EDAPT Example Project  
1123 W 3rd Ave, Denver, CO 80223

Xcel Energy’s Energy Design Assistance Program

Preliminary Energy Analysis Report

June 29, 2013

**Prepared for:**

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Table of Contents

[Energy Design Assistance Program Process & Timeline 3](#_Toc345326293)

[Project Summary 4](#_Toc345326294)

[Project Participants 5](#_Toc345326295)

[Building Energy Goals and Key Findings 6](#_Toc345326296)

[1. Energy Modeling Overview 7](#_Toc345326297)

[1.1. Baseline Models 7](#_Toc345326298)

[2. EDA Baseline Model Results 8](#_Toc345326299)

[2.1. EDA Base Model Description and Assumptions 8](#_Toc345326300)

[3. Energy Efficiency Measure Analysis 9](#_Toc345326301)

[3.1. Building Envelope Energy Efficiency Measures 9](#_Toc345326302)

[3.1.1. Discussion of Building Envelope Measures 10](#_Toc345326303)

[3.2. Lighting and Interior Load Energy Efficiency Measures 10](#_Toc345326304)

[3.2.1. Discussion of Lighting and Interior Load Measures 10](#_Toc345326305)

[3.3. HVAC & DHW Efficiency Measures 11](#_Toc345326306)

[3.3.1. Discussion of HVAC & DHW Measures 11](#_Toc345326307)

[Appendix A Modeling Inputs and Assumptions 12](#_Toc345326308)

[Appendix B Detailed Modeling Results 13](#_Toc345326309)

Energy Design Assistance Program Process & Timeline

Xcel Energy’s Energy Design Assistance (EDA) process is designed to assist the Owner and Design Team in making decisions concerning energy-efficiency measures for the project. The main steps of the process are as follows.

|  |  |  |
| --- | --- | --- |
| **Construction stage** | ENERGY DESIGN ASSISTANCE STATE | **DATE** |
| **aPPLICaTIon**  **Design phase** | Step 1: APPLICATION  Complete application  Xcel Energy accept/reject of application | **June 29, 2013** |
| **PRE/EARLY SCHEMATIC DESIGN PHASE** | Step 2: INTRODUCTION  Introductory meeting  EDA Program overview  Energy efficiency measure discussion  Begin collection of building and incremental cost data  Submit introductory report | **July 15, 2013** |
| **Schematic Design phase** | Step 3: PRELIMINARY ENERGY ANALYSIS (PEA)  Early massing, HVAC, daylighting (Enhanced Track only)  Preliminary energy analysis meeting  Review of analysis results in PEA report  Selection of measures to be included in final energy analysis  Submit PEA report |  |
| SD completion | |  |
| **Design Development phase** | Step 4: FINAL ENERGY ANALYSIS (FEA)  Final energy analysis meeting  Review of updated whole building analysis in FEA report  Review of program incentives  Introduction to verification process  Customer selects an energy design alternative, showing an intent to move forward with selected measures |  |
| DD completion | |  |
| **Construction Document phase** | Step 5: CONSTRUCTION DOCUMENT (CD)  Customer sends final design CDs to EDA Verification Consultant  **EDA Verification Consultant:**  Confirms measures included in final design documents. Sends to EDA  Modeling Consultant to update model  Submits CD report with updated model results and incentive  EDA consultant complete green certification docs (Enhanced Track only)  Design team completes documentation for fee reimbursement |  |
| **CD Completion** | |  |
| **Construction** | **Construction Occurs. Estimated construction completion date** |  |
| **Construction ends** | |  |
| **Post-Occupancy** | EDA Verification Consultant conducts:  On-site measurement and verification. Sends M&V results to EDA Modeling Consultant to update model  Submits M&V report with updated model results and incentive |  |
| **Incentive payment to customer is received approximately two months post-verification** | | |

Xcel Energy, through the Energy Design Assistance program, has qualified energy consultants to provide our customers with a service that includes an integrated design process. This integration includes using an energy model to predict energy savings. The energy model itself is an instrument to project results and review different energy efficiency opportunities. The results of these models belong to Xcel Energy and their customers as participants through the Energy Design Assistance program.

Xcel Energy customers participating in the Energy Design Assistance program may distribute the results of their model to anyone they choose.  Xcel Energy will not release this information unless written permission from the customer has been obtained.  As a result of this permission, two reports will be provided: the Preliminary Energy Analysis Report and the Final Energy Analysis Report. Xcel Energy also cautions the use of these reports; data is based on an analysis done for a specific time frame.  Buildings naturally adjust as occupancy reaches its full potential, causing variations from pre-construction data.

Project Summary

|  |  |
| --- | --- |
| Project Name | EDAPT Example Project |
| Xcel Energy Project # |  |
| Location | 1123 W 3rd Ave, Denver, CO 80223 |
| Building Type | Hotel |
| Conditioned Floor Area | 52,000 |
| Unconditioned Floor Area | 0 |
| Above-Grade Stories | 3 |
| Below-Grade Stories | 0 |
| Electricity Provided by Xcel | Yes |
| Natural Gas Provided by Xcel | Yes |
| District Heating **Gas Provided by Xcel** | Yes |
| District Cooling **Electricity Provided by Xcel** | Yes |
| EDA Baseline | ASHRAE 90.1-2007 |
| Track (Basic or Enhanced) | Basic |
| Certification (Enhanced Only) | USGBC LEED Silver |
| Early Analysis (Enhanced Only) |  |
| Estimated Savings (vs. baseline) |  |
| Demand (kW) | 20 |
| Energy (kWh) | 100,000 |
| Gas (Dth) | 200 |
| Estimated Construction Completion Date | June 29, 2313 |
| Estimated 80% Occupancy Date |  |
| Estimated Verification Date |  |

|  |  |
| --- | --- |
| Customer incentive calculations are based on the following dollar amounts | |
| Demand ($/kW) | $ 400 |
| Energy ($/kWh) | $ 0.04 |
| Gas ($/Dth) | $ 4 |

Project Participants

Project participants at the meeting included:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name | Company | Role | E-Mail | Phone | In Attendance |
| John Doe | The Best Architects | Architectural Firm | john.doe@arch.com | (252) 626-8842 |  |
| Jim Smith | The Best Mechanical Engineers | Mechanical Engineer | jim.smith@contractor.com | (252) 626-8842 |  |

Building Energy Goals Summary

The customer wants to save at least 15% on electric demand and 15% on gas consumption to meet the EDA Basic Track requirements for incentives. The goal of this building is also to achieve LEED Silver rating from the USGBC. Because of LEED NC credit EAC1, energy savings are critical to achieving this rating. The customer hopes that the energy savings also equate to utility bill savings.

Analysis Results Summary and Key Findings

This building is a franchise of a major hotel chain, which has restrictions on design. In particular, these restrictions apply to HVAC, and therefore HVAC measures are not being considered for this building.

A large majority of the floor area is guest rooms. Although the hotel cannot control when the occupants use the equipment and lighting in their rooms, if this equipment and lighting is more efficient, large savings can be realized. The up-front cost of buying Energy Star rated TVs and mini-fridges for the guest rooms has a simple payback of 2 years. The up-front cost of buying more efficient lighting fixtures and installing vacancy sensors on the guest room lighting has a simple payback of 4 years.

Because of the size of the building site, rotation of the building was considered as a measure. Orienting the building so that the long axis of the building runs East-West saves energy at no cost.

Increased insulation in the roof and walls of the building was also analyzed. Both showed some savings, but the roof insulation had a much bigger impact.

# Energy Modeling Overview

Xcel Energy and its consultants analyze energy efficiency measures for buildings using OpenStudio, an open source application suite and software development kit (SDK) aimed at accelerating the production of analysis and design tools for the built environment. OpenStudio was developed by the Commercial Buildings Group at the National Renewable Energy Laboratory (NREL) with funding from the Department of Energy (DOE) with the goal of making analysis-driven decision making easier and more common during the building design process. OpenStudio uses DOE’s state-of-the-art EnergyPlus whole-building hourly energy simulation engine.

**Building Characteristics** - Consultants gather building description data and assumptions from the owner and design team to construct models. Energy models are simulated using CO Typical Meteorological Year weather files.

**Incremental Costs and Payback Analysis** - The design team supplies incremental construction costs for each energy efficiency measure in order to make informed decisions about energy measures and the paybacks. Gathering building data and costs are some of the required tasks of the design team in order to receive a design team incentive.

## Baseline Models

**EDA Baseline** – This building energy analysis uses a baseline model as a benchmark to compare energy performance for energy efficiency measures. Models follow the Xcel Energy EDA protocol, which is based on an ASHRAE 90.1-2007-compliant baseline building energy model developed following Appendix G energy modeling requirements, with modifications for Xcel Energy’s utility purposes.

This Base model will match the space heating energy source of the proposed building: either electricity or fuel. If the design team is considering scenarios with all electric heating as well as scenarios with natural gas or hybrid heating, two different EDA Base models will be required to calculate energy and cost savings for the different proposed buildings. The baseline model calculates kWh electricity, kW electric demand, and dekatherm (10 therms) natural gas usage. This is the baseline to calculate savings for incentives from Xcel Energy.

**Cost Baseline** – This model uses cost baselines to represent construction that would have been built as standard practice in the absence of this energy analysis. The Cost Base model is developed to be used by the Design Team and Owner to calculate energy cost savings and payback periods for various energy efficiency strategies. Energy consultants guide teams through the process of using the economics of energy efficiency to make design decisions.

**Certification Baseline** – When a 3rd party-verified certification is being pursued (such as LEED) under the EDA enhanced track, a separate baseline and modeling will be conducted using the certification requirements.

# EDA Baseline Model Description and Assumptions

(disclaimer: this model is not a reasonable hotel. Unusual selections were made to test the systems. Do not use the model itself as an example of how to model a hotel).

The baseline model was a 52,000 sf hotel with the long-axis running North-South. The building is mainly guest rooms, with some lobby, storage, and kitchen area. The building is on Secondary General Low Load Factor and Interruptible Industrial Gas utility rates. The building energy consumption is dominated by the plug loads and internal lighting, most of which is in the guest rooms.

See Appendix A for more details on the EDA Baseline Model.

# EDA Baseline Results

The following figures show the energy cost, demand, and consumption breakdowns for the EDA Baseline building model. Baselines assume all energy design parameters meet the prevailing energy code and provide for comparison for all modeled energy measures and measures.

Figure 3‑1 EDA Baseline Annual Utility Cost Breakdown by Fuel Type ($/year)

Figure 3-2 EDA Baseline Annual Utility Cost Breakdown by End Use ($/year)

Figure 3‑3 EDA Baseline Peak Electric Demand per Month by End Use (kW)

Figure 3‑4 EDA Baseline Electricity Consumption per Month by End Use (kWh)

Figure 3‑5 EDA Baseline Natural Gas Consumption per Month by End Use (Dth)

# Energy Efficiency Measure Analysis

The following tables show results for each of the measures modeled and analyzed, including:

* Building envelope,
* Interior loads, and
* HVAC systems.
* Other

Annual energy cost savings are shown for each measure, along with cost premium estimates. These values were used to calculate simple paybacks.

## Building Envelope Energy Efficiency Measures

For this project, many different envelope measures were considered. Measures analyzed included changing the amount of air leaking into and out of the building (reducing infiltration), adding insulation to the walls and roof, lowering the size of the windows on the East-facing walls, changing the orientation of the building, and using better windows.

Table 4‑1 Envelope Measures - EDA Baseline Annual Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Energy  Cost  ($) | EUI  (kBtu/ft2-yr) | Peak  Demand  (kW) | Electric  Consumption  (kWh) | Natural Gas  (Dth) |
| $146,465 | 102.21 | 136.340 | 645,181 | 1,567.366 |

Table 4‑2 Envelope Measures - Annual Savings vs. EDA Baseline

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Measure | Energy  Cost  Savings  ($) | EUI  Reduction  (kBtu/ft2-yr) | Peak  Demand Savings  (kW) | Electric  Consumption Savings  (kWh) | Natural Gas Savings  (Dth) | Incremental Capital Cost  ($) | Simple Payback  (years) |
| Reduce Infiltration by 10% | $66 | 0.14 (0%) | 2 (2%) | 83 (0%) | 7 (0%) | $3,807 | 58 |
| Reduce Infiltration by 20% | $124 | 0.30 (0%) | 2 (2%) | 167 (0%) | 15 (1%) | $7,614 | 61 |
| R-15 Exterior Wall Insulation | $607 | 1.12 (1%) | 3 (2%) | 1,531 (0%) | 52 (3%) | $1,851 | 3 |
| R-20 Exterior Wall Insulation | $738 | 1.36 (1%) | 3 (2%) | 1,881 (0%) | 63 (4%) | $2,468 | 3 |
| R-30 Roof Insulation | $4,075 | 2.69 (3%) | 0 (0%) | 17,119 (3%) | 81 (5%) | $5,250 | 1 |
| R-50 Roof Insulation | $4,319 | 3.29 (3%) | 5 (4%) | 17,386 (3%) | 111 (7%) | $8,750 | 2 |
| 0.35 WWR on E Facade | $563 | 0.65 (1%) | 2 (2%) | 2,275 (0%) | 15 (1%) | $-165 | 0 |
| 0.2 WWR on E Facade | $2,198 | 2.49 (2%) | 3 (2%) | 9,061 (1%) | 56 (4%) | $-665 | 0 |
| Rotate Building 90 Degrees | $2,703 | 5.52 (6%) | 1 (1%) | 11,108 (2%) | 75 (5%) | $0 | 0 |
| Low U-Factor Windows | $895 | 3.68 (4%) | 2 (2%) | -692 (-0%) | 198 (13%) | $-8,228 | 0 |

### Discussion of Building Envelope Measures

(disclaimer: all costs were totally made up. This example should not be used for cost data. The narratives about where cost data were obtained is for example only)

**Reducing Infiltration:**

Lower the amount of air leaking into the building by changing small architectural details. Modeling assumption for initial infiltration rate came from DOE reference building models. Costs were obtained from the contractor.

**Increasing Insulation:**

Increase the thickness of the insulation layer in the walls to lower the heat moving through the walls and roof of the building. This lowers the load that the heating and cooling systems must meet. This was modeled by finding the insulation layer in the walls and increasing the thickness until the desired insulation level was reached. Costs were obtained from the contractor.

**Lowering the Size of East-Facing Windows:**

Reduce the size of east-facing windows to lower the amount of early-morning heat entering the building. Windows details were not yet available, so a single large band of glass was modeled. Costs were obtained by getting window and wall costs from the contractor, and doing the tradeoff calculations.

**Rotate the Building:**

The building site is large because of the required parking. For this reason, it was possible to rotate the building on the site. At this stage, the cost is 0 to rotate the building.

**Low U-Factor Windows:**

U-Factor is a measure of how quickly heat moves through windows. Low U-Factor windows lower the amount of heat that can move through the windows, lowering the load that the heating and cooling systems must meet. Costs were obtained from contractor.

## Lighting and Interior Load Energy Efficiency Measures

This analysis focused on the lights and electric equipment in the guest rooms, which make up a majority of the building area. The analysis included purchasing more efficient equipment, as well as turning off lights when no one was in the room.

Table 3‑3 Lighting and Interior Load Measures - EDA Baseline Annual Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Energy  Cost  ($) | EUI  (kBtu/ft2-yr) | Peak  Demand  (kW) | Electric  Consumption  (kWh) | Natural Gas  (Dth) |
| $146,465 | 102.21 | 136.340 | 645,181 | 1,567.366 |

Table 3‑4 Lighting and Interior Load Measures - Annual Savings vs. EDA Baseline

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Measure | Energy  Cost  Savings  ($) | EUI  Reduction  (kBtu/ft2-yr) | Peak  Demand Savings  (kW) | Electric  Consumption Savings  (kWh) | Natural Gas Savings  (Dth) | Incremental Capital Cost  ($) | Simple Payback  (years) |
| 20% EPD Reduction in Guest Rooms | $9,068 | 2.47 (2%) | 11 (8%) | 42,861 | -24 (-2%) | $19,899 | 2 |
| 30% EPD Reduction in Guest Rooms | $13,587 | 3.69 (4%) | 15 (11%) | 64,272 | -37 (-2%) | $29,849 | 2 |
| 10% LPD Reduction in Guest Rooms | $3,690 | 1.03 (1%) | 7 (5%) | 16,967 | -7 (-0%) | $19,899 | 5 |
| 20% LPD Reduction in Guest Rooms | $7,366 | 2.06 (2%) | 12 (9%) | 33,925 | -14 (-1%) | $39,798 | 5 |

### Discussion of Lighting and Interior Load Measures

(disclaimer: all costs were totally made up. This example should not be used for cost data. The narratives about where cost data were obtained is for example only)

**Reducing Electric Power Density (EPD) in Guest Rooms:**

Plug-in equipment in guest rooms is a major energy use in this hotel. This measure assumed buying EnergyStar TVs and mini-fridges for the guest rooms. Costs were obtained by getting volume pricing details from the supplier who would be supplying this equipment to the building.

**Reducing Lighting Power Density (LPD) in Guest Rooms:**

Lights in guest rooms are a major energy use in this hotel. This measure assumed that all lighting in guest rooms would be CFLs, and in the higher reduction case, that vacancy sensors would be installed to turn off the lights if no motion or noise was detected in the room after 20 minutes. Costs were obtained from the contractor.

1. Modeling Inputs and Assumptions
   1. Location and Climate Data

|  |  |
| --- | --- |
| Weather File | Denver-Stapleton CO USA TMY--23062 WMO#=724690 |
| Latitude [deg] | 39.76 |
| Longitude [deg] | -104.9 |
| Elevation [m] | 1611.00 |
| Hours Simulated [hrs] | 8760.00 |

* 1. Utility Rates

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | |  | Meter | Annual Cost ($) | | SECONDARYGENERALLOWLOADFACTOR | ELECTRICITYPURCHASED:FACILITY | 138,568.21 | | INTERRUPTIBLEINDUSTRIALG | GAS:FACILITY | 7,896.89 | |

* 1. Building Envelope Model Inputs

**Opaque Exterior**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Construction | Reflectance | U-Factor with Film [W/m2-K] | Gross Area [m2] | Cardinal Direction |
| SURFACE 25 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 943.23 |  |
| SURFACE 14 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | E |
| SURFACE 13 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 222.88 |  |
| SURFACE 8 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | N |
| SURFACE 7 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 118.41 |  |
| SURFACE 20 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | S |
| SURFACE 19 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 118.41 |  |
| SURFACE 2 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | W |
| SURFACE 1 | 90.1-2004 NONRES 5B EXT SLAB UNHEATED - 4IN SLAB WITH CARPET | 0.30 | 1.862 | 222.88 |  |
| SURFACE 44 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | E |
| SURFACE 38 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | N |
| SURFACE 50 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | S |
| SURFACE 32 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | W |
| SURFACE 90 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 943.23 |  |
| SURFACE 74 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | E |
| SURFACE 78 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 222.88 |  |
| SURFACE 68 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | N |
| SURFACE 72 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 118.41 |  |
| SURFACE 80 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 115.82 | S |
| SURFACE 84 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 118.41 |  |
| SURFACE 62 | 90.1-2004 NONRES 5B EXT WALL MASS | 0.08 | 0.698 | 202.69 | W |
| SURFACE 66 | 90.1-2004 NONRES 5B ROOF IEAD | 0.30 | 0.357 | 222.88 |  |

**Exterior Fenestration**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Construction | Glass Area [m2] | Glass U-Factor [W/m2-K] | Glass SHGC | Glass Visible Transmittance | Cardinal Direction |
| SUB SURFACE 12 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | E |
| SUB SURFACE 4 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | N |
| SUB SURFACE 8 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | S |
| SUB SURFACE 9 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | W |
| SUB SURFACE 11 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | E |
| SUB SURFACE 3 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | N |
| SUB SURFACE 10 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | S |
| SUB SURFACE 1 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | W |
| SUB SURFACE 2 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | E |
| SUB SURFACE 7 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | N |
| SUB SURFACE 5 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 46.33 | 3.241 | 0.385 | 0.311 | S |
| SUB SURFACE 6 | ASHRAE 90.1-2004 EXTWINDOW CLIMATEZONE 4-6 | 81.08 | 3.241 | 0.385 | 0.311 | W |
| Total or Average |  |  | 3.241 | 0.385 | 0.311 |  |
| North Total or Average |  |  | 3.241 | 0.385 | 0.311 |  |
| Non-North Total or Average |  |  | 3.241 | 0.385 | 0.311 |  |

* 1. Lighting and Internal Load Inputs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Zone | Lighting Power Density [W/m2] | Zone Area [m2] | Hours/Week > 1% [hr] | Full Load Hours/Week [hr] |
| THERMAL ZONE: STORY 1 EAST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 WEST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 CORE SPACE | 11.8403 | 943.23 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 EAST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 NORTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 SOUTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 2 WEST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 CORE SPACE | 11.8403 | 943.23 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 EAST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 NORTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 SOUTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 3 WEST PERIMETER SPACE | 11.8403 | 222.88 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 SOUTH PERIMETER SPACE | 12.9167 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 NORTH PERIMETER SPACE | 11.8403 | 118.41 | 168.00 | 58.70 |
| THERMAL ZONE: STORY 1 CORE SPACE | 8.6111 | 943.23 | 168.00 | 58.70 |
|  | 11.2420 | 4877.41 |  |  |

* 1. HVAC & DHW Inputs

This baseline building is a simple rectangular core-and-perimeter shape, with 5 zones per floor. These zones are served by three separate VAV systems, one for each floor. The first floor has hot and chilled water provided by district heating and cooling plants. The second and third floor share a hot water loop heated by a gas-fired boiler and a chilled water loop cooled by a water-cooled chiller.