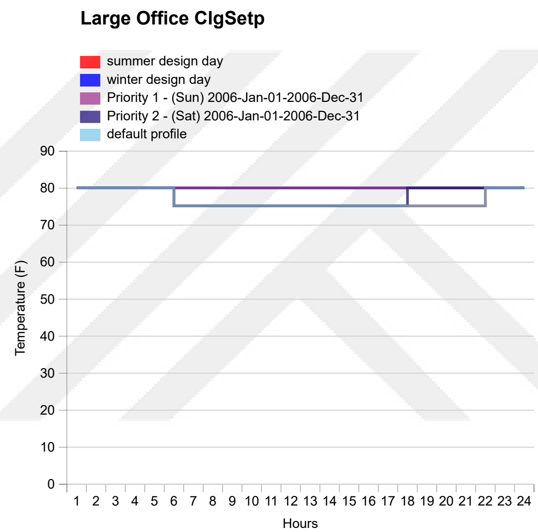
Schedule Overview

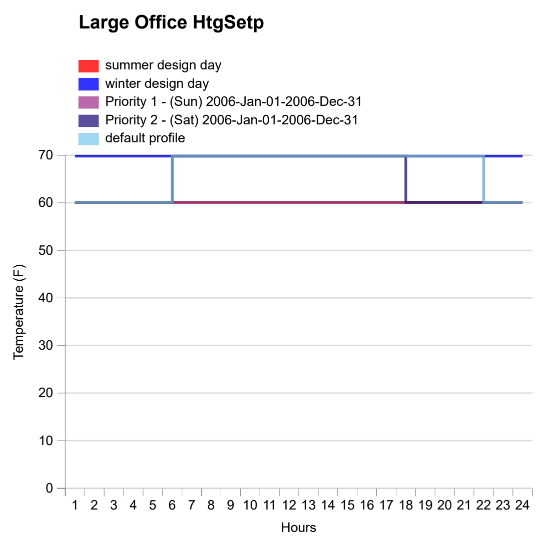
Schedule Overview - view table


Chilled_Water_Temperature 2
summer design day
winter design day
default profile
Temperature (F)
Hours


Deck_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours


Hot_Water_Temperature 1
summer design day
winter design day
default profile
Temperature (F)
Hours


Large Office ClgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours


Large Office HtgSetp
summer design day
winter design day
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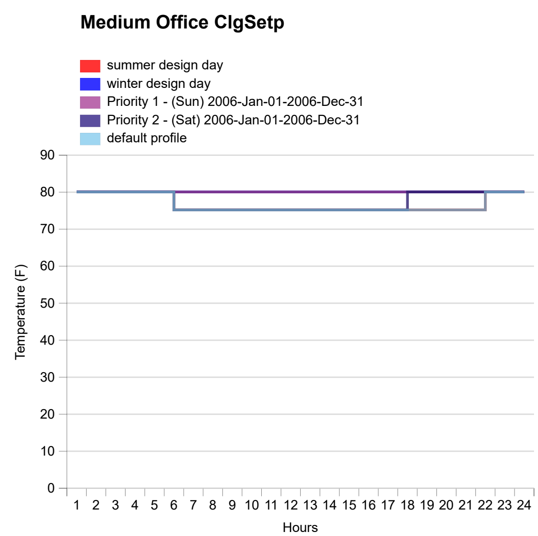
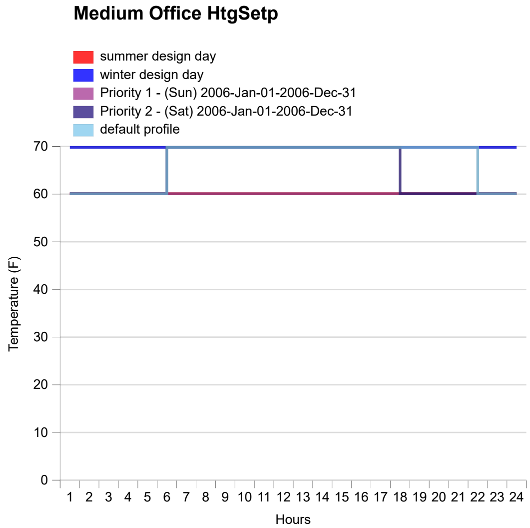
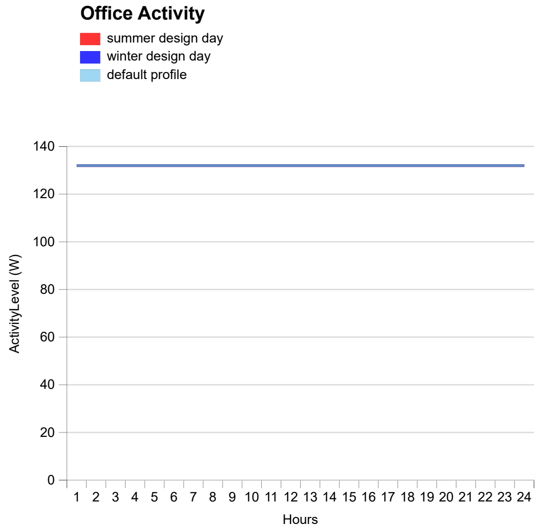
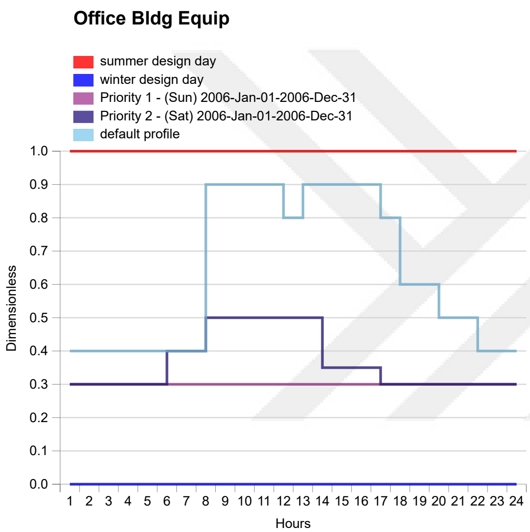
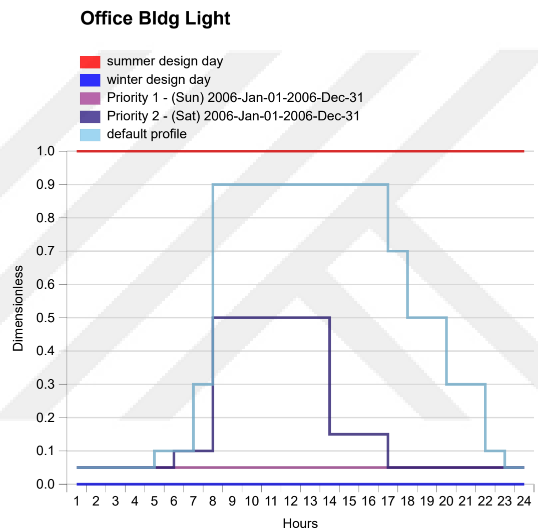
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours


Medium Office ClgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours

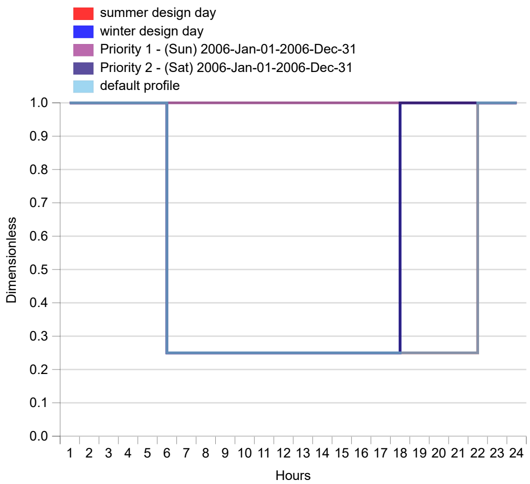

Medium Office HtgSetp
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Temperature (F)
Hours


Office Activity
summer design day
winter design day
default profile
ActivityLevel (W)
Hours

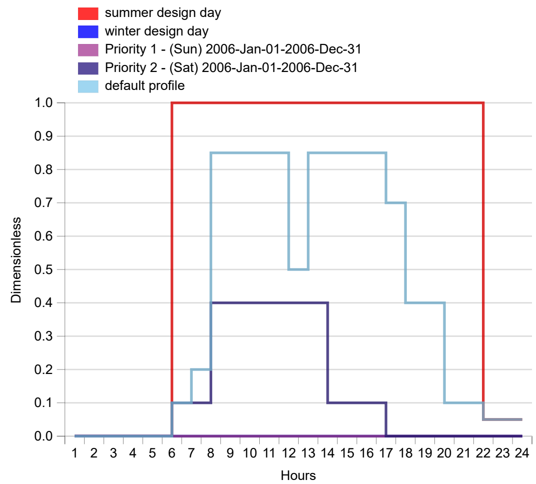

Office Bldg Equip
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Dimensionless
Hours


Office Bldg Light
summer design day
winter design day
Priority 1 - (Sun) 2006-Jan-01-2006-Dec-31
Priority 2 - (Sat) 2006-Jan-01-2006-Dec-31
default profile
Dimensionless
Hours

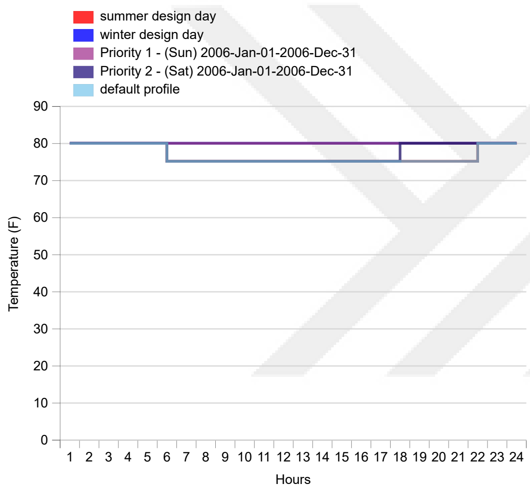
Office Infil Quarter On



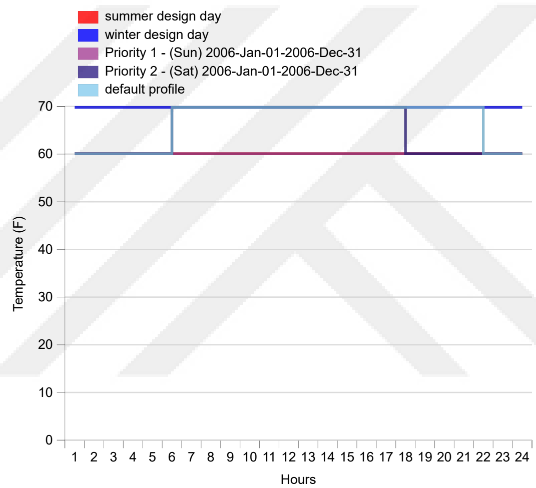
Office Work Occ



Small Office ClgSetp



Small Office HtgSetp



Measure Warnings

Measure Warning Summary

Description	Count
Number of measures in workflow	2
Number of measures with warnings	0
Total number of warnings	0