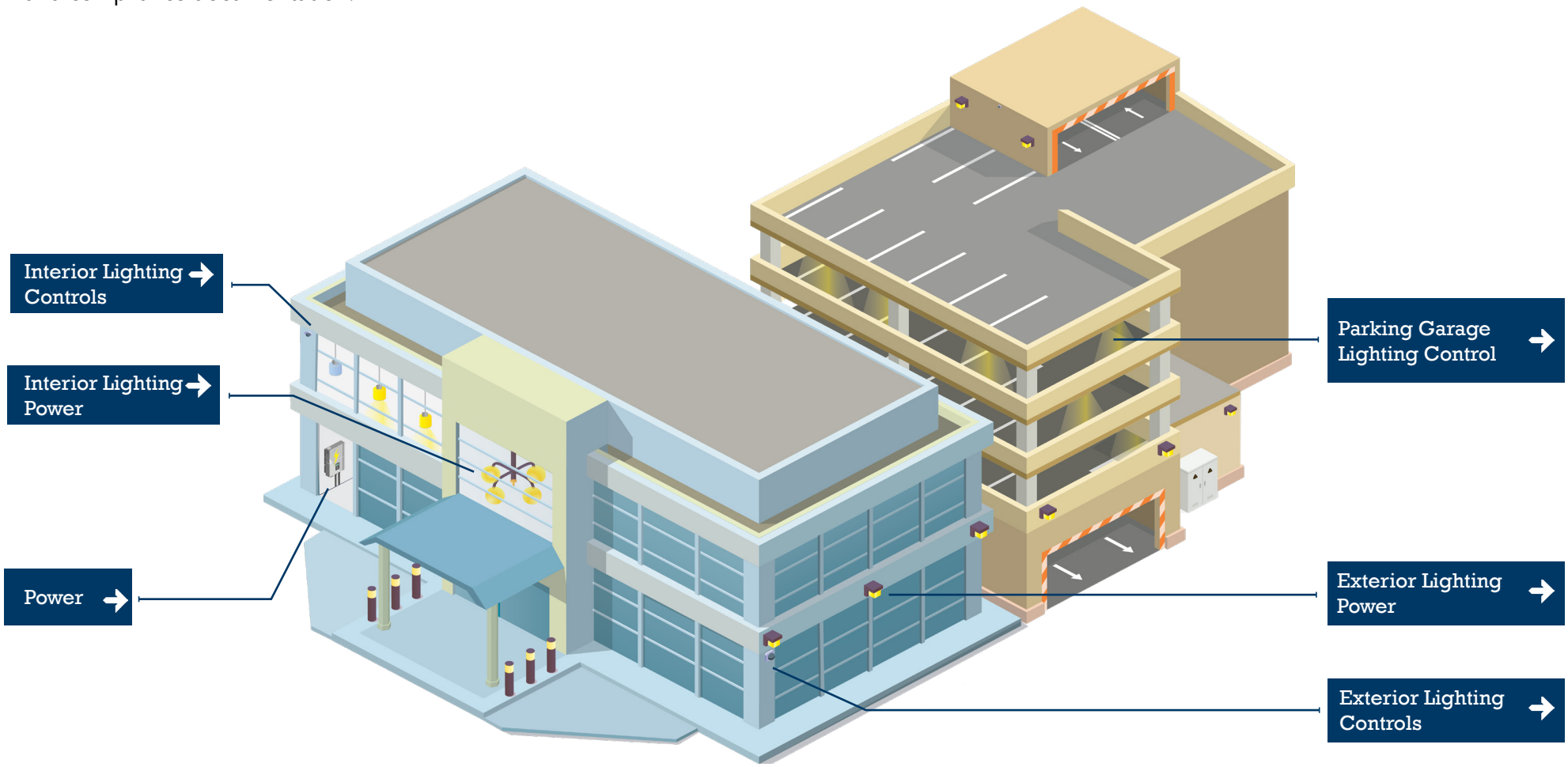
Minnesota Commercial Energy Code

Lighting Application Guide

BuildUp MN
Supporting Energy Codes in Minnesota

This Application Guide supports the Minnesota Commercial Energy Code lighting and power requirements for commercial building projects that are new construction, additions, and alterations.

Click on any of the topics in this interactive infographic for detailed information about requirements, key decisions, roles and responsibilities, and compliance documentation.



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Application Guides

This Application Guide is meant to provide guidance to industry practitioners and code enforcement officials on the intent and application of Minnesota's 2024 Commercial Energy Code (Energy Code).

A suite of Guides will be published covering the building systems which are regulated in the Energy Code.

Envelope – Envelope system components such as roof, walls, windows, floors, doors, etc. ***COMING SOON!***

Mechanical - Space conditioning, ventilation and refrigeration system components such as fans, ductwork, controls, heat rejection equipment, etc.

Lighting & Electrical – Indoor and outdoor lighting and electrical system components such as luminaires, controls, receptacles, metering, etc.

Plumbing – Domestic water heating system components such as water heaters, piping, controls, etc. ***COMING SOON!***

Contributors:

NORESCO

CEE Center for Energy and Environment

This Application Guide was developed by BuildUp MN, a program implemented by the MN Advanced Energy Codes Partnership with the goal of improving energy code compliance across Minnesota and developing the workforce for the next generation of buildings. This material is based on work supported by the US Department of Energy's Energy Efficiency & Renewable Energy Office (EERE) under Award Number DE-EE0010933.

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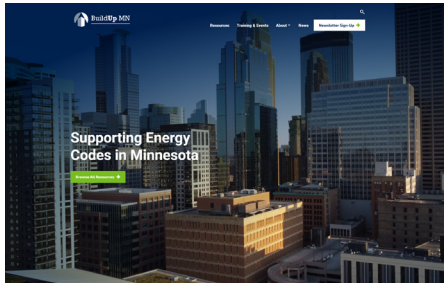
BuildUp MN
Supporting Energy Codes in Minnesota

BuildUp MN offers training, tools and resources to support energy code compliance with the MN Commercial Energy Code.

Visit our website: https://buildupmn.org



Using This Guide

Look for these color-coded call out boxes with helpful context, additional information and calculation support.

Important Information

Additional Resources

Example Calculation

Importance of Energy Efficient Lighting Systems

Since lighting systems are constant energy consumers in Minnesota's buildings, a focus on reducing loads associated with this end use is important. Lighting building spaces is a considerable portion of a commercial building's energy consumption. As a result, requiring energy efficient lighting systems and associated controls can have a significant contribution towards efficient building operation, and at a statewide scale, a sizable contribution to meeting Minnesota's energy efficiency goals.

Lighting systems can provide energy and cost savings based on how they operate over time. If efficient systems are included in the building design, and are installed, maintained, and monitored consistently, operational cost savings over the life of the equipment can be realized. This is emphasized in the 2024 MN Commercial Energy Code (Energy Code), and in this Guide, by focusing on lighting power density, lighting controls, monitoring systems, and commissioning.

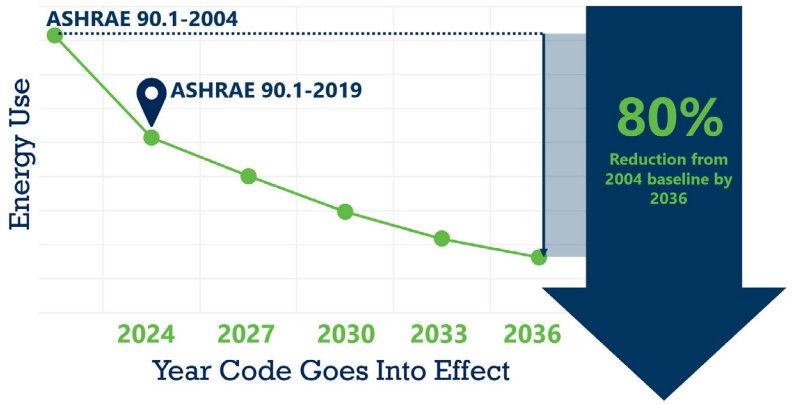
Glare and daylight in buildings are also impacted by the design, installation and maintenance of lighting systems. Energy Code requirements promote healthy environments in addition to operational cost savings in an effort to set a minimum performance standard for all buildings, not just those with adequate project budgets. Automated lighting controls and monitoring of these systems can also contribute to building resiliency when major weather events arise, getting buildings back online for safe and secure operations and by helping predict how systems will respond in the future.

MINNESOTA'S ENERGY EFFICIENCY GOALS

Minnesota's Climate Action Framework calls for new commercial and multifamily buildings to reach net zero by 2036 and achieve significant energy and emissions reductions in existing buildings. To meet energy reduction goals and ensure our next generation of buildings are ready for the changing climate, Minnesota has committed to advancing energy codes for commercial and multifamily buildings.

Recent legislation has enshrined in statute aggressive energy efficiency improvement goals for the commercial energy code. Beginning in 2024, Minnesota must adopt a new energy code each time a new model code is released at the national level —approximately every three years— with an 80% efficiency improvement over a 2004 baseline by 2036.

Read more here: https://climate.state.mn.us/minnesotas-climate-action-framework



Applicability and Scope of This Guide

Section 8 Power

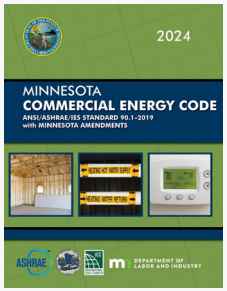
The scope of this guide includes Section 8, for building power distributions systems and equipment including transformers and other equipment. These systems can be installed in new buildings or additions, as well as alterations where equipment is new, and not relocated or reused equipment from the same site. For alterations, the requirements only apply to the sections of the building being altered. There are required Mandatory measures and an Alternative Compliance Path for large computer rooms.

Section 9 Lighting

Section 9 applies to the design of all interior lighting as well as all exterior lighting connected to the building's electrical service. There are some exceptions for lighting types that do not need to meet the Minnesota 2024 Energy Code including emergency lighting, exit signs and other life safety lighting, and decorative gas lighting. The code requirements apply to new commercial buildings, additions, and alterations where at least 80% of the lighting is being changed. There are requirements for lighting power density and lighting controls for both interior and exterior lighting. Compliance includes meeting all Mandatory measures in Section 9.4 plus verifying compliance with one of the Prescriptive or Performance methods available.

Additional Resources

2024 MN COMMERCIAL ENERGY CODE



Minnesota's 2024 Energy Code went into effect on January 5, 2024. The Energy Code includes Minnesota amendments to ANSI/ASHRAE/IES Standard 90.1-2019. The complete Energy Code, including the Minnesota amendments, is available from the International Code Council (ICC) online or via hard copy code books.

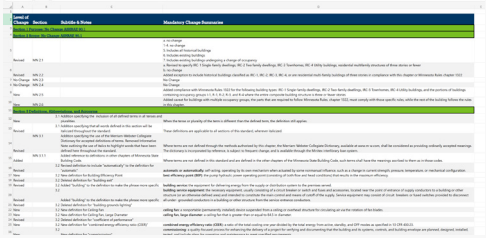
Online: https://codes.iccsafe.org/content/MNEC2024P1/2024-minnesota-commercial-energy-code

Code Books: https://shop.iccsafe.org/custom-codes/state-codes/minnesota.html

WHAT'S CHANGED FROM 2020 TO 2024 ENERGY CODE

BuildUp MN has created a spreadsheet noting significant changes between the 2020 MN Commercial Energy Code and the 2024 MN Commercial Energy Code. Both new requirements and revisions to previous requirements are noted. The tables also note which changes are Minnesota Amendments to ASHRAE 90.1-2019.

Find the What's Changed spreadsheet online: https://www.buildupmn.org/all-resources



What's New in the 2024 MN Commercial Energy Code

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The 2020 MN Commercial Energy Code incorporated the 2018 International Energy Conservation Code (IECC) and ANSI/ASHRAE/IES Standard 90.1-2016 with Minnesota-specific amendments made by the State. For the 2024 MN Commercial Energy Code update, incorporation of the IECC provisions has been removed and the requirements are based on ANSI/ASHRAE/IES Standard 90.1-2019 with Minnesota amendments per Section 1323.0010.

In addition, the following building lighting and power requirements have been added or changed in the 2024 Energy Code:

Section 8: Power

Minor changes were made in this Section:

- Minnesota removed Section 8.4.2 requiring automatic receptacle controls because of a perception of possible safety issues. Issues cited during rulemaking include that automatic controls provide limited energy efficiency due to a need for continuous use by building occupants. There was a concern that occupants may connect power strips and extension cords to receptacles that provide continuous electricity, thereby creating a hazardous condition.
- Section 8.6.1 provides large power distribution systems and equipment dedicated solely to computer rooms with IT equipment load greater than 10kW an option to meet ASHRAE Standard 90.4 Energy Standards for Data Centers as an alternative compliance path to meeting Mandatory provisions in Section 8.4.
- Reorganization of compliance and record documentation has been included in Section 8.7.3.
- Section 8.9 for testing, verification and commissioning has also been added.

Section 9: Lighting

Beyond the addition of a simplified method option for three building types, changes were minimal:

- Added the Simplified Method for interior and exterior lighting in office, retail, and school projects.
- Minor revisions to lighting power allowances for interior and exterior lighting, parking garage lighting controls, special applications, and dwelling units.
- Parking lot lighting fixture efficacy is also governed by the Minnesota Department of Transportation in Minnesota Rules, chapter 8885.
- Changes to Performance Rating Method (Appendix G) related to Mandatory provisions and proposed and baseline calculations for lighting.
- Section 9.9 for testing, verification and commissioning has also been added.

Compliance Pathways

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The 2024 Energy Code utilizes ASHRAE 90.1-2019 and therefore includes Prescriptive and Performance compliance pathways, and for lighting, also includes a Simplified Building Method compliance pathway. The Energy Code requires the entire project to follow the same compliance path, either Prescriptive or Performance. A project cannot mix Prescriptive Path and Performance Path for building compliance. For example, if lighting is pursuing the Simplified Lighting Approach under the Prescriptive Path, other building systems such as HVAC, envelope, water heating, etc. must also comply prescriptively. This is also true when following the Performance Path using Performance Rating Method (PRM) or Energy Cost Budget (ECB). The Building Area Method can be applied to any building types not covered by the Simplified Method. Figure 1 on page 8 outlines the different options for compliance.

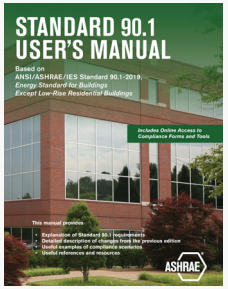
Irrespective of which path you choose, Mandatory control requirements under Section 9.4 are required for all projects including Performance Path.

There are many factors that must be considered to decide which compliance option to choose, even within the Prescriptive paths available. Some options are only offered for single building use types, while others allow for flexibility in lighting across spaces. While prescriptive paths progress (Simplified, Building Area Method, then Space-by-Space) in terms of the complexity of calculations, they are the inverse when it comes to flexibility in designing lighting systems and related controls.

The Simplified Method can only be used for schools, offices, and retail if 80% of more of the floor area supports these building types. For any mixed-use building types, the Simplified Building Method is not an option. This approach is best for smaller and less complex buildings, as the approach implies. Lighting controls are also included in the tables in Section 9.3.2 alongside interior and exterior lighting power allowances, making this approach straightforward to use. Calculations should be performed to verify compliance by the design team before plan check, since COM*check*™ does not support calculations for the Simplified Method. The Simplified Method can also be used as an early design tool to create a baseline lighting power allowance for both interior and exterior lighting. The lighting power density calculated can help guide the design strategy as the concept and early design phases progress. Mandatory control requirements are incorporated into the Simplified Method per Section 9.3.

Additional Resources

ASHRAE/IES 90.1-2019 USER'S MANUAL AND COMPLIANCE FORMS



Guidance and compliance forms are published in the ASHRAE/IES 90.1-2019 User's Manual to assist in understanding and documenting compliance. The guidance and forms do not include Minnesota's amendments to ASHRAE/IES 90.1-2019 that together make up the 2024 Minnesota Energy Code. However, these could be used for instruction, and in some cases, such as for the Simplified Approach compliance path, would only need minor modifications to reflect Minnesota's amendments.

Find the ASHRAE/IES 90.1-2019 Compliance forms on the ASHRAE website: https://www.ashrae.org/technical-resources/bookstore/supplemental-files/supplemental-files-for-the-standard-90-1-2019-users-manual

The Building Area Method can be applied to any building types not covered by the Simplified Method. Designers will need to subdivide building areas by type, then apply the associated lighting power allowance to each gross lighted floor area. COM*check*™ can greatly streamline compliance calculations and eliminate data entry errors by automatically applying the allocated building envelope area types to lighting areas. The tool auto populates the lighting power density and totals the lighting power allowance for all space types to create the baseline.

The Building Area Method is flexible enough to use for prescriptive compliance for most building types, however if the lighting designed exceeds the lighting power allowance or there are more specific lighting applications, the Space-by-Space method may be the most flexible compliance option. This method allows for additional interior lighting power for retail lighting and allows additional lighting power for implementing non-mandatory lighting controls. COM*check*™ can provide compliance verification for the Space-by-Space option as well.

If additional flexibility is required for the building design, compliance can be verified through one of two Performance methods, including the Energy Cost Budget method, outlined in Section 11 or the Performance Rating Method using Appendix G. Both of these compliance methods require energy modeling and are usually dictated by envelope and HVAC system trade-offs that can be made between building systems using the Performance approach. Either of these compliance options are well suited for more complex buildings and lighting and power loads are either neutral or can sometimes benefit projects based on the lighting design.

Power requirements in Section 8 are Mandatory and straightforward. There are no Prescriptive options available, so compliance is shown by meeting Mandatory measures in the construction documents.

Lighting and Power Requirements for All Compliance Paths

The following sections apply to all newly installed power distributions systems, regardless of the compliance path chosen:

- Section 8.1 General
- Section 8.4 Mandatory Provisions (except for Alternative Compliance Path for computer room systems)
- Section 8.7 Submittals

The following sections apply to lighting systems for all projects, even alterations, regardless of the compliance path chosen:

- Section 9.1 General
- Section 9.4 Mandatory Provisions (Lighting Mandatory Provisions built into the Simplified Method)
- Section 9.7 Submittals

Compliance Pathways

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Figure 1 shows the compliance pathways for lighting and power systems, the required documentation for each option, and the context that lighting systems play alongside Envelope and HVAC in selecting a compliance approach.

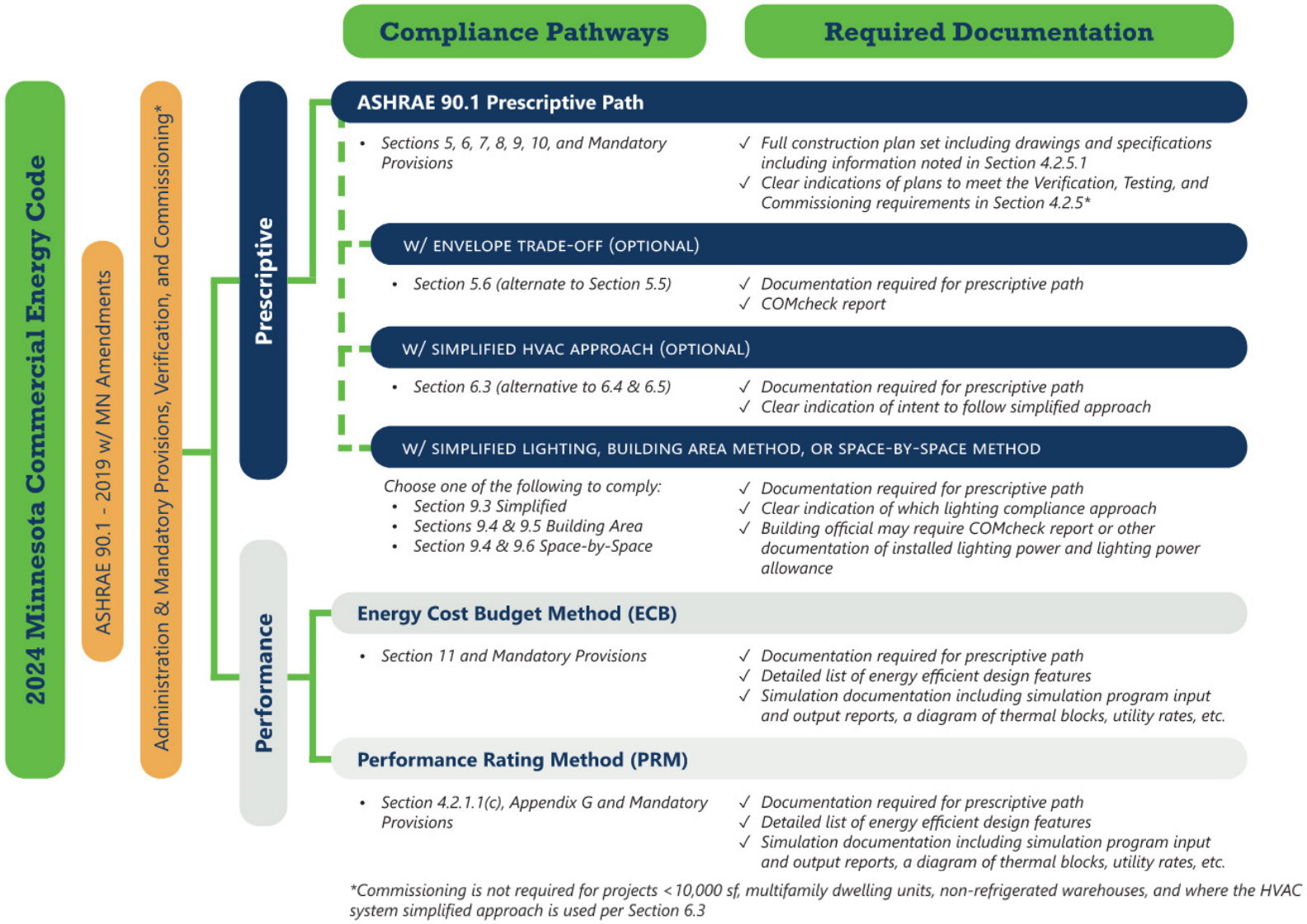

Figure 1: Compliance Pathways Available in the 2024 MN Commercial Energy Code

Alternative Compliance Path for Power

While provisions in the power section are Mandatory, there is an alternative compliance path available for power distribution systems and equipment serving a computer room with IT equipment with a load greater than 10 kW. This level of power consumption is typically associated with a large server room or small data center, thus the application of ASHRAE 90.4 for Energy Standards for Data Centers, which more readily applies to large IT loads for computer rooms. For all other power systems and equipment, the provisions in all of Section 8.4 are required.

Prescriptive Compliance Paths for Lighting

There are three different Prescriptive paths available to use the Simplified Method, Building Area Method, and the Space-by-Space Method.

Simplified Building Method Path for Lighting

This approach can only be used for small projects including tenant improvements or new construction projects less than 25,000 ft^2. The Simplified Building Method provides one interior maximum allowable power allowance per ft^2, but with varying control requirements. The exterior wattage allowances are calculated a little differently, starting with a base allowance plus additional allowance for several lighting design elements, and each has associated control requirements. These control requirements are the same for the majority of additional lighting. Interior and exterior calculations are meant to be completed separately.

- Office (Table 9.3.1-1) and School Buildings (Table 9.3.1-3): 0.70 W/ft^2 for all spaces except parking lots (which are 0.13 W/ft^2)
- Retail Buildings (Table 9.3.1-2): 1.0 W/ft^2 for all spaces except parking lots (which are 0.13 W/ft^2)
- Exterior lighting power allowances vary by application type and are located in Table 9.3.2.

When using the Simplified Building Method, compliance with Mandatory provisions in Section 9.4 is not required, however general requirements in Section 9.1 and submittal requirements in Section 9.7 are still applicable. The intention of this compliance pathway is to provide a streamlined set of requirements for lighting power density and lighting controls that apply to single building use types and small projects. The tables in the section are straightforward to help designers, plans examiners and installers easily include, comply with, and verify each requirement.

Documenting and verifying compliance should include lighting schedules and calculations showing installed lighting is less than or equivalent to the maximum allowance in each table.

ENERGY CODE TRAINING

Training will be offered in several modalities including in-person and online options. Visit BuildUp MN's website to see upcoming and recorded training offerings!

Available training on the BuildUp MN website:

https://www.buildupmn.org/training-events

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Building Area Method for Lighting

The advantage of this Prescriptive calculation method is the ease in which lighting power allowance can be calculated. In this approach, based on the building type, the corresponding lighting power density (LPD) (W/ft^2) in Table 9.5.1 is multiplied by the building gross area to determine the lighting power allowance (W).

For example, a collegiate recreation center could be allocated by area to gymnasium, office, sports arena, and exercise center use types. If specific building use types are not listed in the table, a reasonable equivalent use type can be utilized.

Calculations of maximum allowed lighting power are additive and based on gross lighting floor area in ft^2. Once all areas of the building are accounted for with an associated lighting power allowance, the cumulative lighting power allowance can be used as a total amount to allocate as desired. Lighting power can be distributed according to the intended design, as long as the maximum allowable is not exceeded. This compliance methodology provides flexibility without complex calculations. Lighting controls are mandated by the Mandatory measures and are dependent on space type and application according to Table 9.6.1.

Space-by-Space Method for Lighting

This method of calculating lighting power density allows for the most flexibility in lighting design. Considered the alternative methodology, the Space-by-Space Method involves more complex calculations but allows for more varied controls based on particular lighting needs. Trade-offs can also be used with this compliance option as long as the total lighting power allowance for the building is not exceeded.

Both LPD and lighting controls are outlined in Table 9.6.1, divided up by general space type in the top section and by specific space type in the bottom section. Similar to the Building Area Method, the Space-by-Space Method is followed by breaking down the building into individual spaces, allocating each one a lighting power allowance according to the table and summing them for a total. There are specific qualifications for a space or subspace written in section 9.6.1. As a rule of thumb, multi-functional spaces that are less than 1,000 ft^2 or 20% of a general space type don't need to be broken down any further. When spaces have differing functions, the goal of this approach is to break spaces down as much as possible by use type.

Reasonable equivalency can also be used here if the space function is not listed. Design teams will need to assess these unique spaces and allocate them appropriately. Note that lighting control requirements are applicable to the same space that is used for determining the LPD. There are no trade-offs between LPD and required lighting controls.

Additional interior lighting power can be added for specialty lighting functions, as long as they are controlled independently. Typically, these are related to retail sales, exhibits, and art lighting. If applicable, follow the calculations shown within Section 9.6.2 to calculate any additional interior lighting the project may be allocated. Additional interior lighting power can also be added if non-mandatory controls are installed per Table 9.6.3.

In Table 9.6.1, Room Cavity Ratio (RCR) thresholds are shown. This refers to an adjustment that can be applied to the lighting power density if the RCR is greater than the threshold listed in the table. This is only applied to smaller tight spaces, like corridor or transition spaces narrower than 8 feet wide, which are allowed to increase the LPD by 20%, regardless of the stated RCR.

Prescriptive Path Compliance Verification

Compliance with many Mandatory and Prescriptive requirements can be documented using a COM*check*™ report submitted with the permit application. Consider completing a preliminary COM*check*™ analysis during Design Development to ensure compliance will be achieved before final construction documents are completed. Also note all inputs into the COM*check*™ tool must be shown on final construction documents to be verified during plan check. Keep in mind that while COM*check*™ reports are useful tools to demonstrate how lighting systems are complying with the Energy Code requirements they are generally not part of the contract documents that the contractor is being held to fulfill.

ASHRAE 90.1 Performance Paths

If the project team cannot or desires not to meet a Prescriptive requirement, the Performance Path must be used to "trade-off" that requirement and still demonstrate compliance.

ASHRAE 90.1 Energy Cost Budget Method

One of the two options to demonstrate compliance via a Performance Path is to use the Energy Cost Budget Method outlined in Section 11. Performance Path projects must be modeled using energy simulation software that meets detailed requirements and is tested according to ASHRAE Standard 140, such as IESVE, eQUEST, Trane TRACE® and EnergyPlus™. These programs model all building systems and calculate the impact of "trade-offs" between certain building features. For example, if a building design has more window area than is allowed via the Prescriptive Path, a lighting or HVAC design that is more efficient than prescriptively required could be used as a "trade-off" to bring the building as a whole into compliance. Section 11 also requires compliance with Mandatory lighting provisions in Section 9.4 and Mandatory power requirements in Section 8.4, which cannot be traded-off.

Important Information

LIGHTING WATTAGE TIPS, TERMINOLOGY, AND EXCEPTIONS

Generally, installed lighting power means the luminaire wattage which includes all the power used by the luminaire including the lamps, ballasts, drivers, transformers, and control devices. If there are two or more lighting systems in the same space that can be used separately but not simultaneously, the higher of the two system wattages must be used. This is the case for interior and exterior lighting conditions.

To determine luminaire wattage, here are typical ways to find the total wattage, based on system type:

Lighting equipment: On the manufacturer's label as maximum wattage.

Remote ballasts and drivers in line voltage equipment: Sum of the total input wattage of all line voltage components in the system.

With adjustable ballasts: Wattage should be based on the ballast factor that will be used in the space.

Lighting track (line voltage) and plug-in busways which allow addition and/or relocation of lighting equipment: Use a minimum of 40 W/linear foot or the wattage limit of the systems' circuit breaker, or the wattage limit of other current-limiting devices.

Low-voltage lighting track, cable conductor, or flexible lighting systems: Specified by wattage of ballast or driver to transformer supplying the system.

DC low-voltage lighting system: On the manufacturer's label as maximum wattage of the system power supply. If a combined system (lighting and other equipment), reduce the maximum wattage by the non-lighting equipment connected.

All others: Specified wattage of the lighting equipment.

When using the Energy Cost Budget Method, the energy simulation software program applies building science physics principles to the representative building models built by the energy modeler. The energy modeler must follow the modeling rules per Section 11 while building the models. Two models are created, one representing the building as designed and the other representing a baseline building that just meets the Prescriptive Path code requirements across all disciplines. To determine compliance with the Energy Cost Budget Method, the simulation program calculates an annual energy cost associated with the building as designed (design energy cost) and an annual energy cost associated with the baseline building that sets a compliant energy budget (energy cost budget). To comply, the design energy cost must be equal to or less than the energy cost budget. The energy simulation software produces results via output reports, which are reviewed for accuracy and compliance by the energy modeler and are summarized for permit application in clear summary tables. Accurately documenting compliance using a whole building energy model requires modeler proficiency with the chosen energy simulation program and knowledge of how to apply the rules of the Energy Cost Budget Method in Section 11.

Even though an exhaustive plan review of the simulation models also requires a deep level of knowledge of simulation software and the modeling rules in Section 11, there are many valuable reality checks that plan reviewers can make without having energy modeling expertise. As with the review of COM*check*™ reports, verifying key inputs (that are usually clearly summarized in a table) against the construction documents is a critical step in the review. Additionally, verification of baseline model inputs against the Section 11 rules and simple comparisons of some key simulation outputs frequently uncovers any important discrepancies.

The design energy cost and energy cost budget modeling requirements for lighting are listed in section 6 of Table 11.5.1, while power requirements are outlined in section 12 under

Additional Resources

COM*CHECK*™ WEB TOOL

COMcheck•Web™

COM*check*™ is supported by the U.S. Department of Energy to assist builders, designers, and contractors in demonstrating energy code compliance with the Prescriptive Path and create compliance reports for code officials on project inputs. Select the MN Commercial Energy Code for the tool to reflect Minnesota amendments. DOE also maintains a recorded video called COM*check*™ Basics that includes an overview of the basic functions of the COM*check*™ software, how to identify the construction specifications needed to complete a compliance calculation and how to enter the building thermal envelope components, lighting and mechanical systems into the software.

Access the COM*check*™ web tool at https://energycode.pnl.gov/COMcheckWeb/

Watch the COM*check*™ Basics video at https://training.energycodes.gov/ui/course/1884/preview/true

GUIDANCE ON PLAN CHECKING COM*CHECK*™ REPORTS

MINNESOTA ENERGY CODE SUPPORT PROGRAM

The Minnesota Energy Code Support Program has produced four Commercial Energy Compliance Certificate Technical Documents that review how to read COM*check*™ reports for thermal envelope, HVAC, indoor lighting and outdoor lighting. Training is also offered to review the COM*check*™ tool, its inputs, and walking through the reports.

Find the Technical Documents and the Training on the Program website: www.minnesotaenergycodesupport.org

Miscellaneous Loads. As with the other lighting compliance options, the lighting design still must meet 9.2.1, which includes the Mandatory measures plus the requirements within 9.1 General and 9.7 Submittals.

ASHRAE 90.1 Performance Rating Method (Appendix G)

The other option to demonstrate compliance via a Performance Path is to use the Performance Rating Method in Appendix G. Just like the Energy Cost Budget Method, whole building energy models are created using energy simulation software that evaluates the impact of trade-offs between building systems. Using this compliance method requires the project to meet the Mandatory requirements in Section 9.4 and Section 8.4, which cannot be traded-off.

Similar to the Energy Cost Budget Method, two energy models are created by the energy modeler and building physics are applied by the software to simulate performance during building operation. The energy cost results from the two models are compared to determine compliance with the rules outlined in Appendix G. The primary difference form the Energy Cost Budget method is that the baseline model for the Performance Rating Method is based on a level of performance that roughly matches the 2004 version of ASHRAE Standard 90.1 and does not change with each iteration of the energy code.

What does change with each code cycle are the Building Performance Factors that scale the regulated portion of baseline building energy that is used to calculate a Performance Cost Index Target that the proposed design model must match or be better than (i.e. lower). Simulation output reports are reviewed by the modeler to evaluate accuracy of the models and to evaluate compliance. The compliance results should be summarized and included in the permit application. As with the Energy Cost Budget Method, modeling to demonstrate compliance with the Performance Rating Method necessitates some level of expertise with the Appendix G modeling methodology and use of the energy simulation program.

The Performance Rating Method in Appendix G outlines the proposed and baseline lighting performance in Section 6 of Table G3.1, while power requirements are shown in Section 12 Receptacles and Other Loads and Section 15 Distribution Transformers. Minnesota has updated the baseline lighting language to use the values set in Table G3.7 unless lighting is neither existing nor included in design documents, such as in the case of a core and shell design. In this case, and when the proposed design is determined using the Building Area Method, then the baseline design will be created using values from Table G3.8.

Additional Resources

Energy Cost Budget Method (ECB) vs. Performance Rating Method (PRM)

U.S. Department of Energy's Building Energy Codes Program maintains a webpage with information comparing the ECB versus the PRM Methods for Performance Path compliance. The information includes a basic overview of the two methods as well as links to a spreadsheet-based compliance form that can be used for either method, a companion tool for additional calculations, and a review manual to guide plans examiners through reviewing Performance Path permit applications.

Find the DOE Performance Path Resources at https://www.energycodes.gov/performance_based_compliance

If retail display lighting is included in the design, there are two calculations available and the lesser one should be used as the baseline case. If the proposed case applies additional interior lighting power from Section 9.6.2(b), the baseline can be the same as proposed or can be the limits of the additional interior lighting power section, whichever is less.

Areas for which the lighting design is neither existing nor submitted with the design documents must be modeled based on the requirements in Section 9. If space types for the area are known, the Space-by-Space Method should be used to determine the modeled lighting power density; otherwise, the Building Area Method may be used.

Exterior lighting and parking garage lighting must also be modeled in both the proposed and baseline models. The baseline model should include the same exterior spaces as the proposed design. Lighting power levels for the baseline case should be set per the values in Table G3.6.

As with the other lighting compliance options, the lighting design still must meet 9.2.1, which includes the Mandatory measures plus the requirements within 9.1 General and 9.7 Submittals.

Important Information

ONE-FOR-ONE LIGHTING ALTERATIONS

If applying the Simplified Method to an alteration that is not adding new fixtures and is only a luminaire, lamp, or ballast replacement (considered one-for-one), the installed power would need to be reduced by at least 35% for a T12 system, 20% for a T8 or T5 system, 45% for an HID system, and 75% for an existing incandescent system. All these can be achieved by updating to LEDs.

"EQUAL OR BETTER" INSTALLATIONS

Whether using the Prescriptive or Performance Path, it's important that installations are "equal or better" than what was documented for Energy Code compliance for plan check. Field changes and substitutions for building equipment and systems that impact energy consumption might result in the project becoming non-compliant. If the project used the Prescriptive Path, it is easy to determine if a substitution still meets or exceeds a Prescriptive requirement. If the project used the Performance Path, it might be necessary to rerun the energy simulation to determine if the substitution still complies. For that reason, it could be easier for installers to stick to "equal or better" when making substitutions or other field changes.

The possibilities of field substitutions makes it inadequate to simply list a equipment type and product numbers that has compliant performance. It is critical that the CDs also note the minimum performance related to key energy performance parameters within the lighting or electrical schedules, drawing notes, and/or specifications to ensure that any 'equal or better" substitution can be compared against clearly defined requirements.

Lighting Controls Strategies

Interior lighting controls options are specified in Section 9.4.1.1 and are summarized here.

MANUAL

Local controls are required throughout the space to provide occupants with ready access to change the level of lighting in their space. Some examples include:

- ***Restricted to manual ON***, where no lighting is automatically turned on, occupants must use local controls.
- ***Restricted to partial automatic ON***, restricted to 50% of lighting power to be automatically turned on.
- ***Bilevel lighting control***, where additional lighting levels or continuous dimming is provided in addition to full ON and full OFF.
- ***Exception:*** Remote controls are permitted for reasons of safety or security, for example warehouses or retail spaces where continuous lighting is needed.

MOTION

Motion or vacancy sensors adjust lighting levels based on occupant activity within a space. Examples include:

- ***Automatic partial OFF*** must reduce lighting power by 50% within 20 minutes of a space being empty of occupants. ***Full OFF*** also complies here.
- ***Automatic full OFF*** shuts off all lighting within 20 minutes of occupants leaving a space, and is limited to controlling ≤5,000ft².

TIMECLOCK/SCHEDULE

A timeclock runs on a programmed schedule based on when the space will be occupied.

- ***Scheduled shutoff*** will automatically turn off all lighting during times when a space is scheduled to be unoccupied using a time-of-day operated control device, a signal from another control device, or alarm or security system. It may control lighting for ≤25,000 ft², include no more than one floor, and consider weekends and holidays. Manual overrides via local controls may control up to 5,000 ft² and shall be automatically turned off after no more than 2 hours per activation.
- ***Scheduled OFF during nonbusiness hours*** will automatically turn off lights at the end of business hours using time-of-day operated control device, a signal from another control device, or alarm or security system. Manual overrides via local controls shall be automatically turned off after no more than 2 hours per activation.

LIGHT CONTROL AND DAYLIGHT HARVESTING

These controls use photocontrols to respond to available daylight and adjust lighting power levels accordingly.

- ***Automatic daylight responsive controls for sidelighting*** modulates lighting levels in primary and secondary sidelighted areas with calibration adjustment controls using continuous dimming.
- ***Automatic daylight responsive controls for toplighting*** modulates lighting levels in area under skylights and roof monitors with calibration adjustment controls using continuous dimming.

Documenting Compliance within Construction Documents

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After determining the building lighting and power features that will result in Energy Code compliance, it's important to ensure they are properly documented within the construction documents. Floor plans, details, elevations, roof plans, schedules, specifications, etc. all need to reflect the product and performance requirements necessary to comply. This will require coordination with the energy modeler (if the Performance Path is used) or project team member who has evaluated compliance to ensure all inputs into the energy simulation program are properly reflected. If inputs are not reflected in the construction documents, plans examiners will not be able to verify compliance and may issue correction comments and installers won't be able to include compliant products and lighting or electrical features within their bids. The table starting on page 22 of this Guide suggests how Energy Code measures should be reflected in the construction documents.

The possibilities of field substitutions make it inadequate to simply list luminaire types and product numbers that have compliant performance. It is critical that the CDs also note the minimum performance related to key energy performance parameters within the luminaire schedules, drawing notes, and/or specifications to ensure that any 'equal or better" substitution can be compared against clearly defined requirements.

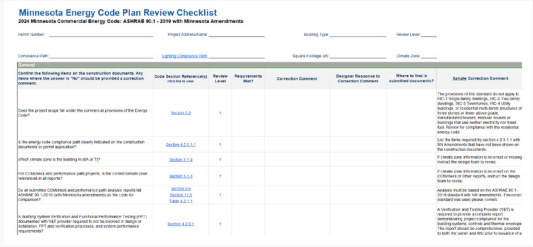
For existing buildings undergoing alterations of any interior and or exterior lighting systems, installed lighting must meet lighting power density and lighting control requirements. Note the definition of alteration in Section 3 to first determine if the Energy Code provisions apply to the scope of the project. All lighting being installed as part of an addition must comply with Mandatory requirements, as well as Prescriptive or Performance requirements just as new buildings must. If an addition can't comply on its own, direction is provided in Section 4.2.1.2.1 regarding how existing building components can be incorporated into the project to comply.

Additional Resources

PLANS EXAMINER CHECKLISTS

BuildUp MN has developed a checklist resource tailored for Plan Examiners to streamline the review process for energy code compliance. This checklist focuses on the most impactful measures, including Mandatory provisions, building envelope, mechanical systems, and lighting components. It also features direct links to applicable code references and helpful sample correction comments to support consistent enforcement. Additionally, the checklist serves as a valuable tool for designers, providing insights to enhance their understanding of Energy Code requirements and improve compliance in their designs.

Find the checklists on the BuildUp MN website: www.buildupmn.org/all-resources


Minnesota Energy Code Plan Review Checklist

Additions and Alterations

There are exceptions including alterations that impact <20% of the connected lighting load as long as the alterations do not increase the connected lighting load, or density. One-for-one luminaire replacements, or replacement of lamps plus ballasts or drivers, are only required to meet lighting power density requirements and one controls requirement: either automatic full OFF (9.4.1.1 (h)) or scheduled shutoff (9.4.1.1 (i)). Any repair or regular maintenance is exempt from code requirements per Section 9.1.2. Historical buildings may qualify for exemptions from some elements of the Energy Code. Reference Minnesota Rules, chapter 1322 for more details.

Compliance for alterations using a one-for-one luminaire replacement scenario should consider using the Simplified Building Method which only requires a reduction of installed power by a certain percentage based on existing luminaire type. See exception 9.3 for compliance thresholds. If more complicated lighting alterations are included in the project scope, consider either the Building Area Method or Space-by-Space Method plus control requirements in the Mandatory measures, as applicable.

For exterior alterations, projects must comply with Mandatory requirements for lighting power in Section 9.4.2 as well as control requirements in Section 9.4.1.4. Remember that lighting power allowances are determined by exterior lighting zone shown in Table 9.4.2-1 Exterior Lighting Zones. Most projects will be in Zone 2-4, and designers must select the most applicable zone for the project location.

Additional Resources

Minnesota State Historical Preservation Office (SHPO)

The National Historic Preservation Act of 1966 provided for a network of historic preservation offices in every state to spearhead state preservation initiatives and help carry out the nation's historic preservation program. Minnesota's SHPO was created by state statute in 1969 to provide statewide leadership. The SHPO website includes a statewide inventory of Minnesota's historic resources, historic reports, and archaeological reports, 1,750 Minnesota listings, encompassing over 6,000 properties from all counties in the state found on the National Register of Historic Places, links to the federal and state laws that protect historic and archaeological properties, as well as the project review process in Minnesota, and many more resources.

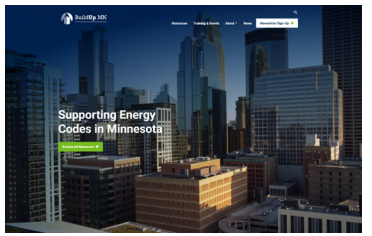
Find information on Minnesota's historic preservation efforts on the SHPO website: https://mn.gov/admin/shpo/

ENERGY CODE SUPPORT

BuildUp MN offers no-cost training, tools and resources to ease code navigation, application and compliance.

Visit our website to learn more and sign up for our newsletter to stay up to date.

https://buildupmn.org



Commissioning & Field Testing

Commissioning and functional testing has been incorporated into the Energy Code because energy efficient operations depend upon following design intent, quality installation, equipment start-up, controls programming, functional performance testing, and training building maintenance staff on systems operation, which are all part of the commissioning process. Owners and tenants reap operational benefits intended by the Energy Code when efficiency features are installed and function properly, which is the primary purpose of building commissioning and testing.

The intent of commissioning and functional testing is not necessarily focused on code compliance, but rather to deliver a building project meeting the design requirements of the owner and initial operations based on the design. However, the required submissions for documentation of field testing and a preliminary commissioning report can be leveraged by code officials to be informed by a third-party verification.

Verification During Design and Construction

Sections 8.9.1 and 9.9.1 require that detailed instructions for testing lighting controls and power systems are included in the construction documents, which typically takes the form of verification specifications or quality control sections of lighting specifications in the project manual. The commissioning plan often includes content such as goals of the commissioning process, building systems to be included in the commissioning scope, original design intent for those systems, test procedures and conditions for functions to be tested, and acceptance criteria.

Project management content such as roles for involved team members, schedule, and deliverables is also commonly included. Section 4.2.5.1.1 lists information to be included in the permit application, which reasonably aligns with content typical in commissioning plans. Drafting this plan during design and before permitting requires a commissioning provider be designated during the design phase, not at the start of construction.

DEFINED ROLES FOR COMMISSIONING

Commissioning Provider: Section 3 defines the commissioning provider as an entity who manages the commissioning team to implement building commissioning. Section 4.2.5.2 has additional requirements for the commissioning provider when the listed exceptions (see page 21) don't apply.

The commissioning provider shall be:

(a) a third-party entity not associated with the building project,

(b) owner's qualified employees, or

(c) an individual associated with the design firm or contractor but not directly associated with design or installation of the building systems, controls, or building envelope being commissioned.

Verification and Testing Provider (V&T Provider): Also per Section 3, a verification and testing provider is an entity who completes the activities needed to implement the building functional performance testing (FPT) activities or verify that elements of the building project meet stated requirements. Per Section 4.2.5.1 Verification and Testing (V&T), Providers can't test equipment or systems where they served as the designer or installer. V&T Providers must be identified within the construction documents, most logically within the draft commissioning plan.

Building projects which do not meet the exceptions for Section 4.2.5.2 (listed on page 21 of this guide) are required to meet additional commissioning requirements including a design review conducted by the commissioning provider. The design review must document how the design meets the owner requirements documented during programming in the Owner's Project Requirements (OPR) document and summarize how the project design meets the Energy Code. Informative Appendix H includes Table H-3 listing specific items to check during the design review related to Energy Code compliance verification.

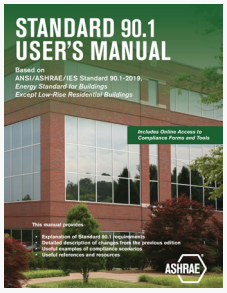
During construction, functional performance testing (FPT) and verification should occur based on the schedule outlined in the commissioning plan. As construction schedules often change, the commissioning provider and others involved should be kept up to date, so the FPT happens at the right time and does not delay or interfere with ongoing construction activities. Results from testing and verification are required to be provided to the building owner along with a plan to conduct any future testing that requires seasonal weather conditions or other types of deferred testing. Unless the project meets a listed exception to Section 4.2.5.2, these preliminary results must be included in a draft commissioning report, created by the commissioning provider, along with the other required content listed in Section 4.2.5.2.2(c). Commissioning continues after the building is occupied and must be completed before the contractor's general warranty period expires. The final commissioning report is provided to the owner at that time.

Commissioning and the Permitting and Inspection Process

Although the commissioning process is parallel to permitting and inspection processes, there are specific Energy Code requirements that should be verified during plan check and inspection. During plan check, the existence of commissioning specifications within the project manual should be confirmed. Unless the project meets one of the exceptions listed in Section 4.2.5.2, a draft commissioning plan and results from a design review should also be included in the permit application.

Additional Resources

ASHRAE/IES STANDARD 202 THE COMMISSIONING PROCESS REQUIREMENTS FOR NEW BUILDINGS AND NEW SYSTEMS



Section 4.2.5.2 requires using ASHRAE/IES Standard 202 or other generally accepted engineering standards approved by the building official for building projects equal or greater than 10,000 ft^2 of conditioned floor area and with combined heating, cooling and service water heating equipment with total capacity 960 kBtu/h or greater. Other exceptions are listed in Section 4.2.5.2.

Find Standard 202 and other commissioning resources on the ASHRAE website: https://www.ashrae.org/technical-resources/bookstore/commissioning

During inspection, a letter from the building owner should be submitted stating that functional performance testing and field verification results and an issues and resolution log have been provided to the owner. Unless the project meets a listed exception to Section 4.2.5.2, a preliminary commissioning report should also be provided to the owner before occupancy and documented as received in the owner's letter to the inspector. Section 4.2.5.3(c) gives the AHJ authority to ask for a copy of these documents in addition to the owner's letter. Note the final commissioning report will not be completed until after building occupancy, but a preliminary report should be available if requested by the AHJ.

Commissioning-related Lighting and Power Submittals Required by the Energy Code

Section 9.7 of the Energy Code requires several lighting submittals that relate the commissioning process to other construction processes such as verification and testing. Lighting control devices and control system testing is required by Section 9.9.1 and would typically be verified by the commissioning provider as part of the commissioning process. Commissioning also typically includes verifying that operation and maintenance (O&M) manuals are provided to the building owner, which are required in Section 9.7.3.2. Sections 8.9.1 and 8.7.3.2 in the Power Section have similar requirements for the energy monitoring equipment.

Additional Resources

ENERGY CODE HELPLINE

MINNESOTA ENERGY CODE SUPPORT PROGRAM

The Minnesota Energy Code Support Program offers a helpline to ask Energy Code experts questions. Frequently asked questions will be posted on their website to increase access to the answers. Questions will also inform training topics and other support offered by the Program.

Submit an Energy Code question on the Program's website: www.minnesotaenergycodesupport.org/helpline

Commissioning & Field Testing

Verification, Testing and Commissioning Activities Timeline

4.2.5.1 TESTING & VERIFICATION: All projects must comply with section 4.2.5.1 Verification and Testing requirements.

4.2.5.2 COMMISSIONING: Most projects must also comply with section 4.2.5.2 for Commissioning, with these exceptions:

- Buildings, additions or alterations with <10,000 ft^2 of conditioned space AND with combined heating, cooling and service water heating equipment totaling <96 kBtu/h in capacity OR
- Buildings or portions of buildings using the Simplified Approach Building Compliance Path for HVAC Systems (Section 6.3) OR
- Dwelling units OR
- Nonrefrigerated warehouses

	4.2.5.1 TESTING & VERIFICATION	4.2.5.2 COMMISSIONING
Design	Include information listed in Section 4.2.5.1.1 in construction documents prior to permit application.	Select Commissioning Provider per Section 4.2.5.2 and identify in construction documents. Commissioning Provider performs design review & submits report to owner. Identify construction phase commissioning requirements in specifications and/ or draft commissioning plan. (4.2.5.2.1)
Permitting		Include information listed in Section 4.2.5.1.1 in draft commissioning plan. Copy may be requested by plans examiner. (4.2.5.2.1)
Construction	V&T Provider performs verification/ FPT to confirm compliance. (4.2.5.1)	Commissioning Provider finalizes commissioning plan and provides to owner and project team (4.2.5.2.2) Commissioning Provider performs verification/ FPT to confirm compliance. Performs commissioning per ASHRAE/IES Standard 202. (4.2.5.2)
Occupancy	Results of verification/FPT provided to owner by V&T Provider with plan to complete any deferred FPT. Copy may be requested by inspector or letter from owner confirming receipt required. (4.2.5.1.2/ 4.2.5.3)	Commissioning Provider provides preliminary commissioning report to owner prior to occupancy. Copy may be requested by inspector or letter from owner confirming receipt required. Provides final report to owner before warranty period expiration. (4.2.5.2.2/ 4.2.5.3)

Lighting and Power Energy Code Measures

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The following table lists Mandatory, Prescriptive and optional Performance measures based on the 2024 Energy Code along with what design features "trigger" the code requirement and where the measure should be documented within the construction documents. Where available, examples have been provided of what the measure might look like in the floor plans, luminaire schedules, specifications, etc.

This table is not meant to replace Energy Code language and does not include details of the requirements. It can be used as a reference to understand what measures are regulated and applicable to each compliance path, what triggers each measure, and includes hyperlinks to the code section so the full Energy Code requirements can be accessed.

Icons are used throughout the table to label compliance paths, Minnesota Amendments, and compliance documentation examples.

KEY

Denotes compliance paths for which section is required.

- → Simplified
- ☑ Prescriptive
- Performance

mn Denotes sections with MN Amendments to ASHRAE 90.1-2019

POWER				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: → Simplified ☑ Prescriptive Performance	8.4.1	**Voltage Drop** Section 8.4.1 requires that feeder conductors and branch circuits together have to be sized for a maximum total voltage drop of 5%. ***Intention of Requirements***: Limit energy losses caused by undersized wiring.	Required for any new equipment installed in all new buildings, additions, and alterations.	The Project Manual or Specifications will have feeder and branch conductor sizing guidelines that include the maximum voltage drop.

Lighting and Power Energy Code Measures

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POWER				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: → Simplified ☑ Prescriptive Performance	8.4.3.1 and 8.4.3.2	**Electrical Energy Monitoring** Section 8.4.3.1 requires measurement devices be installed to separately monitor the electrical energy use for the total electric load, HVAC systems, interior lighting, exterior lighting, and receptacles. Section 8.4.3.2 details the mandatory requirements for recording and reporting the data that is collected from measurement devices. ***Intention of Requirements:*** To provide data for managing electrical loads in buildings to benchmark uses, make decisions, and understand how to operate a building efficiently.	Required for buildings 25,000 ft^2 and larger, except for dwelling units, individual tenant spaces less than 10,000 ft^2, residential buildings with less than 10,000 ft^2 of common area, and critical and equipment branches of NEC article 517: Healthcare Facilities.	Drawing plans or One-line diagram shall Indicate location of metering devices. Project Manual (Specification): Add narrative for metering device requirement to compliant with energy code. Controls drawing: Metering devices are also integrated with building management system. (This requirement would also be listed in the specification).
Mandatory when using: → Simplified ☑ Prescriptive Performance	8.4.4	**Low-Voltage Dry-Type Distribution Transformers** Section 8.4.4 requires low voltage dry-type transformers comply with nominal efficiency percentages shown according to kVA and single-phase and three-phase transformers in Table 8.4.4, and in accordance with the Energy Policy Act of 2005. There are several types of transformers which are exceptions to this requirement listed in the Section exceptions. ***Intention of Requirements***: To provide a minimum level of energy efficient transformers on electrical equipment.	All permitted projects with Low-Voltage Dry-Type Distribution Transformers.	Energy code requirement narrative must be listed in the Project manual (Specification). Energy code requirement can also be listed in the "Notes or Remarks" line items in the equipment schedule or on the one-line diagram.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

POWER				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: → Simplified Alternative Compliance Path	8.6.1	**Computer Room System Alternative Compliance Path** For large computer room systems, with an IT equipment load greater than 10 kW, the requirements of ASHRAE 90.2 Energy Standard for Data Centers shall apply. ***Intention of Requirements***: Providing a methodology for large IT equipment to meet energy efficiency standards which correspond with the level of complexity of the system.	Power distribution systems and equipment that only serves a computer room with IT equipment load greater than 10 kW.	Information is shown in the Project Manual or Specifications.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
→ **Simplified Building Method for Office, Retail and Schools**	Table 9.3.1-1 Table 9.3.1-2 Table 9.3.1-3	**Lighting Power Allowances and Lighting Controls** The tables in Section 9.3 outline the interior lighting power allowances in W/ft² and associated lighting controls, segmented by interior space type. All lighting in space types listed must be controlled. ***Intention of Requirements***: To provide lighting power maximums and control minimums in order to ensure energy efficient lighting is installed in new construction projects.	Projects electing to use Simplified Building Method Compliance Path. Eligible projects include new buildings or tenant improvements of less than 25,000 ft^2 where at least 80% of the gross floor area supports office, retail, or school function.	Lighting plan pages within the electrical plan pages (or sometimes in a reflected ceiling plans) show locations and type of every light fixture with the fixture type indicated by various capital letter or capital letter and number combinations. A lighting fixture schedule (near the end of the electrical plan pages) lists more detailed information about each lighting fixture type, including the wattage. Area of the building is usually listed in the code summary section. Areas of spaces or space types may be listed in a table near the beginning of the architectural plans, or they can be measured off of drawings.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(a)	**Local Control** Manual control (ON/OFF) of lighting, one control covering no more than 2,500 ft² (for spaces ≤10,000 ft²) or at least one control per every 10,000 ft² (for larger spaces), accessible to occupants. Readily accessible controls must be in the space they are controlling. There is an exception when safety or security requires remote local controls. ***Intention of Requirements***: Providing occupants manual control over the lighting needs in the spaces they occupy reduces the possibility that lights will be automatically turned on when they are not needed.	Required for almost all space types, shown as REQ in Table 9.6.1. Required as a minimum required control for several lighting use exceptions to lighting power allowances in Table 9.2.3.1. Required as an option for control of task lighting per 9.4.1.3 Special Applications.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control and control function per space type or lighting control approach code, with the codes noted in individual spaces on the lighting plan pages.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(b)	**Restricted to Manual ON** Lighting should be turned on manually, without automatic activation. This is applicable for all general lighting except when there is a safety or security risk. ***Intention of Requirements***: Providing occupants manual control over the lighting needs in the spaces they occupy reduces the possibility that lights will be automatically turned on when they are not needed.	This control is typically one of two options for ADD1 lighting control requirements, applicable to most common and building-specific space types in Table 9.6.1.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control and control function per space type or lighting control approach code, with the codes noted in individual spaces on the lighting plan pages.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(c)	**Restricted to Partial Automatic ON** Only up to 50% of lighting power may turn on automatically, with the rest requiring manual control. Applies to general lighting only. ***Intention of Requirements***: Partially turning on lights automatically results in a lower default operating lighting power while allowing occupants to manually increase lighting levels if needed.	This control is typically one of two options for ADD1 lighting control requirements, applicable to most common and building-specific space types in Table 9.6.1. Open-plan office spaces can exceed the 50% provided control zones are limited to 600 ft^2 or less.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS—occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this is usually indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control and control function per space type or lighting control approach code, with the codes noted in individual spaces on the lighting plan pages.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(d)	**Bilevel Lighting Control** General lighting should support at least one intermediate lighting level between 30% and 70% of full power, in addition to full ON and OFF. Continuous dimming is also compliant with this control requirement. ***Intention of Requirements***: Providing occupants manual control over a range of comfortable levels to meet the needs of the spaces they occupy.	This control is required, shown as REQ, for about half of the common and building-specific space types in Table 9.6.1.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control and control function per space type or lighting control approach code, with the codes noted in individual spaces on the lighting plan pages.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(e)	**Automatic Daylight Controls (Sidelighting)** Photocontrols should manage lighting in primary sidelighted areas if total lighting power is 150 W+ (or 300 W+ for combined primary and secondary sidelighted areas). Controls must adjust lighting according to available daylight, with calibration controls no higher than 11 ft. Primary and secondary sidelighted areas should be controlled separately. Detailed photocontrols characteristics including requirements for continuous dimming and interactions with other control requirements are detailed in this section. ***Intention of Requirements***: To save energy on general lighting when daylight is available to light the space adequately.	Required for almost all space types when daylight via sidelighting is present, shown as REQ in Table 9.6.1.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. Lighting plans show switching and lighting controls per the symbols noted in the key. Sidelighting and toplighting zones should be marked on the lighting plans in an effort to coordinate primary and secondary sidelighted zones. Additional information may be needed from exterior elevations to determine sidelighting zones if not shown on lighting plans.

mn denotes sections with MN Amendments to ASHRAE 90.1-2019

Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(f)	**Automatic Daylight Controls (Toplighting)** Photocontrols should manage lighting in daylight areas under skylights and roof monitors if the combined lighting power of fixtures completely and partially in the daylight area 150 W+. Detailed photocontrols characteristics including requirements for continuous dimming and interactions with other control requirements are detailed in this section. ***Intention of Requirements***: To save energy on general lighting when daylight is available to light the space adequately.	Required for almost all space types when daylight via toplighting is present, shown as REQ in Table 9.6.1.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. Lighting plans show switching and lighting controls per the symbols noted in the key. Toplighting zones should be marked on the lighting plans in an effort to coordinate lighting strategy with sidelighting. Additional information may be needed from roof plans to determine toplighting if zones not shown on lighting plans.

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Lighting and Power Energy Code Measures

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(g)	**Partial Automatic OFF Control** Lighting must be reduced by at least 50% within 20 minutes after the space is unoccupied. Full OFF also complies. One exception for HID lamps is outlined in this section. ***Intention of Requirements***: To save energy in unoccupied spaces.	Required for only a few common and building-specific space types, shown as REQ in Table 9.6.1 This type of control is an ADD2 option for Hospitals.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control, percent reduction details, time gap between vacancy and reduction per space type or lighting control approach code, coordinating with the codes noted in individual spaces on the lighting plan pages. These control details may also be found in the lighting specifications.

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Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(h)	**Full Automatic OFF** All lighting (including lighting connected to emergency circuits) should turn off or reduce within 20 minutes of vacancy, with control zones no larger than 5,000 ft^2. Exceptions include all lighting in shop and laboratory classrooms, areas where this control would harm occupants or put the space at risk (safety or security), lighting required for 24/7 operation, and minimal loads not exceeding 0.02W/ft^2 across the total gross ft^2 of the building. ***Intention of Requirements***: To save energy in unoccupied spaces.	Required as a minimum required control for several lighting use exceptions to lighting power allowances in Table 9.2.3.1. Required as an option for control of display or accent lighting, lighting in display cases, and task lighting per 9.4.1.3 Special Applications. This control is typically one of two options for ADD2 lighting control requirements, applicable to most common and building-specific space types in Table 9.6.1.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control, time gap between vacancy and reduction per space type or lighting control approach code, coordinating with the codes noted in individual spaces on the lighting plan pages. These control details may also be found in the lighting specifications.

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Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(i)	**Scheduled Shutoff** All lighting (including lighting connected to emergency circuits) must turn off during scheduled unoccupied times, either by a time-of-day control device or a signal from another system. Control schedules must account for weekends and holidays and control areas should not exceed 25,000 ft² and a single floor. Override controls are limited to two-hour activations and may cover no more than 5,000 ft². Several exceptions apply and are shown in this section. ***Intention of Requirements***: To save energy in scheduled unoccupied spaces.	Required as a minimum required control for several lighting use exceptions to lighting power allowances in Table 9.2.3.1. Required as an option for control of display or accent lighting, lighting in display cases, and task lighting per 9.4.1.3 Special Applications. Note that commonly there is an either or requirement for 9.4.1.1(h) and 9.4.1.1(i).	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control, time gap between vacancy and reduction per space type or lighting control approach code, coordinating with the codes noted in individual spaces on the lighting plan pages. These control details may also be found in the lighting specifications.

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Lighting and Power Energy Code Measures

INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.1(j)	**Nonbusiness Hours OFF** Lighting should turn off automatically at the end of business hours, with override controls allowing two-hour activation during off hours. Controls can be met with time clock programming or by signal from another automatic control device or security system. ***Intention of Requirements***: To save energy in scheduled unoccupied spaces.	Required as a minimum required control for specific lighting functions within additional lighting power allowances using the Space-by-Space Method in Section 9.6.2.	Switches and other lighting control devices are included in lighting plan pages in the electrical drawing set or sometimes in a reflected ceiling plan. A key on the first electrical plan page indicates the type of each control device (e.g., OS--occupancy sensor and D--dimmer switch). When more than one control device is used in a single space, lower case letters are used to indicate which fixtures are controlled by which control device. When lighting control devices are integrated into light fixtures (e.g. stairway fixtures with occupancy sensors), this can often be indicated within the lighting fixture schedule in the description column. There is also commonly a lighting control intent table showing type of control, time gap between vacancy and reduction per space type or lighting control approach code, coordinating with the codes noted in individual spaces on the lighting plan pages. These control details may also be found in the lighting specifications.

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.2	**Parking Garage Lighting** Must meet the following requirements: 1. Automatic Shutoff: All lighting should automatically turn off based on Section 9.4.1.1(i) requirements. 2. Activity-Based Reduction: Each luminaire's power should reduce by at least 50% if no activity is detected within a lighting zone (no larger than 3,600 ft^2) for 10 minutes. 3. Daylight Transition Lighting Control: Transition lighting exempted by Section 9.2.3.1 must automatically adjust to the light level of the rest of the parking garage area from sunset to sunrise. 4. Daylight-Responsive Dimming: Luminaires within 20 ft of perimeter wall openings totaling 24 ft^2 or more should continuously dim in response to available daylight. ***Intention of Requirements:*** To save energy in scheduled unoccupied spaces.	All permitted projects with Parking Garages.	More detailed information on lighting control manufacturer and model name should be provided in the specifications and supported during construction with shop drawings and product submittals.

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.3	**Special Applications and Equipment** This section includes controls for specified equipment and applications. Exempt lighting must follow Table 9.2.3.1 controls, and additional lighting applications must follow Section 9.6.2. Key requirements include: 1. Independent Controls for Specific Lighting: • Display/Accent Lighting and Display Case Lighting: Must have local controls separate from general lighting and comply with automatic shutoff (Sections 9.4.1.1(h) or 9.4.1.1(i)). 2. Guestroom Lighting Control: • Automatic Shutoff: Lighting and switched outlets in hotel rooms must turn off within 20 minutes of vacancy (except for rooms with key card controls and bathrooms). • Bathroom Lighting: Requires automatic shutoff within 30 minutes of vacancy, allowing up to 5W for night lighting. 3. Supplemental Task Lighting: • Under-shelf or under-cabinet lighting, must be controlled by an integral or local device separate from general lighting, with automatic shutoff in compliance with Sections 9.4.1.1(h) or 9.4.1.1(i). ***Intention of Requirements:*** To provide control flexibility for specialty lighting applications, while maintaining energy efficiency.	All permitted projects with lighting applications listed in this section.	Switches and controls should be included in lighting control diagrams included in the drawing set. A lighting control intent table showing type of control and control function per space type can help show alignment between luminaires and their associated controls. Lighting plans show switching and lighting controls per the symbols noted in the key. More detailed information on lighting control manufacturer and model name should be provided in the specifications and supported during construction with shop drawings and product submittals.

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.3	**Dwelling Units** At least 75% of permanently installed lighting fixtures in dwelling units must use lamps with an efficacy of at least 55 lumens per watt (lm/W) or have a total luminaire efficacy of at least 45 lm/W. ***Intention of Requirements***: To provide a minimum level of efficiency for lighting in dwelling units.	All permitted projects containing dwelling units.	All designed luminaires should be included in a lighting schedule, with information on wattage, number of fixtures, and notation of location. Lighting plans within a drawing set will show locations and type of luminaires per space, on a architectural floor plan. More detailed information on luminaire and lighting control manufacturer and model name should be provided in the specifications.
☑ Prescriptive: Building Area Method	9.5.1	**Lighting Power Allowances - Building Area Method** Section 9.5.1 required lighting designs to meet power allowance limitations based on building area type. Table 9.6.1 sets the limits by specifying a maximum lighting power density (LPD) measured in W/ft^2. ***Intention of Requirements:*** To provide a maximum lighting power threshold to ensure energy efficient lighting is installed in new construction projects.	Projects using the Building Area Method for the Prescriptive path compliance.	All designed luminaires should be included in a lighting schedule, with information on wattage, number of fixtures, and notation of location. Lighting plans within a drawing set will show locations and type of luminaires per space, on a architectural floor plan. More detailed information on luminaire and lighting control manufacturer and model name should be provided in the specifications.

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INTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
☑ Prescriptive: Space-by-Space Method	9.6.1 9.6.2 9.6.3	**Lighting Power Allowances - Space-by-Space Method** Section 9.6.1 requires lighting designs to meet power allowance limitations based on space type. Table 9.6.1 sets the limitations by specifying a maximum lighting power density (LPD) measured in W/ft^2. Additional power allowances are included in Section 9.6.2 for retail spaces. Additional power allowances are also available as a trade off when nonmandatory controls are implemented, as outlined in Section 9.6.3. ***Intention of Requirements:*** To provide lighting power maximums and control minimums in order to ensure energy efficient lighting is installed in new construction projects.	Projects using the Space-by-Space Method for the Prescriptive path compliance.	All designed luminaires should be included in a lighting schedule, with information on wattage, number of fixtures, and notation of location. Lighting plans within a drawing set will show locations and type of luminaires per space, on a architectural floor plan. More detailed information on luminaire and lighting control manufacturer and model name should be provided in the specifications.

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EXTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
→ **Simplified Building Method**	9.3.2	**Lighting Power Allowances and Lighting Controls** Section 9.3.2 requires exterior lighting to meet the allowance limitations starting with a base allowance (in W), followed by additional lighting allowances in W/ft^2 and W/linear foot and associated lighting controls, segmented by exterior area type. These values are shown in Table 9.3.2. ***Intention of Requirements***: To provide lighting power maximums and control minimums in order to ensure energy efficient exterior lighting is installed in new construction projects.	Projects electing to use Simplified Building Method Compliance Path for interiors that also have exterior lighting.	All designed luminaires should be included in an exterior lighting schedule, with information on wattage, number of fixtures, and notation of location. Exterior lighting plans within a drawing set will show locations and type of luminaires per space, on a site floor plan. Adding a lighting control intent table showing type of control and control function per space type can help show alignment between luminaires and their associated controls. Lighting control plans show switching and lighting controls per the symbols noted in the key. More detailed information on luminaire and lighting control manufacturer and model name should be provided in the specifications.

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EXTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	9.4.1.4	**Exterior Lighting Control** Section 9.4.1.4 requires exterior lighting to have automatic photocell controls, requires facade and landscape lighting to be turned off during late overnight hours, and requires all other lighting to be dimmed to 50% of less during late overnight hours or to be shut off within 15 minutes of no activity. ***Intention of Requirements***: To provide a variety of exterior lighting controls that minimize connected lighting loads when spaces and areas do not require lighting.	All exterior lighting on projects except for: • Covered vehicle entrance lighting required for safety, security, or eye adaptation • Lighting integral to signage installed by the manufacturer • Applications that are exempted in Section 9.1.	Exterior lighting controls are included in the exterior lighting or site lighting plans which show the location of the control devices. The lighting control specifications indicated the control device type and function.
Mandatory when using: ☑ Prescriptive Performance	9.4.2	**Exterior Building Lighting Power** The total exterior lighting power allowance is calculated by combining the base site allowance with allowances for specific illuminated areas as defined in Table 9.4.2-2 for the applicable lighting zone identified in Table 9.4.2-1. The installed exterior lighting power must not exceed this calculated allowance. Trade-offs are permitted only among applications listed as "Tradable Surfaces" in Table 9.4.2-2. There are a number of exterior lighting power allowance exceptions outlined in Section 9.4.2.1. ***Intention of Requirements***: To provide a maximum exterior lighting power threshold to ensure energy efficient lighting is installed in new construction projects.	All exterior building applications except for those specified in this section.	All designed luminaires should be included in an exterior lighting schedule, with information on wattage, number of fixtures, and notation of location. Exterior lighting plans within a drawing set will show locations and type of luminaires. More detailed information on luminaire manufacturer and model name should be provided in the specifications.

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EXTERIOR LIGHTING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: ☑ Prescriptive Performance	mn 9.4.4	**Parking Lot Lighting** Parking lot lighting efficacy is also regulated by the Minnesota Department of Transportation in Minnesota Rules, chapter 8885.	All permitted projects containing parking lots.	All designed luminaires should be included in an exterior lighting schedule, with information on wattage, number of fixtures, and notation of location. Exterior lighting plans within a drawing set will show locations and type of luminaires.

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Lighting and Power Energy Code Measures

SUBMITTALS, VERIFICATION, TESTING AND COMMISSIONING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: → Simplified ☑ Prescriptive Performance	9.7.3.1 and 9.7.3.2	**Record Documents and Manuals** Construction documents must specify that, within 90 days of system acceptance, record documents and operating and maintenance manuals for all lighting equipment be given to the building owner or their representative. These records must include, at minimum, details on the location, luminaire identifier, controls, and circuiting for each lighting component. Section 9.7.3.1 and 9.7.3.2 provide more detail for what record documents and manuals should include. ***Intention of Requirements***: Record documents provided to the owner assist the owner with maintenance and repair of installed equipment and provides a starting point for the design of future replacement projects.	All permitted projects	The Project Manual should require record documents and O&M manuals are turned over to the owner. If commissioning is required on the project, this should also be included in the commissioning specifications.

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SUBMITTALS, VERIFICATION, TESTING AND COMMISSIONING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: → Simplified ☑ Prescriptive Performance	9.7.3.3	**Daylighting Documentation** The design documents shall identify all luminaires for general lighting that are located within daylight areas under skylights, daylight areas under roof monitors, and primary sidelighted area and secondary sidelighted areas. ***Intention of Requirements***: To provide supporting documentation for calculations of sidelighting and toplighting.	Required for all permitted projects when daylight via sidelighting or toplighting is applicable.	Sidelighting and toplighting zones should be marked on the lighting plans in an effort to coordinate primary and secondary sidelit zones. Additional information may be needed from exterior elevations to determine sidelighting zones and roof plans to determine toplighting if zones not shown on lighting plans. See definitions for figures to calculate daylighting properly.
Mandatory when using: → Simplified ☑ Prescriptive Performance	4.2.5.1 9.9.1	**Verification and Testing** Lighting control systems shall be tested in accordance with Section 9.9.1 and provisions of Section 4.2.5.1. Testing shall verify that lighting control devices and systems are calibrated, adjusted, configured, and operating in accordance with applicable requirements of Sections 9.3, 9.4, 9.5, and 9.6. Verification and FTP documentation shall comply with Section 4.2.5.1.2. ***Intention of Requirements***: Testing and verification of the lighting control systems ensures that systems will operate correctly. Incorrectly operating controls will waste energy and may not provide the lighting reduction or responsiveness required by code.	.	Requirements for testing and verification must be listed in the Project Manual or Specifications. Requirements should be added to the lighting specification section as well as the electrical commissioning or general commissioning specifications. The contractor owes startup and assistance for commissioning.

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Lighting and Power Energy Code Measures

SUBMITTALS, VERIFICATION, TESTING AND COMMISSIONING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Mandatory when using: → Simplified ☑ Prescriptive Performance	4.2.5.2 9.9.2	**Commissioning** The energy performance of lighting systems must be commissioned per Section 4.2.5.2, with reporting requirements following Sections 4.2.5.2.2 and 4.2.5.2.3. ***Intention of Requirements***: Commissioning provides a check following construction to assure that lighting systems and controls have been properly installed and are operating correctly.	Lighting systems in buildings, additions or alterations with <10,000 ft² of conditioned space AND with combined heating, cooling and service water heating equipment totaling <96 kBtu/h in capacity; or in buildings or portions of buildings using the Simplified Approach for HVAC Systems. Dwelling units and refrigerated warehouses do not need to be commissioned and their areas should not be counted toward the 10,000 ft² threshold.	The Project Manual or Specifications should require commissioning during the acceptance phase of construction by including a section on commissioning requirements. A draft commissioning plan and results from the design review should be submitted with the permit application.
Performance (Energy Cost Budget)	mn 11.2	**Energy Cost Budget Method** Compliance documentation must be submitted to the building official, including a list of energy features that differ between the design and the reference building, a list showing compliance with mandatory provisions, and calculations supporting model entries (such as lighting power). ***Intention of Requirements***: Code compliance using a performance approach offers vast flexibility to the design team but is challenging for code officials to verify. Specification of submittals attempts to assist code officials by ensuring that minimum documentation is provided.	All buildings following the Energy Cost Budget compliance path.	Section 11.7.2 includes a list of information that must be submitted with the permit application when using Energy Cost Budget Method. An additional package of documentation beyond what is normally in construction documents is required.

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Lighting and Power Energy Code Measures

SUBMITTALS, VERIFICATION, TESTING AND COMMISSIONING				
Compliance Path (See page 8 for details)	Energy Code Section	Requirement Summary & Intent	Trigger	Typical Documentation in Construction Documents
Performance (Performance Rating Method)	mn Appendix G	**Performance Rating Method** Compliance documentation must be submitted to the building official, including a list of energy features that differ between the design and the reference building, a list showing compliance with mandatory provisions, and calculations supporting model entries (such as lighting power). ***Intention of Requirements***: Code compliance using a performance approach offers vast flexibility to the design team but is challenging for code officials to verify. Specification of submittals attempts to assist code officials by ensuring that minimum documentation is provided.	All buildings following the Energy Cost Budget compliance path.	Section G1.3.2 includes a list of information that must be submitted with the permit application when using Performance Rating Method. An additional package of documentation beyond what is normally in construction documents is required.

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Key Terms

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Section 3 of the MN Energy Code includes definitions, abbreviations and acronyms used in the code language. Terms defined in other chapters of the Minnesota State Building Code also apply. Minnesota has amended Section 3 to refer to the Merriam-Webster Collegiate Dictionary, available at www.m-w.com, for terms not defined in the Energy Code or other chapters of the *Minnesota State Building Code*.

Terms relevant to the content in this Guide have been copied from Section 3 here for convenience.

A

addition: an extension or increase in floor area or height of a *building* outside of the *existing building envelope*.

adopting authority: the agency or agent that adopts this standard.

alteration: a replacement or addition to a *building* or its *systems* and *equipment*; routine maintenance, *repair*, and service, or a change in the *building*'s use classification or category shall not constitute an *alteration*.

authority having jurisdiction: the agency or agent responsible for enforcing this standard.

automatic or automatically: self-acting, operating by its own mechanism when actuated by some nonmanual influence, such as a change in current strength, pressure, temperature, or mechanical configuration.

automatic control device: a device capable of *automatically* turning loads off and on without *manual* intervention.

B

ballast: *a device used in conjunction with an electric-discharge lamp to cause the lamp to start and operate under the proper circuit conditions of voltage, current, wave form, electrode heat, etc.*

baseline building design: a computer representation of a hypothetical design based on the proposed design. This representation is used as the basis for calculating the *baseline building performance* for rating above-standard design or when using the *Performance Rating Method* as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

baseline building performance: the annual *energy* cost for a *building* design intended for use as a baseline for rating above-standard design or when using the *Performance Rating Method* as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

branch circuit: the circuit conductors between the final *overcurrent* device protecting the circuit and the outlets; the final wiring run to the load.

budget building design: a computer representation of a hypothetical design based on the actual *proposed design*. This representation is used as the basis for calculating the *energy cost budget*.

building: any structure used or intended for supporting or sheltering any use or occupancy.

building envelope: the exterior plus the semiexterior portions of a *building*. For the purposes of determining *building envelope* requirements, the classifications are defined as follows:

exterior building envelope: the elements of a *building* that separate *conditioned spaces* from the exterior.

semiexterior building envelope: the elements of a *building* that separate *conditioned space* from *unconditioned space* or that enclose *semiheated spaces* through which thermal *energy* may be transferred to or from the exterior, to or from *unconditioned spaces*, or to or from *conditioned spaces*.

building official: the officer or other designated *authority having jurisdiction* charged with the administration and enforcement of this standard, or a duly authorized representative.

building service equipment: the necessary *equipment*, usually consisting of a *circuit breaker* or switch and fuses and accessories, located near the point of entrance of supply conductors to a *building* or other structure (or an otherwise defined area) and intended to constitute the main *control* and means of cutoff of the supply. Service *equipment* may consist of *circuit breakers* or fused switches provided to *disconnect* all undergrounded conductors in a *building* or other structure from the service-entrance conductors.

C

circuit breaker: a device designed to open and close a circuit by *nonautomatic* means and to open the circuit *automatically* at a predetermined *overcurrent* without damage to itself when properly applied within its rating.

commercial parking facility: a building or structure intended for containment of motor vehicles where the parking is related to or associated with commerce, defined as the activity of buying and selling goods and services, which may include the parking itself.

commissioning: a quality-focused process for enhancing the delivery of a project for verifying and documenting that the *building* and its *systems*, controls, and *building envelope* are planned, designed, installed, tested, and include plans for operation and maintenance to meet specified requirements.

commissioning provider: an entity who manages the commissioning team to implement *building commissioning*.

computer room: a room whose primary function is to house *equipment* for the processing and storage of electronic data and that has a design electronic data *equipment* power density of greater than 20 W/ft^2 (20 watts per 0.092 m2) of conditioned floor area or a connected design electronic data equipment load of greater than 10 kW.

conditioned floor area, gross: see floor area, gross.

conditioned space: see *space*.

construction: the fabrication and erection of a new *building* or any *addition* to or *alteration* of an *existing building*.

construction documents: drawings and specifications used to construct a *building, building systems*, or portions thereof.

continuous dimming: a lighting control strategy that varies the light output of a *lighting system* over a continuous range from full light output to a minimum light output in imperceptible steps without flickering.

control: to regulate the operation of *equipment*. This definition is not applicable to the use of this word as a noun to describe a combination of *control devices* and software, used to achieve *control* of HVAC, lighting, or other equipment or *systems*.

control device: a specialized device used to regulate the operation of *equipment*.

D

daylight area: the floor area substantially illuminated by daylight.

daylight area under roof monitors: the *daylight area under roof monitors* is the combined *daylight area* under each roof *monitor* within each space. The *daylight area* under each roof monitor is the product of

a. the width of the *vertical fenestration* above the ceiling level plus, on each side, the smallest of
   1. 2 ft,
   2. the distance to any 5 ft or higher vertical obstruction, or
   3. the distance to the edge of any *primary sidelighted area*

and

b. the smaller of the following horizontal distances inward from the bottom edge of the *vertical fenestration* (see Figure 3.2-1):
   1. The monitor sill height (MSH) (the vertical distance from the floor to the bottom edge of the monitor glazing)

2. The distance to the nearest face of any *opaque* vertical obstruction, where any part of the obstruction is farther away than the difference between the height of the obstruction and the monitor sill height (MSH – OH)

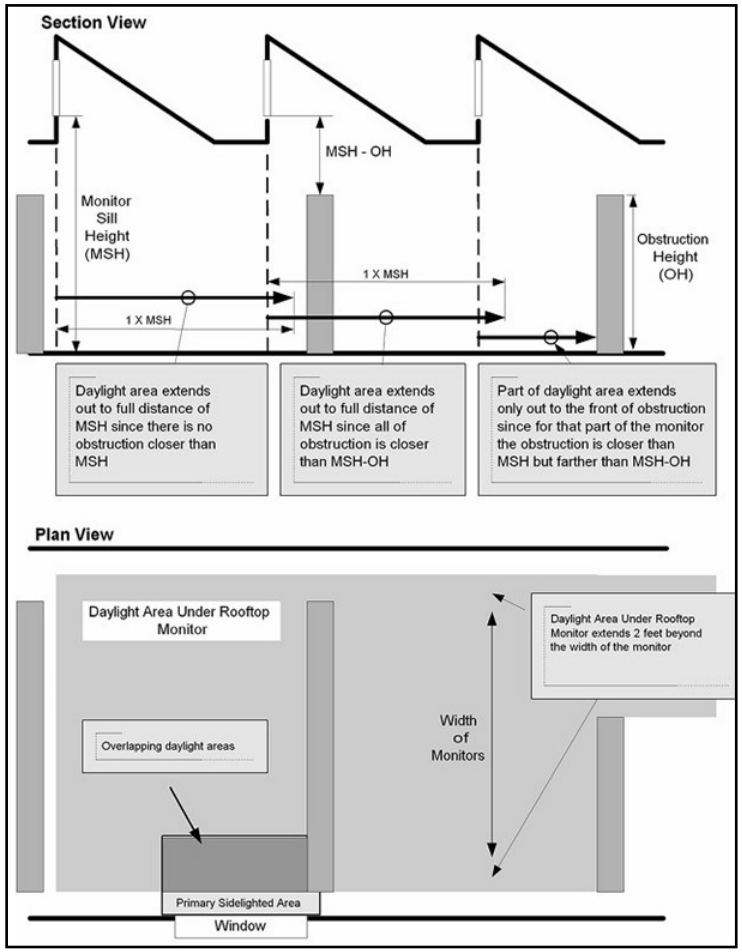

Figure 3.2-1 Computing the daylight area under roof monitors. (from Section 3.2 Definitions)

daylight area under skylights: the *daylight area under skylights* is the combined *daylight area* under each *skylight* within a space. The *daylight area* under each *skylight* is bounded by the opening beneath the *skylight* and horizontally in each direction (see Figure 3.2-2), the smaller of

a. 70% of the ceiling height (0.7 × CH) or

b. the distance to the nearest face of any opaque vertical obstruction, where any part of the obstruction is farther away than 70% of the distance between the top of the obstruction and the ceiling (0.7 × [CH – OH], where CH = the height of the ceiling at the lowest edge of the *skylight* and OH = the height to the top of the obstruction).

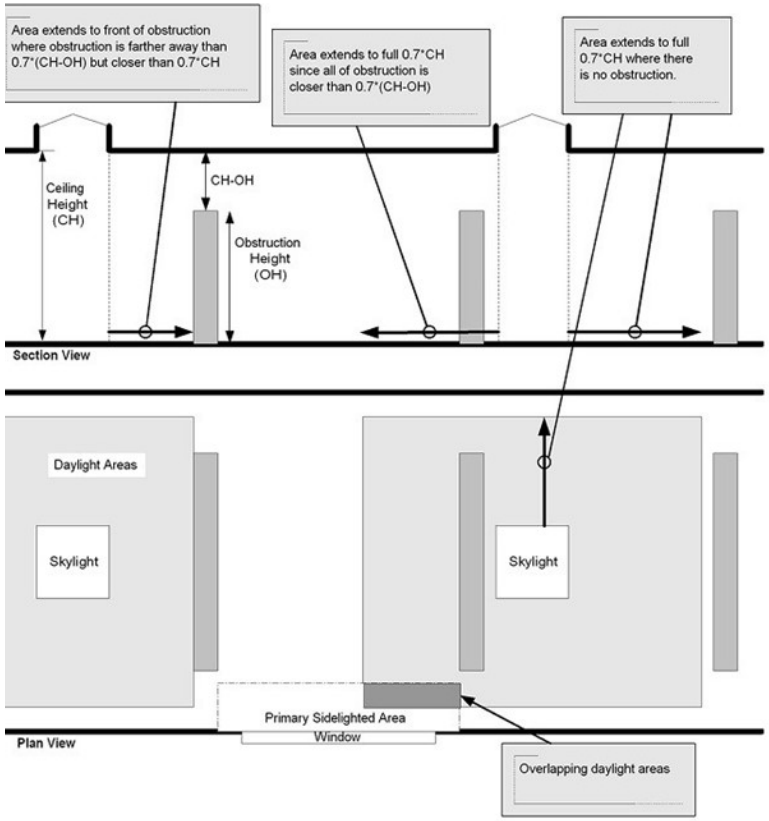

Figure 3.2-2 Computing the daylight area under skylights. (from Section 3.2 Definitions)

daylight area under skylights in multistory spaces: the *daylight area under skylights in multistory spaces* shall include *floor* areas directly beneath the skylight and portions of the uppermost *floor* adjacent to the multistory space that meet the criteria for a *daylight area under skylights*, where CH is the ceiling height of the uppermost *floor* (see Figure 3.2-3).

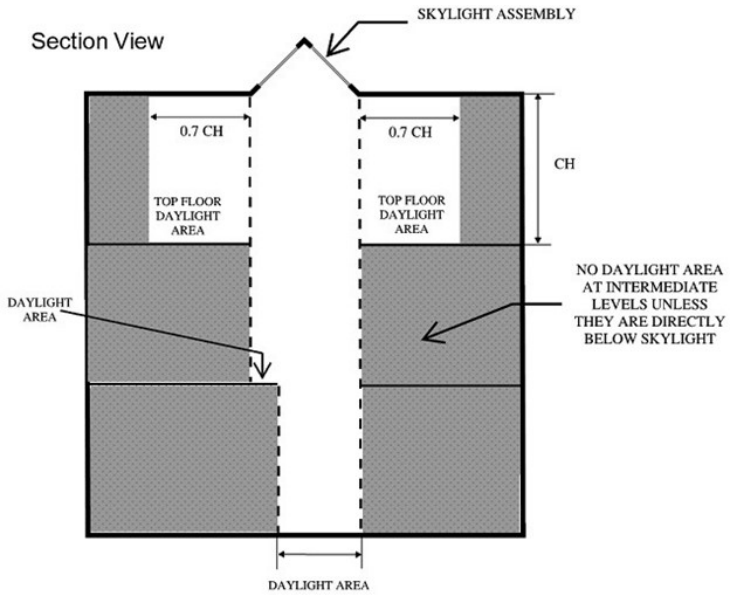

Figure 3.2-3 Computing the daylight area under skylights in multistory spaces. (from Section 3.2 Definitions)

decorative lighting: see lighting, decorative.

design conditions: specified environmental conditions, such as temperature and light intensity, required to be produced and maintained by a *system* and under which the *system* must operate.

design energy cost: the annual *energy* cost calculated for a *proposed design*.

dimmer: a lighting *control device* that is capable of varying the light output and *energy* usage of light sources.

distribution system: conveying means, such as ducts, pipes, and wires, to bring substances or *energy* from a source to the point of use. The *distribution system* includes such auxiliary *equipment* as fans, pumps, and *transformers*.

driver: a device designed to operate a solid-state (e.g., LED) light source.

dwelling unit: a single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

E

efficacy (of a lamp): the ratio of the total luminous output of a *lamp* to the total power input to the *lamp*, typically expressed in lm/W.

efficiency: *performance at specified rating conditions.*

enclosed space: a volume substantially surrounded by solid surfaces, such as *walls, floors, roofs,* and openable devices, such as *doors* and *operable* windows.

energy: the capacity for doing work. It takes a number of forms that may be transformed from one into another such as thermal (heat), mechanical (work), electrical, and chemical (Btu).

energy cost budget: the annual *energy* cost for the *budget building design* intended for use in determining minimum compliance with this standard.

equipment: devices for space heating, space cooling, *ventilation*, humidification, dehumidification, electric power, lighting, transportation, refrigeration, cooking, or *service water heating*, including but not limited to furnaces, *boilers*, air conditioners, heat pumps, chillers, *water heaters*, *lamps*, *luminaires*, *ballasts*, elevators, escalators, or other devices or installations.

existing building: a *building* or portion thereof that was previously occupied or approved for occupancy by the *authority having jurisdiction*.

existing equipment: *equipment* previously installed in an *existing building*.

existing system: a *system* or *systems* previously installed in an *existing building*.

exterior lighting power allowance: see *lighting power allowance, exterior.*

exterior wall: see *building envelope* and *wall*.

eye adaptation: the process by which the retina becomes accustomed to more or less light than it was exposed to during an immediately preceding period. It results in a change in the sensitivity to light.

F

façade area: area of the façade, including overhanging soffits, cornices, and protruding columns, measured in elevation in a vertical plane parallel to the plane of the face of the *building*. Nonhorizontal *roof* surfaces shall be included in the calculation of vertical *façade area* by measuring the area in a plane parallel to the surface.

feeder conductors: the wires that connect the service equipment to the branch circuit breaker panels.

fenestration: an assembly, including the frame, in the *building envelope* that allows light to pass. *Fenestration* assemblies include, but are not limited to, windows, plastic panels, clerestories, *roof monitors, skylights*, glass block, and *doors* where more than one-half of the *door area* is glazed.

skylight: a *fenestration* surface having a slope of less than 60 degrees from the horizontal plane. Other *fenestration*, even if mounted on the *roof* of a *building*, is considered *vertical fenestration*.

vertical fenestration: all *fenestration* other than *skylights*. Trombe *wall assemblies*, where glazing is installed within 12 in. of a *mass wall*, are considered *walls*, not *fenestration*.

fixture: the component of a *luminaire* that houses the *lamp* or *lamps* or positions the *lamp*, shields it from view, and distributes the light. The *fixture* also provides for connection to the power supply, which may require the use of a *ballast/driver*.

floor: that lower portion of the *building envelope*, including *opaque* area and *fenestration*, that has conditioned or *semiheated space* above and is horizontal or tilted at an angle of less than 60 degrees from horizontal but excluding *slab-on-grade floors*.

floor area, gross: the sum of the *floor* areas of the *spaces* within the *building*, including basements, mezzanine and intermediate-floored tiers, and penthouses with a headroom height of 7.5 ft or greater. It is measured from the exterior faces of *walls* or from the centerline of *walls* separating buildings, but excluding covered walkways, open roofed-over areas, porches and similar *spaces*, pipe trenches, exterior terraces or steps, chimneys, *roof* overhangs, and similar features.

gross conditioned floor area: *the gross floor area* of *conditioned spaces.*

gross lighted floor area: *the gross floor area of lighted spaces.*

functional performance testing (FPT): a systematic process to verify that controls and other elements of the *building* project are capable of and configured to operate or perform as required.

G

general lighting: see *lighting, general.*

gross conditioned floor area: see floor area, gross.

gross floor area: see floor area, gross.

gross lighted floor area: see *floor area, gross.*

H

heat capacity (HC): the amount of heat necessary to raise the temperature of a given mass 1°F. Numerically, the *HC* per unit area of surface (Btu/ft^2·°F) is the sum of the products of the mass per unit area of each individual material in the *roof, wall,* or *floor* surface multiplied by its individual specific heat.

high-intensity discharge (HID) lamp: an electric discharge *lamp* in which light is produced when an electric arc is discharged through a vaporized metal such as mercury or sodium. Some *HID lamps* may also have a

phosphor coating that contributes to the light produced or enhances the light color.

historic: a *building* or *space* that has been specifically designated historically significant by the *adopting authority* or is listed in The National Register of *Historic* Places or has been determined to be eligible for such listing by the U.S. Secretary of the Interior.

HVAC system: the *equipment, distribution systems*, and *terminals* that provide, either collectively or individually, the processes of heating, ventilating, or air conditioning to a *building* or portion of a *building*.

I

installed exterior lighting power: the power in watts of all site, landscape, and building *lighting systems* for exterior *luminaires*.

installed interior lighting power: the power in watts of all general, task, and furniture *lighting systems* for interior *luminaires*.

interior lighting power allowance: see lighting power allowance.

IT equipment energy: annual *energy* used for computer storage and network *equipment* along with supplemental *equipment* represented by the uninterruptible power supply (UPS) output calculated in accordance with industry-accepted standards (see Informative Appendix E).

K

kilovolt-ampere (kVA): where the term *kilovolt-ampere* is used in this standard, it is the product of the line current (amperes) times the nominal *system* voltage (kilovolts) times 1.732 for three-phase currents. For single-phase applications, *kVA* is the product of the line current (amperes) times the nominal *system* voltage (kilovolts).

kilowatt (kW): the basic unit of electric power, equal to 1000 W.

L

lamp: a generic term for a man-made light source, often called a "bulb" or "tube."

labeled: *equipment* or materials to which a symbol or other identifying mark has been attached by the *manufacturer* indicating compliance with specified standards or performance in a specified manner.

lighting, general: lighting that provides a substantially uniform level of illumination throughout an area. *General lighting* shall not include *decorative lighting* or lighting that provides a dissimilar level of illumination to serve a specialized application or feature within such area.

lighting, decorative: lighting that is ornamental or installed for aesthetic effect. *Decorative lighting* shall not include *general lighting*.

lighting power allowance, exterior: the maximum lighting power in watts allowed for the exterior of a *building*.

lighting power allowance, interior: the maximum lighting power in watts allowed for the interior of a *building*.

lighting power density (LPD): the lighting power per unit area of a *building, space*, or outdoor area expressed in W/ft^2.

lighting system: a group of *luminaires* circuited or controlled to perform a specific function.

luminaire: a complete lighting unit consisting of a *lamp* or *lamps* together with the housing designed to distribute the light, position and protect the *lamps*, and connect the *lamps* to the power supply.

M

manual (nonautomatic): requiring personal intervention for *control. Nonautomatic* does not necessarily imply a *manual* controller, only that personal intervention is necessary. (See *automatic.)*

manufacturer: the company engaged in the original production and assembly of products or *equipment* or a company that purchases such products and *equipment* manufactured in accordance with company specifications.

metering: instruments that measure electric voltage, current, power, etc.

N

networked guest room control system: a *control system*, accessible from the hotel/motel front desk or other central location, that is capable of identifying rented and unrented rooms according to a timed schedule, and is capable of controlling HVAC in each hotel/motel guest room separately.

nonautomatic: see manual.

nonresidential: all occupancies other than *residential*. (See residential.)

nontransient: occupancy of a dwelling unit or sleeping unit for more than 30 days.

north-oriented: facing within 45 degrees of true north in the northern hemisphere (however, facing within 45 degrees of true south in the southern hemisphere).

O

occupancy sensor: a device that detects the presence or absence of people within an area and causes lighting, *equipment*, or appliances to be regulated accordingly.

occupied-standby mode: when a zone is scheduled to be occupied, and an occupant sensor indicates no occupants are within the zone.

opaque: all areas in the *building envelope*, except *fenestration* and *building service* openings such as vents and grilles. (See building envelope and fenestration.)

orientation: the direction an envelope element faces, i.e., the direction of a vector perpendicular to and pointing away from the surface outside of the element.

overcurrent: any current in excess of the rated current of *equipment* or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

P

parking garage section: a part of a parking garage where airflow is restricted from other parts of the garage by solid walls.

Performance Rating Method: a calculation procedure that generates an index of merit for the performance of *building* designs that substantially exceeds the *energy efficiency* levels required by this standard or when using the *Performance Rating Method* as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

permanently installed: *equipment* that is fixed in place and is not portable or movable.

photosensor: a device that detects the presence of visible light, infrared (IR) transmission, and/or ultraviolet (UV) *energy*.

pool: any structure, basin, or tank containing an artificial body of water for swimming, diving, or recreational bathing. The term includes, but is not limited to, swimming *pool,* whirlpool, spa, and hot tub.

primary sidelighted area: see *daylight area*.

primary sidelighted area: the total *primary sidelighted area* is the combined *primary sidelighted area* within each *space*. Each *primary sidelighted area* is directly adjacent to *vertical fenestration* in an exterior *wall* below the ceiling (see Figure 3.2-4).

a. The *primary sidelighted area* width is the width of the *vertical fenestration* plus, on each side, the smaller of

   1. one half of the *vertical fenestration* head height (where head height is the distance from the *floor* to the top of the glazing) or

   2. the distance to any 5 ft or higher *opaque* vertical obstruction.

b. The *primary sidelighted area* depth is the horizontal distance perpendicular to the *vertical fenestration*, which is the smaller of

   1. one *vertical fenestration* head height or

2. the distance to any 5 ft or higher *opaque* vertical obstruction.

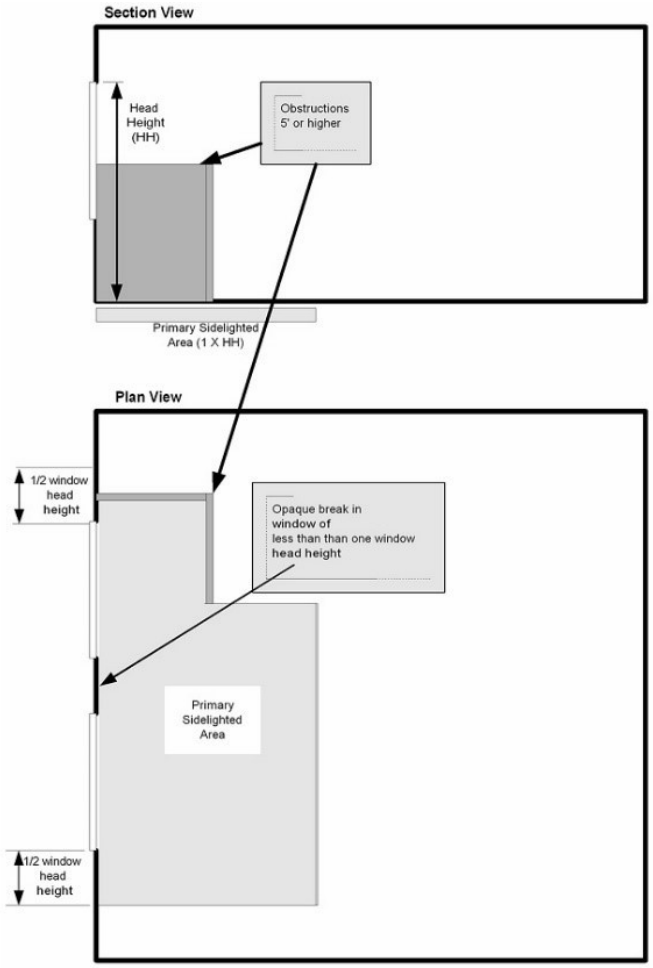

Figure 3.2-4 Computing the primary sidelighted area. (from Section 3.2 Definitions)

process application: a manufacturing, industrial, or commercial procedure or activity where the primary purpose is other than conditioning *spaces* and maintaining comfort and amenities for the occupants of a *building*.

projection factor (PF): the ratio of the horizontal depth of the external shading projection divided by the sum of the height of the *fenestration* and the distance from the top of the *fenestration* to the bottom of the farthest point of the external shading projection, in consistent units.

proposed building performance: the annual *energy* cost calculated for a *proposed design*.

proposed design: a computer representation of the actual proposed *building* design, or portion thereof, used as the basis for calculating the *design energy cost*.

R

rating authority: the organization or agency that adopts or sanctions use of Normative Appendix G when quantifying performance that exceeds requirements of this standard.

record documents: drawings and other documents that record the conditions of the project as constructed. These include any refinements of the *construction* or bid documents.

readily accessible: installed in a manner and location that allows it to be reached quickly for operation, renewal, or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc. In public facilities, accessibility may be limited to certified personnel through locking covers or by placing *equipment* in locked rooms.

repair: the reconstruction or renewal of any part of an *existing building* for the purpose of its maintenance.

residential: *spaces* in buildings used primarily for living and sleeping. *Residential spaces* include, but are not limited to, *dwelling units*, hotel/motel guest rooms, dormitories, nursing homes, patient rooms in hospitals, lodging houses, fraternity/sorority houses, hostels, prisons, and fire stations.

roof monitor: that part of a *building* that projects above the plane of the *roof* and whose *walls* contain *vertical fenestration* for lighting the interior.

room cavity ratio (RCR): a factor that characterizes room configuration as a ratio between the *walls* and ceiling and is based upon room dimensions.

S

secondary sidelighted area: the total *secondary sidelighted area* is the combined *secondary sidelighted area* within a *space*. Each *secondary sidelighted area* is directly adjacent to a *primary sidelighted area* (see Figure 3.2-5):

a. The *secondary sidelighted area* width is the width of the *vertical fenestration* plus, on each side, the smaller of

   1. one half of the *vertical fenestration* head height or

   2. the distance to any 5 ft or higher *opaque* vertical obstruction.

b. The *secondary sidelighted area* depth is the horizontal distance perpendicular to the *vertical fenestration*, which begins at the edge of the *primary sidelighted area* depth and ends at the smaller of

   1. one *vertical fenestration* head height or

   2. the distance to any 5 ft or higher *opaque* vertical

   3. obstruction.

semiexterior wall: see building envelope and wall.

semiheated space: see *space*.

service agency: *an agency capable of providing calibration, testing, or manufacture of equipment, instrumentation, metering, or control apparatus, such as a contractor, laboratory, or manufacturer.*

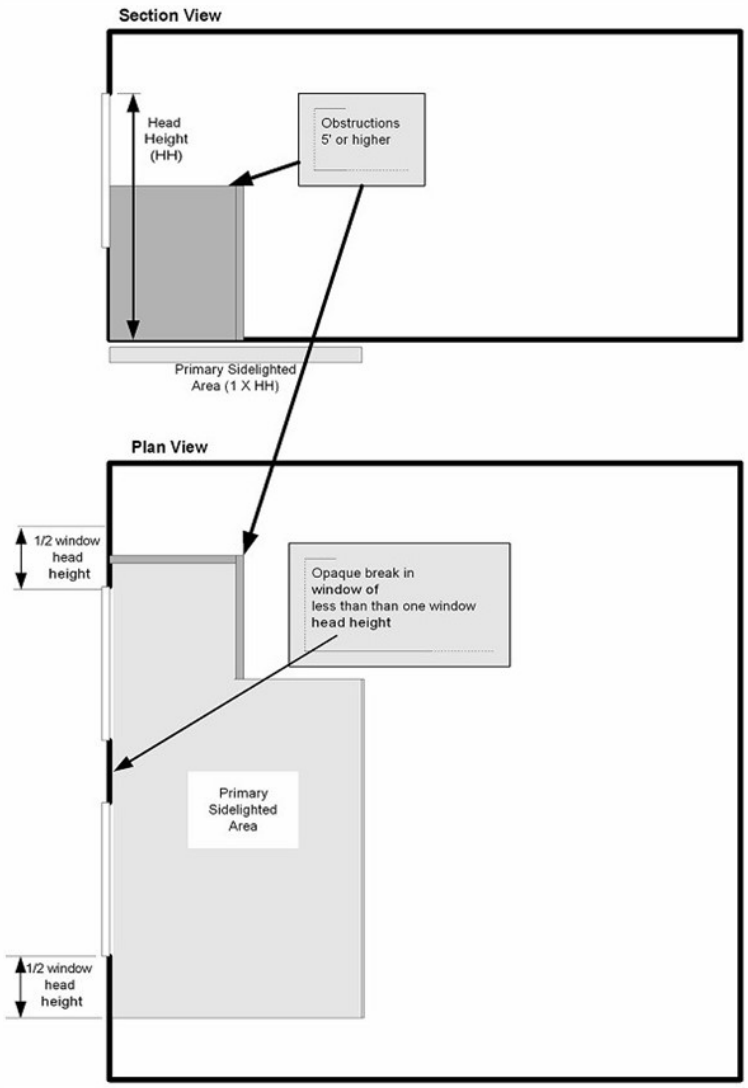

Figure 3.2-5 Computing the secondary sidelighted area. (from Section 3.2 Definitions)

single-line diagram: *a simplified schematic drawing that shows the connection between two or more items. Common multiple connections are shown as one line.*

simulation program: a computer program, including the simulation engine and the corresponding user interface, that is capable of simulating the *energy* performance of *building systems*.

skylight: a *fenestration* surface having a slope of less than 60 degrees from the horizontal plane. Other *fenestration*, even if mounted on the *roof* of a *building*, is considered *vertical fenestration*.

skylight effective aperture: the overall amount of *visible transmittance* of the *roof* via *skylights*. *Skylight effective aperture* is calculated according to the following formula:

where

skylight area = total *fenestration area* of *skylights*

skylight VT = area-weighted average *visible transmittance* of *skylights* as determined in accordance with Section 5.8.2.5.

WF = area-weighted average *skylight well* factor, where *skylight well* factor is 0.9 if *skylight well* depth is less than 2 ft, or 0.7 if *skylight well* depth is 2 ft or greater. *Skylight well* depth is measured vertically from the underside of the lowest point on the *skylight* glazing to the ceiling plane under the *skylight*.

slab-on-grade floor: that portion of a slab *floor* of the *building envelope* that is in contact with the ground and that is either above *grade* or is less than or equal to 24 in. below the final elevation of the nearest exterior *grade*.

heated slab-on-grade floor: a *slab-on-grade floor* with a heating source either within or below it.

unheated slab-on-grade floor: a *slab-on-grade floor* that is not a *heated slab-on-grade floor*.

small electric motor: a NEMA general purpose, alternating current, single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1-1987, including IEC metric equivalent motors; constructed in the NEMA 42, 48, and 56 frame sizes or IEC metric equivalent.

space: an *enclosed space* within a *building*. The classifications of *spaces* are as follows for the purpose of determining *building envelope* requirements:

conditioned space: a *cooled space, heated space*, or *indirectly conditioned space* defined as follows:

a. ***cooled space:*** an *enclosed space* within a *building* that is cooled by a cooling *system* whose sensible output capacity is ≥3.4 Btu/h·ft² of floor area.

b. ***heated space:*** an *enclosed space* within a *building* that is heated by a heating *system* whose output capacity relative to the floor area is greater than or equal to the criteria in Table 3.2.

Table 3.2 Heated Space Criteria

CLIMATE ZONE	HEATING OUTPUT, BTU/H·FT²
6	>14
7	>16

c. ***indirectly conditioned space:*** an *enclosed space* within a *building* that is not a *heated space* or a *cooled space*, which is heated or cooled indirectly by being connected to adjacent *spaces*, provided

1. the product of the *U-factors* and surface areas of the *space* adjacent to connected *spaces* exceeds the combined sum of the product of the *U-factors* and surface

areas of the *space* adjoining the outdoors, *unconditioned spaces*, and to or from *semiheated spaces* (e.g., corridors) or

2. that air from heated or *cooled spaces* is intentionally transferred (naturally or mechanically) into the *space* at a rate exceeding 3 ach (e.g., atria).

semiheated space: *an* enclosed space *within a* building *that is heated by a heating* system *whose output capacity is greater than or equal to 3.4 Btu/h·ft² of floor area but is not a* conditioned space.

unconditioned space: *an* enclosed space *within a* building *that is not a* conditioned space *or a* semiheated space. *Crawlspaces, attics, and parking garages with natural or mechanical* ventilation *are not considered* enclosed spaces.

system: a combination of *equipment* and auxiliary devices (e.g., *controls*, accessories, interconnecting means, and *terminal* elements) by which *energy* is transformed so it performs a specific function, such as HVAC, *service water heating*, or lighting.

T

task lighting: lighting directed to a specific surface or area that provides illumination for visual tasks.

terminal: device by which *energy* from a *system* is finally delivered, e.g., registers, diffusers, lighting *fixtures*, faucets, etc.

thermal block: a collection of one or more *HVAC zones* grouped together for simulation purposes. *Spaces* need not be contiguous to be combined within a single *thermal block*.

thermal transmittance (U-factor): heat transmission in unit time through unit area of a material or *construction* and the boundary air films, induced by unit temperature difference between the environments on each side (Btu/h·ft²·°F).

toplighting: lighting *building* interiors with daylight admitted through *fenestration*, such as *skylights* and *roof monitors*, located on the *roof*.

transformer: a piece of electrical *equipment* used to convert electric power from one voltage to another voltage.

dry-type transformer: a *transformer* in which the core and coils are in a gaseous or drycompound.

U

U-factor: see thermal transmittance.

V

ventilation: the process of supplying or removing air by natural or mechanical means to or from any *space*. Such air is not required to have been conditioned.

vertical fenestration: all *fenestration* other than *skylights*. Trombe *wall* assemblies, where glazing is installed within 12 in. of a *mass wall*, are considered *walls*, not *fenestration*. For the purposes of determining *building envelope* requirements, the *vertical fenestration* classifications are defined as follows:

entrance door: any doorway, set of *doors*, turnstile, vestibule, or other form of portal that is ordinarily used to gain access by its users and occupants to the *building* or to individual tenant *spaces* accessed from the exterior. (See building entrance and door.)

fixed: all types of *vertical fenestration*, other than *entrance door* and operable, including, but not limited to, curtain *walls*, window *walls*, fixed windows, picture windows, glass block *walls*, nonopenable clerestory windows, roof monitors with nonopenable windows, and nonopenable sidelights and transoms.

operable: all *vertical fenestration* that opens, except *entrance doors*, including, but not limited to, casement windows, projecting windows, pivoting windows, horizontal sliding windows, vertical sliding windows, openable clerestory windows, openable sidelights and transoms, sliding glass *doors*, roof monitors with openable windows, and *doors* that are not *entrance doors*.

visible transmittance (VT): the ratio of visible radiation entering

the *space* through the *fenestration* product to the incident visible radiation, determined as the spectral transmittance of the total *fenestration system*, weighted by the photopic response of the eye and integrated into a single dimensionless value.

voltage drop: a decrease in voltage caused by losses in the lines connecting the power source to the load.

W

wall: that portion of the *building envelope*, including *opaque* area and *fenestration*, that is vertical or tilted at an angle of 60 degrees from horizontal or greater. This includes above- and *below-grade walls*, between *floor* spandrels, peripheral edges of *floors*, and foundation *walls*.

water heater: vessel in which water is heated and is withdrawn for use external to the *system*.

Abbreviations/Acronyms

ac - alternating current

ANSI - American National Standards Institute

bhp - brake horsepower

Btu/h·ft^2 - British thermal unit per hour per square foot

F - Fahrenheit

hp – horsepower

IES - Illuminating Engineering Society

J - joule

kVA - kilovolt-ampere

kW – kilowatt

LED - light-emitting diode

LPD - lighting power density

SC- shading coefficient

SHGC - solar heat gain coefficient

UPS - uninterruptible power supply

VT - visible transmittance

W - watt

W/ft^2 - watts per square foot

Wh - watt-hour

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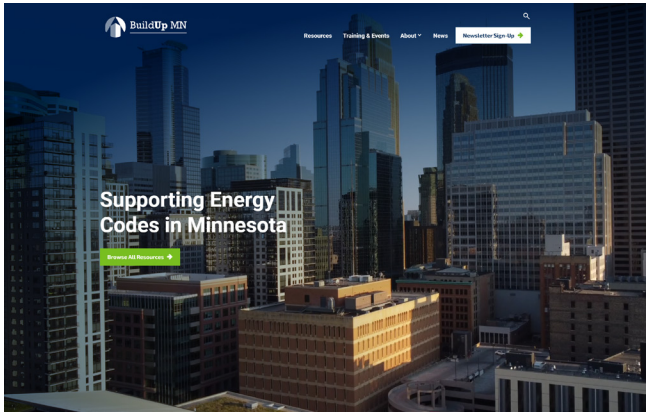

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This Application Guide was developed by BuildUp MN, a program implemented by the MN Advanced Energy Codes Partnership with the goal of improving energy code compliance across Minnesota and developing the workforce for the next generation of buildings. This material is based on work supported by the US Department of Energy's Energy Efficiency & Renewable Energy Office (EERE) under Award Number DE-EE0010933.