

COM*check-EZ* Software User's Guide for 90.1-1989

Building Energy Codes Program



Table Of Contents

COMcheck-EZ	1
Table Columns and Rows	3
Columns	3
Rows	3
File Menu	4
Edit Menu	5
Cut	5
Copy	5
Paste	5
Delete Row(s)	5
Duplicate Row(s)	6
View Menu	6
Toolbar and Status Bar	6
Mandatory Requirements	6
Mechanical System Requirements	6
Options Menu	7
Comments/Description (Envelope)	7
Orientation (Envelope)	7
Daylight Control Factor (Envelope)	7
Spaces (Lighting)	7
Exemptions (Lighting)	8
Context Menu	8
Cut, Copy, Paste, Delete Row(s), and Duplicate Row(s)	8
Use Default	9

Edit Text	9
Edit Inputs	10
Code Menu	10
Help Menu	10
Project Screen	13
Location.....	13
Building Use	13
Project Type	13
Project Information	13
Envelope Screen.....	15
Roofs.....	15
Roof Types	15
Roof Software Inputs	16
Skylights.....	17
Skylight Software Inputs	17
Exterior Walls	18
Exterior and Interior Wall Types.....	19
Exterior and Interior Wall Software Inputs	20
Interior Walls	23
Windows.....	23
Window Software Inputs	23
Doors.....	26
Door Types	26
Door Software Inputs.....	27
Basement Walls	27

Basement Wall Types.....	28
Basement Wall Software Inputs.....	28
Floors	30
Floor Types.....	31
Floor Software Inputs.....	31
Comments	33
Orientation.....	33
Daylight Control Factor (Envelope)	33
Visible Light Transmittance (Envelope)	34
Lighting Screen.....	35
T8/T12 Fluorescent	35
Compact Fluorescent	36
HID	36
Incandescent.....	36
Spaces	36
Lighting Screen Inputs.....	37
Fixture ID	37
Fixture Description	37
Lamp Description/Wattage Per Lamp.....	37
Ballast.....	37
Lamps Per Fixture	38
Number of Fixtures	38
Fixture Wattage	38
Exemptions (Lighting).....	38
Mechanical Screen	41

Viewing Mechanical Requirements	41
HVAC System	42
Heating Equipment Type	43
Cooling Equipment Type	45
Zoning Category	46
HVAC System Software Inputs	46
Plant Screen.....	52
Plant Software Inputs.....	53
Service Water Heating Screen	54
Service Water Heating Software Inputs	54
Building Use Types	55
Whole Building Types.....	55
Area Categories	56
Mandatory Requirements.....	59
Envelope Requirements	59
Documenting Compliance.....	59
Air Leakage.....	59
Maximum Allowed Air Leakage Rates	60
Building Component Certification.....	60
Certifying Installed Insulation	60
Fiberglass Batt Insulation R-Values And Standard Thicknesses	61
Vapor Retarders	61
Lighting Requirements	62
Documenting Compliance.....	62
Control, Switching, And Wiring Requirements	62

Interior-Lighting Controls	63
Master Switches In Hotel And Motel Guest Rooms	63
Bi-Level Switching	63
Exterior-Lighting Controls	64
Tandem Wiring	64
Interior-Lighting Requirements.....	64
Exterior-Lighting Requirements	64
Mechanical Requirements.....	65
Demonstrating Compliance.....	65
Heating and Cooling Loads	65
System Controls	66
Outdoor-Air Ventilation	67
Duct Construction and Insulation	67
Pipe Insulation	67
Materials and Equipment Information	68
Glossary.....	69
Index.....	79

COMcheck-EZ

You can use COMcheck-EZ™ to demonstrate that your commercial or high-rise residential building designs comply with energy codes based on ASHRAE/IES Energy Code for Commercial and High Rise **Residential Buildings** [ASHRAE 90.1 ('89) Code]. COMcheck-EZ includes a software method and a manual method for demonstrating compliance.

The COMcheck-EZ software provides a highly flexible way to demonstrate compliance with minimal input. The envelope section allows tradeoffs between envelope components, including roofs, walls, windows, floors, and skylights. The lighting section enables you to quickly determine if your lighting design meets interior-lighting power limits. The mechanical section enables you to assemble a customized list of code requirements that are applicable to the systems and equipment in your building.

Table Columns and Rows

Many of the main screens have grid-like tables used to enter and store data. You can delete, move, collapse, and expand the rows and columns in the tables.

Columns

Columns can be moved by:

1. clicking the left mouse button on the column heading to be moved,
2. holding down the mouse button on the column heading of the of the selected column,
3. dragging the mouse to the desired new location where the column should be placed,
4. releasing the mouse button when the column has been placed in the desired location.

Table column widths can be modified by moving the mouse over the right edge of the corresponding column header and dragging the column to the desired width.

Rows

To select a row, click on the leftmost column of that row (the column containing row numbers). The row will be highlighted when correctly selected.

Rows can be moved by:

1. selecting the row(s) to be moved (as described above),
2. releasing the mouse button,
3. clicking and holding down the mouse button on the leftmost column of the selected row,
4. dragging the mouse to the new location-a thin red line will appear indicating where the row should be placed,
5. releasing the mouse button when the red line has been placed in the desired location.

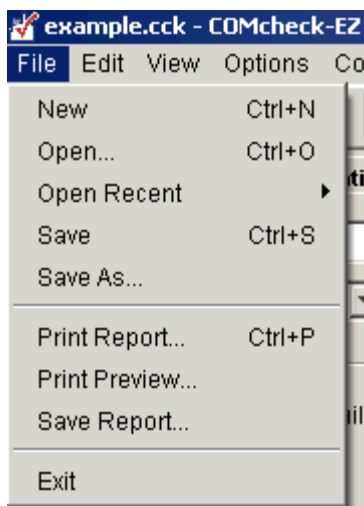
On the main screens, a single table row can also be moved by dragging the corresponding row label in the tree located to the left of the table. Click the mouse on the desired label and drag it to another label on the tree. After

releasing the mouse, the dragged label (and row) will be positioned directly under the label on which it was dropped. Some restrictions apply to the placement of rows. In the *Envelope* screen, for example, **window** and door rows can be placed only under exterior **wall** or basement wall rows. **Skylight** rows can be placed only under **roof** rows.

On the main screens, you can collapse and expand rows by using the tree located to the left of the table. Rows that fall below a "parent" row on the tree can be collapsed so they are not displayed. For example, an exterior wall row with several windows and doors under it can be collapsed to hide the windows and doors. A tree label with a minus sign to the left of the label is already expanded. It can be collapsed by clicking on the box containing the minus sign. Tree labels that are already collapsed have a plus sign to the left of the label. They can be expanded by clicking the box containing the plus sign.

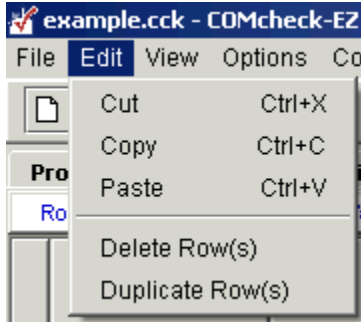
File Menu

Use the *File* menu to open existing project data files (*Open*) and save your project data (*Save*). The *New* option allows you to erase the current data and begin a new project data file. The *Save As* option allows you to save your current project data file to a new name. The program provides options for previewing and printing compliance certificates, and for directing output to selected printers (*Print Report*, *Print Preview*, and *Print Setup*, respectively). You can also save the compliance certificate to a file in rich text format [rtf] (*Save Report*) for inclusion in another document. An example building file is provided with the software ("example.cck").



Edit Menu

Use the *Edit* menu to cut, copy, paste, delete, and duplicate data in the tables. You can also click the right mouse button on any field or tree label to display a pop-up list with these same options (see Context Menu).



The edit commands can be applied to individual table cells, to a selected table row, or to multiple selected rows.

Cut

Use the *Cut* option to delete the highlighted text in a cell. You can paste the deleted text into another cell of the same type.

Copy

Use the *Copy* option to copy the highlighted text in a cell. The copied text can be pasted into another cell of the same type.

Paste

Use the *Paste* option to paste the last copied text into a selected cell. Note that you can only paste cell data of the same type.

Delete Row(s)

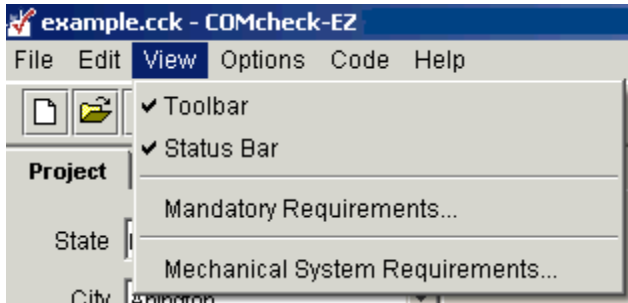
Use the *Delete Row(s)* option to delete all selected rows. To select a row, click on the tree label corresponding to that row or click on the leftmost column of that row (the column containing row numbers). Non-consecutive rows can be selected by holding down the **Ctrl** key while clicking the leftmost column of each row to be selected. You can also delete rows by selecting the corresponding icon from the toolbar.

Duplicate Row(s)

Use the *Duplicate Row(s)* option to duplicate one or more consecutive selected rows. To select a row, click on the tree label corresponding to that row or click on the leftmost column of that row (the column containing row numbers). Non-consecutive rows can be selected by holding down the **Ctrl** key while clicking the leftmost column of each row to be selected. You can also duplicate rows by selecting the corresponding icon from the toolbar.

View Menu

Use the *View* menu to view or hide software features.



Toolbar and Status Bar

The *Toolbar* and *Status Bar* options hide or display the Toolbar or Status Bar.

Mandatory Requirements

The *Mandatory Requirements* option displays requirements that must be met by all buildings in addition to the requirements determined to be applicable by the software. You may view and print separate mandatory requirements for Envelope, Lighting, and Mechanical.

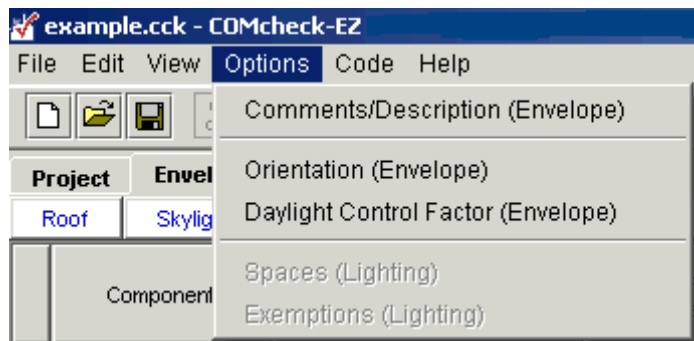
Mechanical System Requirements

The *Mechanical System Requirements* option offers two views: *Checklist* and *Description*. If you select the *Building* label in the tree at the left of the screen, the list of requirements applicable to all building systems is displayed. If you select a specific mechanical component label in the tree, the requirements applicable to only that component are displayed.

The *Checklist* option displays the same lists of requirements as the *Description* option but in an abbreviated (checklist) format. The *Description* option displays a comprehensive description of requirements applicable to the selected component.

Options Menu

Use the *Options* menu to toggle optional software features on or off. All features under the *Options* menu are optional--none are required to demonstrate compliance.



Comments/Description (Envelope)

Select this option to create a *Comments/Description* column on the *Envelope* screen. See *Comments* for more information.

Orientation (Envelope)

Use the *Orientation* option to add a column to the *Envelope* screen to select *North*, *East*, *South*, or *West* orientations for each exterior **wall**, **window**, door, and basement wall assembly. For more information, see *Orientation*.

Daylight Control Factor (Envelope)

If you select *Daylight Control Factor*, COMcheck-EZ adds two columns to the *Envelope* screen--*DLCF* (daylight control factor) and *VLT* (visible light transmittance). For more information, see *Daylight Control Factor*.

Spaces (Lighting)

The *Spaces* option allows you to link lighting fixtures to spaces within the building. The tree on the left side of the *Lighting* screen shows the linkage

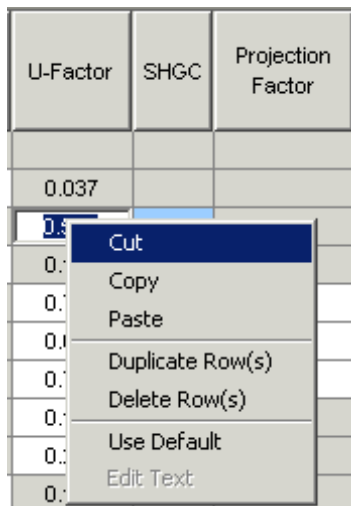
between each space and the fixtures within it. The *Spaces* option is recommended because it simplifies verification of fixture counts.

Exemptions (Lighting)

To use the optional exemptions feature and identify an exempt fixture, click the mouse in the *Exemption* column of that fixture. For more information, see Exemptions.

Context Menu

Clicking the right mouse button on a tree label or table displays a pop-up list, referred to as a context menu. The context menu options are applied to a single field in a table or to an entire row in a table, depending on where the mouse is clicked. If the mouse is clicked on a tree label, the menu options are applied to the row corresponding to that label. If the mouse is clicked on the left field of a row in a table, the options are applied to the entire row. Some options are applicable to individual fields of a table, and the mouse must be clicked on the given field to activate the option.



Context Menu

Cut, Copy, Paste, Delete Row(s), and Duplicate Row(s)

The *Cut*, *Copy*, *Paste*, *Delete Row(s)*, and *Duplicate Row(s)* options are available from the *Edit* menu in the menu bar, from toolbar buttons, and from the context menus. See the previous section on the *Edit* menu for a description of these options. The *Cut*, *Copy*, and *Paste* options can be applied to individual

fields in a table. The *Delete Row(s)* and *Duplicate Row(s)* options are always applied to an entire row or rows.

You cannot duplicate a row of one type and place it over a row of another type.

For example, you cannot duplicate a row in the *Envelope* table containing a **roof** component and place it in a row already containing a **window** component--this will generate an error message.

Use Default

The *Use Default* option enables you to enter a common value for products having the characteristics you have selected. You can use this feature in initial compliance checking before actual products have been selected. However, products used in the building must meet or exceed the performance you assume in the compliance analysis.

The *Use Default* option places a common value into an individual field of a table.

For example, after selecting a window component and describing the **glazing** and frame characteristics of that window, you can right-click the **U-Factor** column of the window component and select the *Use Default* option from the *Context* menu. The software will supply a window U-factor that is "typical" for a window with those characteristics. Select *Use Default* by right-clicking on the **SHGC** column or the **VLT** column (see VLT), and the software will provide a typical **solar heat gain coefficient** (SHGC) value or a typical **visible light transmittance** value for the window.

You can also right-click in the *Fixture Wattage* column on the *Lighting screen*; then select *Use Default* to have the software provide a typical fixture input wattage, i.e., for the lamp/**ballast** combination.

Edit Text

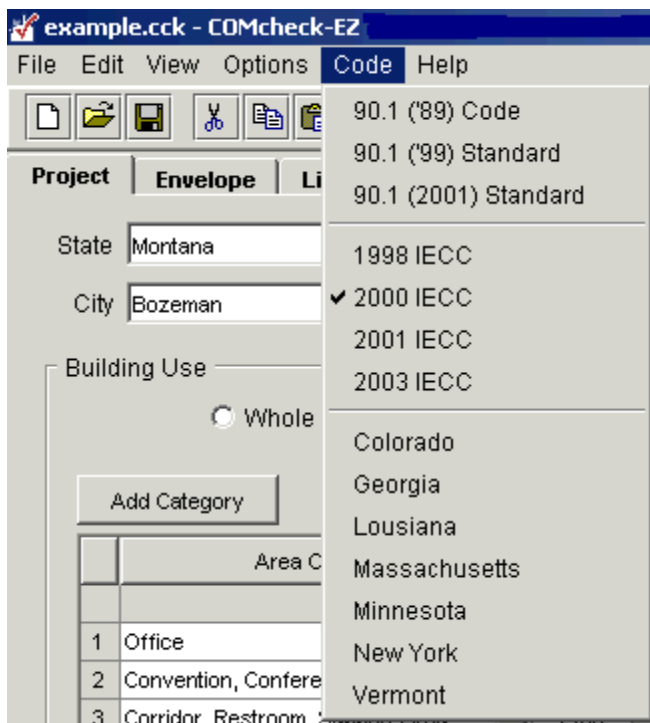
The *Edit Text* option is used to edit the text on a tree label. When you create a new envelope assembly or lighting fixture, a new row appears in the corresponding table and a new tree label appears on the tree to the left. The tree labels are assigned default names such as *Roof 1* or *Incandescent 2*. These labels can be changed by clicking the right mouse button on the label and selecting *Edit Text* from the *Context* menu. An edit box will become visible where the label used to be, and you can rename the label by typing in the edit box. Press **Enter** or click elsewhere when finished. You can enter a maximum of 128 characters in the edit box. You can also edit tree labels by double-clicking on the label.

Edit Inputs

The *Edit Inputs* option is only available on the *Envelope* screen when right-clicking on a basement **wall** row or a slab row. On the *Mechanical* screen, if you want to change any of the inputs for a particular mechanical component, click the right mouse button on the tree label for that component and select *Edit System Inputs*, *Edit Plant Inputs*, or *Edit SWH Inputs* (the context menu option changes depending on which type of mechanical component you have selected). The input screen(s) will be redisplayed with your original inputs, which you can change.

Code Menu

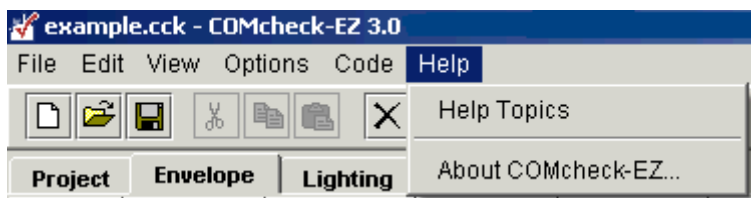
Use the *Code* menu to select which code version you want the program to use when determining compliance.



Help Menu

The *Help* menu provides general information on how to use COMcheck-EZ. The *Help Topics* option displays all of the Help topics within COMcheck-EZ. The

About COMcheck-EZ option displays the program's version number and release date.



Project Screen

The *Project* screen is used to provide the software with information such as: 1) the location of the proposed building (state and city) and 2) the building use category and area. You may also enter specific project information that identifies and describes your project.

Location

COM*check-EZ* lists the available cities for each state. If your city is not listed, choose the closest city with similar weather conditions or consult with your local building department.

Building Use

Use the *Whole Building* compliance method for buildings that entirely match one of the available building types. Use the *Area Category* compliance method for mixed-use buildings when detailed information about space usage is available. For some projects, you may have a choice of which compliance method to use.

A list of building types or area categories is displayed when you click the left mouse in the *Whole Building Type* or *Area Category* column of the *Building Use* table. The *Assembly*, *Hotel/Motel*, and *Multifamily* options displayed in the whole-building types list are only available for envelope compliance. To make them available, you must select the *Envelope and/or Mechanical Compliance Only* checkbox. If lighting compliance is to be determined for one of these building types, you must use the area category method of compliance.

Project Type

Select *New Construction* or *Addition*. The selection will be included on the compliance report although the trade-off calculations remain the same for all project types.

Additions are treated the same way as *New Construction*, ignoring the common walls between the existing building and the addition. All new systems being added must be entered in the software and must comply with the requirements. Existing systems simply extended into an addition do not have to be included.

Project Information

- *Project Name* – Enter a name to identify a specific project.

- *Designer/Contractor* – Use this field to enter contact information for the designer/contractor.
- *Document Author* – Enter contact information for the person completing the compliance documentation.
- *Notes* – Enter any additional information about the project

Envelope Screen

Use the blue-on-white buttons at the top of the *Envelope* screen to create a list of building components present in your proposed design. Each component you select is added to the building components displayed on the *Envelope* screen.

For each component, enter appropriate values for all fields with white backgrounds. These fields may include the assembly type, gross area (or perimeter), cavity **R-value**, continuous R-value, assembly **U-factor**, construction details, **SHGC**, and/or **projection factor**. To view an example building description, open the "example.cck" file.

Concrete slab-on-grade components require a perimeter entered in linear feet (ft). All other components require an area entered in square feet (ft²). The cavity R-value input is used for insulation placed between structural members, while the continuous R-value input is used for insulation that is continuous across the structure such as rigid-roof insulation or insulating **wall** sheathing.

After you have completed the description of each new component, the program automatically updates the compliance results. The results are displayed at the bottom of the screen in the *Envelope* box. If *TBD* (to be determined) is displayed in this field, you have not filled in all necessary fields. To determine which data are missing or invalid, look for fields with white-on-red text. In addition to providing inputs for all white-on-red fields, you must select at least one building use type and provide its area on the *Project* screen before the software can determine compliance.

Roofs

Roofs include portions of the **building envelope** that are above conditioned space and are horizontal or tilted at less than 60 degrees from horizontal.

Select the **Roof** button to add a roof component to the description of your design on the *Envelope* screen. Enter each unique roof assembly as a separate component. You can enter multiple roof elements sharing the same construction as one component with appropriate total area.

Roof Types

- *All-Wood Joist/Truss* – wood frame **roof** structures in which insulation is placed between structural roof members; e.g., batt or loose-fill insulation in cathedral ceilings or attic spaces.
- *Non-Wood Joist/Truss* – metal frame roof structures in which insulation is placed between structural roof members; e.g., steel bar joists or trusses with metal webs having insulation below the roof deck.

- *Structural Slab* – any roof structure in which the roof is insulated primarily or exclusively using continuous rigid insulation above the roof deck.
- *Metal Roof without Thermal Blocks* – metal building roofs where roof insulation is draped across metal structural members and metal roofing is attached to the structural members without rigid insulating spacers.
- *Metal Roof with Thermal Blocks* – metal building roofs where roof insulation is draped across metal structural members and rigid insulating spaces are used between structural members and metal roofing. Because the thermal performance of metal building components is sensitive to assembly and fastener details, you may find it advantageous to enter these assemblies using the Other category and U-factors from manufacturers' literature.
- *Other* – roof assemblies that do not fit in one of the above five categories (see Assembly U-Factor under Roof Software Inputs).

Roof Software Inputs

Gross Area

Enter the gross area of the **roof** component in the *Gross Area* field. The gross roof area includes the area of all skylights that penetrate the roof. Skylights are shown below the roof to which they belong on the tree control on the left side of the *Envelope* screen. To change the linkage of a **skylight** to a roof assembly, drag the skylight label on the tree to a new roof label and release the mouse.

The roof area should be measured along the insulated boundary between conditioned and **unconditioned space** (e.g., along sloping rafters if the roof insulation follows the slope of the roof).

Cavity Insulation R-Value

Enter the **R-value** of any insulation to be installed in the cavities between roof structural members. All R-values should be rated R-values for insulation materials only. These values are commonly printed on the materials. The insulating values of other parts of the building assemblies (e.g., ceilings and air films) are already accounted for by the software based on assembly type.

Continuous Insulation R-Value

Enter the R-value of any continuous roof insulation. Continuous insulation is insulation that runs continuously over structural members and is free of significant thermal bridging; one example is rigid foam insulation above the roof deck. All R-values should be rated R-values for insulation materials. The

insulating values of other parts of the building assemblies (e.g., ceilings and air films) are already accounted for by the software based on assembly type.

Assembly U-Factor

If you have selected the *Other* roof type, enter the overall **U-factor** of the roof assembly, including exterior and interior air films. Do not include the finished **ceiling** in the U-factor calculation if the space between ceiling and roof structure is used as an **HVAC plenum**. Building departments may require supporting documentation for assemblies entered using the *Other* roof category and *U-Factor* field.

Skylights

Skylights are defined as any transparent or translucent section in a building **roof**, which include **glazing** material (glass or plastic), frame, and curb. Glazing having a slope less than 60 degrees from horizontal is considered a **skylight**, while glazing having a slope greater than 60 degrees from horizontal is considered a **window**.

Select the *Skylight* button to add a skylight component to the description of your design on the *Envelope* screen. Enter each unique skylight assembly as a separate component. You can enter multiple skylight elements having the same characteristics as one component with the appropriate total area.

Skylight Software Inputs

The software prompts you to enter three **skylight** characteristics each time you create a skylight component—frame type and **glazing** layers are entered in the *Assembly* column, and glazing type is entered under the *Construction Details* column. Specifying these skylight characteristics is helpful for inspection purposes and enables the software to provide typical performance characteristics (i.e., **U-factor** and **SHGC**) for various glazing options.

Gross Area

Enter the area of the entire skylight component in square feet measured parallel to the skylight surface, including both the glazing material and frame. The rough skylight opening provides an acceptable proxy for this skylight area.

Frame Type and Glazing Layers

The frame type and glazing layers are selected from a pop-up list accessed by clicking the left mouse button in the *Assembly* field. For frame materials not listed, use the frame type that is thermally most similar; e.g., use *Wood* for metal-clad wood skylights. The glazing layers field enables you to identify the number

of glazing layers in the skylight (i.e., single, double, or triple). Low-E coatings are included in the list because the performance impact of low-emissivity films is similar to that of additional glass layers.

Glazing Type

The *Glazing* field (under *Construction Details*) enables you to identify the type of glass in the skylight (i.e., clear, tinted, or reflective). Use *Reflective* if the glass has a reflective surface, even if the glass is also tinted.

U-Factor

Skylight U-factor is based on the entire assembly, including glazing, sash, curbing, and other framing elements. Center-of-glass U-factors cannot be used.

U-factors for skylights must be tested and documented by the manufacturer in accordance with the NFRC test procedure. If an NFRC U factor rating is available for your skylight, you should use its BB-Size rating (i.e., 48 by 48 in.).

The *COMcheck-EZ* program includes a feature that enables you to insert a typical U-factor for the skylight characteristics you have selected. To access this feature, click the right mouse button on the U-factor input field and select *Use Default*. The *Use Default* feature provides values you can use in preliminary evaluations before selecting actual products. However, the actual ratings of products put in place in the building must meet or exceed (i.e., be no higher than) the values you assume in the compliance analysis. Most products on the market will meet or exceed the performance levels provided by the *Use Default* feature.

Solar Heat Gain Coefficient (SHGC)

The *Solar Heat Gain Coefficient (SHGC)* field enables you to specify the glazing's effectiveness in rejecting solar heat gain. SHGC is part of a system for rating glazing performance used by the National Fenestration Rating Council (NFRC). SHGC is gradually replacing the older index, shading coefficient (SC), in product literature and design standards. If you are using glass whose performance is listed in terms of SC, you may convert to SHGC by multiplying the SC value by 0.87. Although skylight SHGC is an important variable for energy-efficient design, it is not important in this compliance procedure.

Deviations from the program's typical values for skylight SHGC are unlikely to impact compliance.

Exterior Walls

Select the *Ext. Wall* button to add an exterior above-grade wall to the description of your design on the *Envelope* screen. Each unique above-grade wall assembly should be entered as a separate component, but multiple wall elements sharing

the same construction and orientation (if used) may be entered as one component with appropriate total area.

Exterior and Interior Wall Types

- *Wood Frame, Any Spacing* - wood frame walls of any stud depth or spacing. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.
- *Metal Frame, 16" o.c.* - metal frame (stud) walls of any gauge or depth, spaced 16" o.c. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.
- *Metal Frame, 24" o.c.* - metal frame (stud) walls of any gauge or depth, spaced 24" o.c. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.
- *Metal **Wall** Without Thermal Blocks* - metal building walls where wall insulation is draped across metal structural members and metal siding is attached directly to the structural members without rigid insulating spacers.
- *Structural Masonry Wall* - a wall construction category used with masonry, precast, and poured-in-place concrete, and concrete masonry units. You can select from six specific types of masonry wall.
 - *Solid Concrete or Masonry $\leq 8"$* - solid precast or poured-in-place concrete, as well as concrete masonry units with grouted cells and actual thickness of 8" or less.
 - *Solid Concrete or Masonry $>8"$* - solid precast or poured-in-place concrete, as well as concrete masonry units with grouted cells and actual thickness $>8"$.
 - *CMU $\leq 8"$ with Empty Cells* - concrete masonry units (CMUs) with at least 50% of the CMU cells free of grout and actual thickness of 8" or less.
 - *CMU $>8"$ with Empty Cells* - CMUs with at least 50% of the CMU cells free of grout and actual thickness $>8"$.
 - *CMU $\leq 8"$ with Integral Insulation* - CMUs with integral insulation (e.g., perlite or rigid insulation inserts within the cells of the concrete masonry units) and actual thickness of 8" or less.

- *CMU >8" with Integral Insulation* - CMUs with integral insulation (e.g., perlite or rigid insulation inserts within the cells of the concrete masonry units) and actual thickness >8".
- *Other* - wall assemblies that do not fit in any of the other above-grade wall categories. You may also use the *Other* category if specific features of your wall give it a significantly lower **U-factor** than the corresponding generic wall type listed in the menu. See Assembly U-Factor under Exterior and Interior Wall Software Inputs.

Warning Note for Integral Insulation

Integral Insulation means insulation placed within the voids of CMUs. Selecting this wall type automatically gives you credit for integral insulation. Loose-fill insulation, such as perlite or rigid foam inserts are typically used. The *CMU with Integral Insulation* wall types assume loose-fill insulation. For walls with better performing integral insulation, use the *Other* wall category.

Do not enter values for *Cavity R-Value* and *Continuous R-Value* unless you have additional insulation attached to this CMU wall assembly. Alternatively, you may enter CMU walls using the *Other* wall type, but be prepared to provide supporting documentation for the U-factor that you are required to enter.

Do not confuse this Integral Insulation discussion with the "Integral" insulation position input available in ASHRAE's ENVSTD program. *COMcheck-EZ* does not provide an insulation position input but instead assumes an "integral" position for any insulation in above-grade exterior walls, as opposed to assuming the insulation is either on the interior or exterior of the wall. This fixed assumption provides the most generous assessment of the benefits of high heat-capacity walls that would have been available if *COMcheck-EZ* included a user-input for insulation position.

Exterior and Interior Wall Software Inputs

Gross Area

Enter the gross area of the **wall** component in the *Gross Area* field. The gross wall area includes the area of all windows and doors that penetrate the wall.

Windows and doors appear below the wall to which they belong on the left side of the *Envelope* screen. To change the linkage of a **window** or door to a wall, drag the window or door label on the tree to the wall label and release the mouse. For interior walls, ignore all window and door assemblies that penetrate the wall.

Cavity Insulation R-Value

Enter the **R-value** of any insulation to be installed in the cavities between above-grade wall structural members. All R-values should be rated R-values for insulation materials, which are commonly printed on the materials. The insulating values of other parts of the building assemblies (e.g., gypsum board and air films) are already accounted for by the software based on assembly type.

Continuous Insulation R-Value

Enter the R-value of any **continuous insulation** in the above-grade wall. Continuous insulation is insulation that is continuous over framing members or furring strips and is free of significant thermal bridging. All R-values should be rated R-values for insulation materials. The insulating values of other parts of the building assemblies (e.g., gypsum board and air films) are already accounted for by the software based on assembly type.

Assembly U-Factor

If you have selected the *Other* wall type option, enter the overall **U-factor** of the above-grade wall assembly, including exterior and interior air films. Building departments may require supporting documentation for assemblies entered using the *Other* wall category and *U-Factor* field.

Furring Type

The *Furring* input field is displayed in the *Construction Details* column for structural masonry (concrete) above-grade walls. The furring input enables you to specify the type of furring material (if any) used on the wall. If the wall has no furring, select *None*. If the wall assembly employs metallic furring strips, clips, or framing members, select *Metal*; otherwise, select *Wood*.

The furring material is assumed to create some thermal bridging of the insulation in the cavity between furring members, thereby reducing insulation effectiveness.

Heat Capacity

The *Heat Capacity* column is only displayed if an exterior wall or basement wall is created and the *Other* assembly type is selected. Heat capacity is the amount of heat (measured in Btus) necessary to raise the temperature of 1 ft² of wall 1°F. Allowable values are 1 to 25 Btu/(ft² °F), although no additional credit is given for heat capacity values >21.

Example heat capacities for common wall constructions are shown below:

Wall Description	Heat Capacity
Typical wood- or steel-framed wall	2
2" brick face/framed wall	5
4" brick/framed wall	9
8" block w/empty cores	11
6" concrete wall	14
8" block w/solid-filled cores	16
12" block	15-18
Solid concrete/masonry wall greater than 8" thick	18-25

To precisely calculate the heat capacity of a wall assembly, sum the products of the thickness, density, and specific heat of each material layer. These properties for many common building materials can be found in Chapter 24 of the 1997 *ASHRAE Handbook of Fundamentals*. Because the specific heats of most building materials average around 0.2 Btu/(lb•°F), a good approximation of heat capacity for any wall assembly can be determined by estimating the weight per square foot of exterior wall surface and dividing by 5.

All COMcheck-EZ compliance calculations assume that any insulation in an above-grade exterior wall (or above-grade portion of a below-grade wall assembly) is integral with the thermal mass of the wall, as opposed to assuming the insulation is either on the exterior or the interior of the wall. This fixed assumption provides the most generous assessment of the benefits of high heat-capacity walls that would have been available had COMcheck-EZ included an insulation position input.

Entering Assemblies by Orientation

The software allows you to enter building components with or without considering the component orientation (north, south, east, and west). Initially, the orientation option is turned off. If you prefer to enter components based on their orientation, select the *Orientation* option under the *Options* menu. The compliance calculation will not be based on orientation-specific components until an orientation has been assigned to each exterior wall, window, door, and basement wall component.

If the orientation feature is not being used, you can group and list like components as a single component. However, if you need more than one entry of the same component (e.g. where two assemblies of the same type have different insulation levels), you must create as many additional components as required.

Interior Walls

Select the *Int. Wall* button to add an interior above-grade wall to the description of your design on the *Envelope* screen. Enter only interior walls separating conditioned from **unconditioned space**; ignore all other interior walls. Wall types for interior walls are the same as the wall types for exterior walls. The software inputs are also the same.

Windows

Windows are defined as any transparent or translucent section in an exterior building **wall**, including sliding-glass doors, patio doors, and glass blocks but excluding glass entry doors (which are entered using the *Door* button). Windows include **glazing** material (which may be glass or plastic), framing (mullions, muntins, and dividers), external shading devices, internal shading devices, and integral (between glass) shading devices. Glazing having a slope greater than 60 degrees from horizontal is considered a **window**, while glazing having a slope less than 60 degrees from horizontal is considered a **skylight**.

Select the *Window* button to add a window component to the description of your design on the *Envelope* screen. Enter each unique window assembly as a separate component. You can enter multiple window elements having the same characteristics as one component with an appropriate total area.

Window Software Inputs

The software prompts you to enter three **window** characteristics each time you create a window component—frame type and **glazing** layers are entered in the *Assembly* column, and glazing type is entered under the *Construction Details* column. Specifying these window characteristics is helpful for inspection purposes and enables the software to provide typical performance characteristics (i.e., **U-factor**, **SHGC**, and VLT) for various glazing options.

Gross Area

Enter the area of the entire window component in square feet (ft²) measured parallel to the window surface, including both glazed materials and frame. The rough window opening provides an acceptable proxy for this window area.

Frame Type and Glazing Layers

The frame type and glazing layers are selected from a pop-up list accessed by clicking the left mouse button in the *Assembly* field. The frame type enables you to identify the window frame material and hence characterize the thermal conductivity of the frame. For frame materials not listed, use the frame type that

is thermally most similar; e.g., use *Wood* for metal-clad wood windows. The glazing layers enables you to identify the number of glazing layers in the windows (i.e., single, double, or triple). Low-E coatings are included in the list because the performance impact of low-emissivity films is similar to that of additional glass layers.

Glazing Type

The *Glazing* field (under *Construction Details*) enables you to identify the type of glass in the window (i.e., clear, tinted, or reflective). Use *Reflective* if the glass has a reflective surface, even if the glass is also tinted.

U-Factor

Window U-factor is based on the entire assembly, including both glazing and frame. Center-of-glass U-factors cannot be used. Glazing U-factors must be tested and documented by the manufacturer in accordance with the National **Fenestration** Rating Council (NFRC) test procedure. The *COMcheck-EZ* software includes a feature that enables you to insert a typical U-factor for the window characteristics you have selected. To access this feature, click the right mouse button on the *U-factor* input field and select *Use Default*. The *Use Default* feature provides values you can use in preliminary evaluations before selecting actual products. However, the actual ratings of products in the building must meet or exceed (i.e., be no higher than) the values you assume in the compliance analysis. Most products on the market will meet or exceed the performance levels provided by the *Use Default* feature.

Solar Heat Gain Coefficient

The Solar Heat Gain Coefficient (SHGC) specifies the glazing's effectiveness in rejecting solar heat gain. SHGC is part of a system for rating window performance used by the NFRC. SHGC is gradually replacing the older index, **shading coefficient** (SC), in product literature and design standards. If you are using glass whose performance is listed in terms of SC, you may convert to SHGC by multiplying the SC value by 0.87.

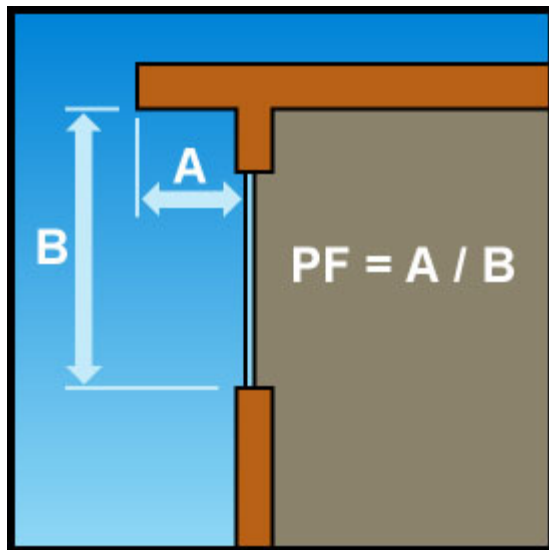
SHGCs must be tested and documented by the manufacturer in accordance with the NFRC test procedure.

If interior blinds are to be used in the building and are documented in the contract documents submitted as part of the permit application, you may account for them in the SHGC value. However, their impact in lowering the effective SHGC must be consistent with manufacturers' data, the ASHRAE Handbook of Fundamentals, or another authoritative source. This credit cannot be used to reduce a window's SHGC by more than 15%. For example, a window with a

SHGC of 0.6 can receive a credit of at most 0.09, which would result in an effective SHGC of 0.51.

Projection Factor

The **projection factor** enables you to characterize the shading impact of horizontal overhangs or canopies that project outward from the plane of the window. The projection factor is the ratio of the distance the overhang projects from the window surface to its height above the sill of the window it shades. The software accepts values from 0.0 to 1.0.



Entering Assemblies by Orientation

The software allows you to enter building components with or without considering the component orientation (north, south, east, and west). Initially, the orientation option is turned off. If you prefer to enter components based on their orientation, select the *Orientation* option under the *Options* menu. The compliance calculation will not be based on orientation-specific components until an orientation has been assigned to each exterior **wall**, window, door, and basement wall component.

If the orientation feature is not being used, you can group and list like components as a single component. However, if you need more than one entry of the same component (e.g. where two assemblies of the same type have different insulation levels), you must create as many additional components as required.

Daylight Control Factor

See Daylight Control Factor under Options Menu.

Visible Light Transmittance

See Visible Light Transmittance under Options Menu.

Doors

Select the *Door* button to add a door component to the description of your design on the *Envelope* screen. Enter each unique door assembly as a separate component. You can enter multiple door elements sharing the same characteristics as one component with the appropriate total area.

The *Door* button is intended for use with most types of commercial doors.

Sliding-glass doors and atrium doors that function primarily as windows rather than to accommodate circulation (e.g., in multifamily or hotel/motel) should be entered using the **Window** button and not the *Door* button. Doors located in exterior walls and the walls of conditioned basements should be included, but areas of doors separating conditioned from unconditioned space should be included in the areas of the interior walls which they penetrate.

Door Types

- *Solid (<+50 % glazing)* - exterior doors that are mostly opaque (i.e., glass covers less than half of the door's area) and are intended to accommodate occupant circulation.
- *Glass (>50% glazing)* - exterior doors that are mostly glazed (i.e., glass covers more than half of the door's area) and are intended to accommodate occupant circulation.
- *Overhead* - any large exterior doors designed to accommodate large objects and/or vehicular circulation.
- *Air Lock Entry* - exterior doors arranged in pairs to limit infiltration associated with occupant circulation.
- *Revolving* - revolving exterior doors such as those frequently used in hotels and large retail establishments.
- *Other* - any exterior doors that do not fit in any of the other five door categories. You must enter a **U-factor** and you should be prepared to provide the building department with manufacturers' literature or documentation of U-factor calculations.

Door Software Inputs

Gross Area

Enter the total area of the door in square feet, including any glazed portions. The rough opening for the door is an acceptable proxy for this door area.

U-Factor

Enter the overall **U-factor** for the door(s) from manufacturers' literature or select the *Use Default* option from the pop-up context menu accessed by clicking the right mouse button in the *U-Factor* field. The *Use Default* option provides a U-factor for a door judged typical of the selected type containing little or no thermal insulation.

Entering Assemblies by Orientation

The software allows you to enter building components with or without considering the component orientation (north, south, east, and west). Initially, the orientation option is turned off. If you prefer to enter components based on their orientation, select the *Orientation* option under the *Options* menu. The compliance calculation will not be based on orientation-specific components until an orientation has been assigned to each exterior **wall**, **window**, door, and basement wall component.

If the orientation feature is not being used, you can group and list like components as a single component. However, if you need more than one entry of the same component (e.g. where two assemblies of the same type have different insulation levels), you must create as many additional components as required.

Daylight Control Factor

See Daylight Control Factor under Options Menu.

Basement Walls

The basement **wall** component is intended for use with walls that are either partially or fully below grade. Ignore portions of basement walls more than 10 ft below grade. The *COMcheck-EZ* software automatically treats above-grade portions of basement wall components like above-grade exterior walls.

Select the *Basement* button to add a basement wall component to the description of your design on the *Envelope* screen. Enter each unique basement wall assembly as a separate component. You can enter multiple basement wall

elements sharing the same construction as one component with the appropriate total area.

Basement Wall Types

- *Solid Concrete or Masonry* $\leq 8"$ - poured-in-place concrete walls and concrete masonry units with grouted cells and actual thickness of 8" or less.
- *Solid Concrete or Masonry* $>8"$ - poured-in-place concrete walls and concrete masonry units with grouted cells and actual thickness $>8"$.
- *CMU* $\leq 8"$ *with Empty Cells* - concrete masonry units with at least 50% of CMU cells free of grout and actual thickness of 8" or less.
- *CMU* $>8"$ *with Empty Cells* - concrete masonry units with at least 50% of CMU cells free of grout and actual thickness $>8"$.
- *CMU* $\leq 8"$ *with Integral Insulation* - concrete masonry units with integral insulation (e.g., perlite or rigid insulation inserts within the cells of the concrete masonry units) and actual thickness of 8" or less.
- *CMU* $>8"$ *with Integral Insulation* - concrete masonry units with integral insulation and actual thickness $> 8"$.
- *Other* - **wall** assemblies that do not fit into any of the other basement wall categories. You may also use the *Other* category if specific features of your wall give it a significantly lower **U-factor** than the corresponding generic basement wall type listed in the menu. See Assembly U-Factor under Basement Wall Software Inputs.

Warning Note for Integral Insulation

Integral Insulation means insulation placed within the voids CMUs. Selecting this wall type automatically gives you credit for integral insulation. Loose-fill insulation, such as perlite or rigid foam inserts are typically used. The *CMU with Integral Insulation* wall types assume loose-fill insulation. For walls with better performing integral insulation, use the *Other* wall category. Alternatively, you may enter CMU walls using the *Other* wall type, but be prepared to provide supporting documentation for the U-factor that you are required to enter.

Basement Wall Software Inputs

Gross Area

Enter the gross area of the basement **wall** component in the *Gross Area or Perimeter* column. The gross wall area includes the area of both above-grade

and below-grade portions of the basement wall, and all windows and doors that penetrate the wall. Windows and doors appear below the wall to which they belong on the tree on the left side of the *Envelope* screen. To change the linkage of a **window** or door to a basement wall, drag the window or door label on the tree to the basement wall label and release the mouse.

Windows and Doors in Basement Walls

When windows and doors are added to basement walls, net opaque wall areas are determined by subtracting windows and doors from any above-grade part of the basement wall. If necessary, the above-grade portion of the basement wall is increased so that windows and doors belong to the above-grade part of the basement wall. See *Wall Height* and *Depth Below Grade* Help topics for an explanation of how basement walls are treated with respect to being above or below grade.

Cavity Insulation R-Value

Enter the **R-value** of any insulation to be installed in the cavities between furring strips. All R-values should be rated R-values for insulation materials, which are commonly printed on the materials. The insulating values of other parts of the building assemblies (e.g., masonry and air films) are already accounted for by the software based on assembly type.

Continuous Insulation R-Value

Enter the R-value of any **continuous insulation** to be installed either on the inside or the outside of the basement wall. Continuous insulation is insulation that runs continuously and is free of significant thermal bridging. All R-values should be rated R-values for insulation materials. The insulating values of other parts of the building assemblies (e.g., masonry and air films) are already accounted for by the software based on assembly type.

Assembly U-Factor

If you have selected the *Other* basement wall type option, you must enter the overall **U-factor** of the basement wall assembly, including the interior air film but excluding the effects of earth and exterior air films. Building departments may require supporting documentation for assemblies entered using the *Other* basement wall category and *U-Factor* field.

Wall Height

Enter the average height of the basement wall measured from the top of the basement floor to the top of the basement wall.

The *Wall Height (ft)* and *Depth Below Grade (ft)* fields together enable you to enter a basement wall assembly partially above and partially below grade as a single entry. If the values in these two fields are the same, the wall will be treated as entirely below grade.

Depth Below Grade

Enter the average depth below grade of the wall in the *Depth Below Grade (ft)* field, measuring from the average grade level to the top of the basement floor.

Furring Type

The *Furring* input field (under *Construction Details*) enables you to specify the type of furring material (if any) used on the wall. If the wall has no furring, select *None*. If the wall assembly employs metallic furring strips, clips, or framing members, select *Metal*; otherwise, select *Wood*.

The furring material is assumed to create some thermal bridging of the insulation in the cavity between furring members, thereby reducing insulation effectiveness.

Entering Assemblies by Orientation

The software allows you to enter building components with or without considering the component orientation (north, south, east, and west). Initially, the orientation option is turned off. If you prefer to enter components based on their orientation, select the *Orientation* option under the *Options* menu. The compliance calculation will not be based on orientation-specific components until an orientation has been assigned to each exterior wall, window, door, and basement wall component.

If the orientation feature is not being used, you can group and list like components as a single component. However, if you need more than one entry of the same component (e.g. where two assemblies of the same type have different insulation levels), you must create as many additional components as required.

Daylight Control Factor

See Daylight Control Factor under Options Menu.

Floors

Select the **Floor** button to add a floor component to the description of your design on the *Envelope* screen. Enter each unique exposed floor assembly as a separate component. You can enter multiple floor elements sharing the same construction as one component with the appropriate total area.

The *Floor* button is used to enter floors over **unconditioned space**, including floors exposed to exterior conditions, floors over crawl spaces, floors over unconditioned parking garages, and slab-on-grade floors. Interior floors that do not separate conditioned from unconditioned space are not included. Ignore slabs more than 2 ft. below grade.

Floor Types

- *All-Wood Joist/Truss* - any structural wood **floor** in which insulation is placed between the structural members; e.g., batt insulation between wood floor joists.
- *Nonwood Joist/Truss* - any floor in which insulation is placed between nonwood structural members; e.g., batt insulation between steel bar joists or trusses with metal webs.
- *Concrete Floor (over unconditioned space)* – a poured-in-place concrete floor over unconditioned space (e.g., concrete floor over an unconditioned parking garage).
- *Slab-On-Grade* – concrete slabs whose perimeters are exposed to exterior conditions.
- *Other* - floor assemblies that do not fit in any of the other three categories. See Assembly U-Factor under Floor Software Inputs.

Floor Software Inputs

Gross Area or Slab Perimeter

Enter the gross area of the **floor** (in square feet) along the boundary where it separates conditioned from **unconditioned space** or enter the perimeter of the slab-on-grade component in linear feet.

Cavity Insulation R-Value

Enter the **R-value** of any insulation to be installed in the cavities between floor structural members. All R-values should be rated R-values for insulation materials, which are commonly printed on the materials. The insulating values of other parts of the building assemblies (e.g., subfloor and air films) are already accounted for by the software.

Continuous Insulation R-Value

Enter the R-value of any continuous floor insulation. Continuous insulation is insulation that runs continuously over structural members and is free of

significant thermal bridging. All R-values should be rated R-values for insulation materials. The insulating values of other parts of the building assemblies (e.g., subfloor and air films) are already accounted for by the software. For slabs, enter the R-value of the slab perimeter insulation.

Assembly U-Factor

If you have selected the *Other* floor type option, you must enter the overall **U-factor** of the floor assembly, including exterior and interior air films. Building departments may require supporting documentation for assemblies entered using the *Other* floor category and *U-Factor* field.

Slab Type

The slab type is selected from a pop-up list accessed by clicking the left mouse button in the *Assembly* field. The slab type enables you to specify whether the concrete slab is heated or unheated. A heated slab (e.g., radiant slab) is one designed as part of a space-conditioning system for transmitting heating into the space. Heated slabs have higher insulation requirements than unheated slabs under the code.

Insulation Position and Depth for Slab-On-Grade

The insulation position pop-up list enables you to specify if perimeter slab insulation will be used and, if so, if it will be placed vertically or horizontally. If no perimeter insulation will be used, select *No Insulation*.

The *Insulation field* (under *Construction Details*) enables you to specify the depth of the insulation. The insulation must extend downward from the top of the slab, or downward to at least the bottom of the slab and then horizontally to the interior or exterior. Where slab insulation is required, it must fully insulate the slab edge and extend from the top of the slab to the depth you select.

Horizontal Insulation Option: Horizontal insulation extending away from the foundation must be covered by pavement or at least 10 in. of soil. If placed horizontally, insulation depth is the total vertical plus horizontal distance. Five options are available for horizontal insulation depth: 1', 2', 3', 4', and *Continuous*. Select *Continuous* if the insulation will run under the entire slab.

Vertical Insulation Option: Insulation that is placed vertically, insulation depth is measured from the top of the slab downward. Four options are available for vertical insulation depth: 1', 2', 3', and 4'.

Comments

Select the *Comments/Description (Envelope)* option to create a *Comments/Description* column on the *Envelope* screen. Use the *Comments/Description* column to type additional information about a building assembly that you wish to be included in the Inspection Checklist, such as its location. The blank *Comment* lines provided in the Inspection Checklist are replaced with any text entered in this column.

Orientation

Use the *Orientation* option to add a column to the *Envelope* screen to select *North, East, South, or West* orientations for each exterior **wall, window**, door, and basement wall assembly. If an orientation is selected for an assembly linked to other assemblies (such as a window linked to an exterior wall), the orientation for all of the linked assemblies is changed to match the new selection.

If an orientation has been assigned to each wall, window, door, and below-grade wall assembly, the compliance calculation will be based on a proposed building using those orientations. This result may be slightly different than the result obtained when orientation is not specified. In the latter case, assemblies are assumed to be equally distributed according to a code-specified aspect ratio. The orientation-specific compliance calculation will not be performed until **all** assemblies have been assigned an orientation.

Daylight Control Factor (Envelope)

If you select *Daylight Control Factor*, COMcheck-EZ adds two columns to the *Envelope* screen--*DLCF* (daylight control factor) and *VLT* (**visible light transmittance**). To receive credit for DLCFs, you must enter the DLCF for all exterior **wall, window**, and door components; the VLT for each window; and the orientation of each exterior wall, window, door, and basement wall assembly.

The *Daylight Control Factor* (DLCF) option offers modest credit toward envelope compliance where automatic lighting controls for daylight use are used. To activate this option, select *Daylight Control Factor* from the *Options* menu. When this option is selected, two new columns are added to the table on the *Envelope* screen. The *VLT* column is used to enter the visible light transmittance (VLT) of windows. The *DLCF* column is used to enter the daylight control factor.

The DLCF is the fraction of the installed lighting power within 15 ft of the exterior wall that will be automatically controlled for daylight use. The software accepts values from 0.0 to 1.0. If the lights will not be controlled for daylight use, the appropriate value to use is zero.

DLCF is an attribute of a daylit exterior **zone**, of which windows, the electric lighting systems, and the daylight control systems are parts. Thus, whatever DLCF value you enter applies uniformly to all components of the daylit zone, which includes an exterior wall and all windows and doors that penetrate the wall.

Changing the DLCF for one of these components changes it for them all. To calculate DLCF, sum the wattage of all electric lights in a 15-ft deep daylit zone that runs the length of the exterior wall, then calculate the decimal fraction of that wattage controlled by daylight sensors.

This feature of the code is intended to permit the use of higher window-wall ratios and higher VLT glazings when used in conjunction with automatic lighting controls for daylighting. Use of DLCF and VLT are only appropriate where such controls are to be used.

The DLCF is dependent on orientation, so components must be entered using the *Orientation* option if *Daylight Control Factor* is selected. If the *Orientation* option was not previously selected, the software will automatically select it and add the *Orientation* column to the table. If a DLCF is entered for an assembly linked to other assemblies (such as a window linked to an exterior wall), the DLCF for all linked assemblies is changed to match the new value.

Visible Light Transmittance (Envelope)

The VLT input column is displayed only after the DLCF option has been selected from the *Options* menu and provides benefit only when used in conjunction with DLCF. VLT is the decimal fraction of visible light that passes through the window. The software accepts values from 0.0 to 1.0. See manufacturer's literature for the correct value to use with your selected **glazing** product. For a typical VLT value for the glazing characteristics you have selected, click with the right mouse button on the VLT input field and select *Use Typical*. The *Use Typical* feature provides values that can be used in preliminary evaluations before actual product selections have been made.

Lighting Screen

Use the blue-on-white buttons at the top of the *Lighting* screen to create a list of lighting fixtures present in your proposed design. Each fixture type you select is added to the lighting fixtures list displayed on the *Lighting* screen. For each fixture type, you must enter a **ballast** type (if applicable), the number of lamps per fixture, quantity, and the fixture input wattage. Input wattage is the electrical power input to the lamp and ballast combination.

After entering complete information for each new fixture, the software automatically updates the compliance results. The results are displayed at the bottom of the screen in the *Lighting:* box. If *TBD* (to be determined) is displayed in this field, you most likely have not yet filled in the fixture wattage or quantity for one or more components. To determine which data are missing or invalid, look for fields with white-on-red text. In addition to providing inputs for all white-on-red fields, you must select at least one building use type and its corresponding area on the *Project* screen before the software can determine compliance.

Optional features available on the *Lighting* screen may be selected from the *Options* menu: *Spaces (Lighting)* and *Exemptions (Lighting)*.

T8/T12 Fluorescent

Select the *T8 / T12 Fluorescent* button to add fixtures using T8, T10, or T12 tubes to your list of fixtures on the *Lighting* screen.

Because of space limitations, lighting types are shown on the menus and main screen using abbreviations. For example, 48" T12 ES 34W stands for a fixture using 48" T-12 energy-saving **fluorescent lamps** rated at 34 watts each. The following abbreviations are used in these descriptions:

- *ES* – energy saving, a designation that usually indicates the lamp will draw 10% to 15% less power than a standard lamp of the same type
- *Slim* – slimline, a type of fluorescent lamp that uses single-pin contacts rather than the normal two-pin contacts
- *T8* – a designation for tubular fluorescent lamps that are 1" in diameter
- *T10* – a designation for tubular fluorescent lamps that are 1-1/4" in diameter
- *T12* – a designation for tubular fluorescent lamps that are 1-1/2" in diameter
- *U* – U-shaped lamps

- *W* – nominal lamp wattage. Note that this is not the fixture wattage that is entered in the *Fixture Wattage* field. The fixture wattage must include **ballast** energy and will generally be higher than this value.

Compact Fluorescent

Select the *Compact Fluor.* button to add compact fluorescent fixtures to your list of fixtures on the *Lighting* screen.

Because of space limitations, lighting types are shown on the menus and main screen using abbreviations. For example, Twin Tube 13W stands for a fixture using compact fluorescent lamps rated at 13 watts each. The following abbreviations are used in the descriptions:

- *Twin, Triple, Quad* – designation referring to the number of fluorescent tubes projecting from the lamp (i.e., two, three, or four)
- *2-pin, 4-pin* – designation referring to the number of contacts at the base of the lamp
- *W* – nominal lamp wattage. Note that this is not the fixture wattage that is entered in the *Fixture Wattage* field. The fixture wattage must include **ballast** energy and will generally be higher than this value.

HID

Select the **HID** button to add fixtures using high-intensity discharge (HID) lamps to your list of fixtures on the *Lighting* screen.

Incandescent

Select the *Incandescent* button to add fixtures using incandescent lamps to your list of fixtures on the *Lighting* screen.

Spaces

The *Lighting* screen contains an optional feature that enables you to organize lighting fixtures under the spaces (or parts of the building) in which they are used. To activate this feature, select *Spaces* from the *Options* menu while in the *Lighting* screen. This feature helps ensure fixture counts are correct and greatly facilitates plan review and inspections.

To add spaces to your list of lighting fixtures on the *Lighting* screen, click on the blue-on-white *Add Space* button (to the right of the fixture type buttons) at the top of the *Lighting* screen. A new line will be entered on the main portion of the

Lighting screen and a new space label will appear in the tree control at the left of the screen. Fixtures listed below each space "belong" to that space and are listed that way on the compliance certificate. You can change the space name from the default name given by the software, which appears in the left-most table column. To reorganize fixtures under these space names, simply drag the fixture labels on the tree control.

Lighting Screen Inputs

Fixture ID

The *Fixture ID* field shows the fixture ID you have entered. You can associate the fixture with a fixture type designation used on the lighting fixture schedule and elsewhere in the construction documents; e.g., F1 for fixture type 1. *Fixture ID* is an optional field that you may leave blank, but it is recommended as it enables fixtures to be clearly defined.

Fixture Description

The *Fixture Description* field is for descriptions of fixtures that you enter. *Fixture Description* is an optional field that you may leave blank. However, fixture descriptions can help you keep track of the fixtures in the list, avoid errors and oversights, and facilitate plan review and inspections because this information is included on the compliance certificate. Fixture descriptions may include manufacturer and part number, dimensions (e.g., 2x4), mounting type (e.g., recessed, surface, suspended), or other distinguishing characteristics.

Lamp Description/Wattage Per Lamp

Click the left mouse button in the *Lamp Description/Wattage Per Lamp* field to select from a drop-down list of available lamp types. The drop-down list contains the most commonly used lamp and **ballast** combinations. Select *Other* if the lamp type you intend to use does not match one of the listed types. The *Lamp Description/Wattage Per Lamp* is not a user-editable field unless you have selected *Other* from the drop-down list.

Ballast

The ballast type is entered by selecting from a drop-down list. (Incandescent fixtures do not require a ballast entry.) Available ballast types are magnetic, electronic, and hybrid. The following definitions have been used in determining default input wattages. You should use these definitions in describing the ballast type in the fixtures you intend to use.

- *Magnetic* – contains conventional capacitor, rectifier, and/or transformer components (core and coil), and operates at a 60 Hz frequency.
- *Electronic* – contains advanced electronic components and no (or very small) core and coil transformers, and operates at high frequency-typically 20,000 Hz or more.
- *Hybrid* – may contain both conventional components and electronic circuitry. Use hybrid for any ballast that does not completely fit the definition for either magnetic ballasts or electronic ballasts.

Lamps Per Fixture

The *Lamps Per Fixture* is entered by selecting from a drop-down list.

Number of Fixtures

The number of fixtures is entered by selecting from a drop-down list.

Fixture Wattage

You can enter the fixture wattage directly or have the software provide a typical wattage for that fixture. To input a typical wattage, click the right mouse button in the *Fixture Wattage* field to display the pop-up context menu. The software will provide a typical input wattage for the fixture. Not all possible lamp and ballast combinations are included-only those for which adequate data were available.

No values are provided for fixtures with hybrid ballasts, because the category includes equipment of highly variable design. If the *Use Default* option is gray, a typical wattage is not available. Input wattage is the related electrical power input to the lamp and ballast combination.

You may either use the typical input wattage provided by the software or override it with a value based on the equipment you intend to install. In either case, you should be prepared to provide supporting documentation based on manufacturer's literature to the building department.

Exemptions (Lighting)

To use the optional exemptions feature and identify an exempt fixture, click the mouse in the *Exemption* column of that fixture. A pop-up list will be displayed offering a list of the types of exemptions available under the code. Select the type of exemption that applies to the fixture type, or None if the fixtures do not qualify for an exemption. When a set of lighting fixtures is identified as exempt, the power for the fixtures is omitted from the wattage total for the building. We recommend that all fixtures—both exempt and nonexempt—be listed, in order to

clarify where exemptions have been claimed and to streamline plan review and inspection.

The following lighting fixtures are exempt from the lighting requirements of the 90.1 ('89) Code:

1. Theatrical/Broadcasting/Entertainment - Lighting that is an essential technical element for the function performed in theatrical, stage, broadcasting, and similar uses
2. Special Medical/Dental/Research Lighting
3. Art/Museum Display - Display lighting for exhibits in galleries, museums, and monuments
4. Plant Growth Lighting - Lighting solely for indoor plant growth (between the hours of 10:00 p.m. and 6:00 a.m.)
5. Emergency Lighting (Automatic Control) - Emergency lighting that is automatically off during normal building operation
6. High-Risk Security Area – Lighting necessary to meet special security needs in a high-risk area. Only lighting that exceeds normal general lighting requirements for the usage type qualifies for this exemption.
7. Lighting for Physically/Visually Impaired – Lighting necessary to meet the special needs of the physically impaired or aged. Only lighting that exceeds the normal general lighting requirement for this usage type qualifies for this exemption.
8. Residential Dwelling Units - Lighting in dwelling units

Mechanical Screen

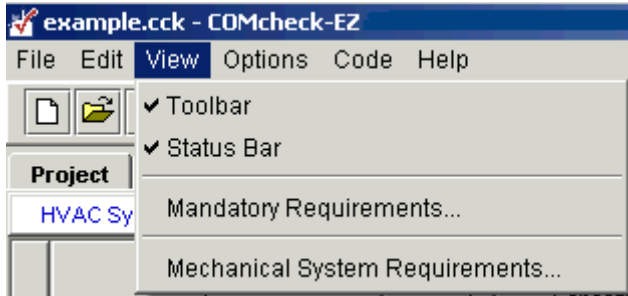
Use the blue-on-white buttons at the top of the *Mechanical* screen to enter characteristics of **HVAC** system, plant, and **water heating** components in your proposed design. Because most requirements in the mechanical section of the energy code are mandatory, the *Mechanical* section of the software works somewhat differently from the *Envelope* and *Lighting* sections. Rather than generating a numerical compliance index, the *Mechanical* section generates a customized list of mandatory requirements applicable to the mechanical components you identify. Click the *Plant* button or *Water Heating* button to enter information about these components. Click the *HVAC System* button to enter information about your building's HVAC components.

The software supplies a default component name, along with a corresponding quantity and description for the component you defined. You can edit the default component description or quantity by simply clicking on the appropriate field and typing a new description or quantity. For clarity and consistency with building plans, it may also be helpful to edit the tree labels in the left-hand screen. To change these default names, double-click on the name in the left-hand screen to bring up an edit box for the text.

Alternatively, you can right-click on the name to display a pop-up list (called a context menu) and select *Edit Text* from this menu. Selecting *Edit System Inputs*, *Edit Plant Inputs*, or *Edit SWH Inputs* from the context menu enables you to redisplay the input screens for the given component and to redefine the component inputs. You may also delete (cut), copy and paste, or duplicate components by selecting the corresponding option from the context menu. For more information on context menus, refer to the Help section Context Menu.

Viewing Mechanical Requirements

To view the requirements that apply to a mechanical component, select the component, then go to the *View* menu and click the **Mechanical System Requirements** option. The *Description* option displays a comprehensive description of requirements applicable to the selected component. The *Checklist* option displays the same requirements, but in an abbreviated (checklist) format. You can use the *View* menu to toggle the display back to the list of mechanical components or to the detailed or concise list of requirements. The output certificate will contain all three views: the list of your selected mechanical components, the checklist of requirements, and the more detailed description of these same requirements.



View Menu - Mechanical

Click the *Building* label on the left-hand screen to view mechanical requirements that apply to all applicable building systems, independent of particular components selected. Even though these requirements apply to all applicable systems, the same list of requirements may not always be displayed. For example, there are duct insulation and construction requirements that apply to all systems that have ducts. Rather than repeat these same requirements for each ducted system in the building, the requirements are printed once as generic requirements and are displayed when the *Building* label is selected. However, if you have not selected any systems having ducts, the requirements will not be displayed. Other requirements will always appear. You can also find a description of the generic requirements by selecting *Mandatory Requirements* from the *View* menu.

To view an example description of mechanical components, load the EXAMPLE file from the *File* menu and click the *Mechanical* screen. To view the Mechanical Compliance Certificate from within the software, select *Print Preview* from the *File* menu. The checklist portion of the compliance certificate is intended for use by building department staff during plan review and site inspection to ensure that applicable requirements have been met.

HVAC System

The **HVAC** *System* button helps you identify key characteristics of the HVAC systems in your building. The term HVAC systems refers to secondary HVAC systems, including controls, fans, terminal boxes, radiators, coils, and package HVAC equipment, not primary HVAC system components such as boilers, chillers, cooling towers, and pumps. The characteristics you select determine which requirements apply.

The *HVAC System* entries enable you to describe the HVAC system features in your building in sufficient detail to exclude large numbers of requirements that do not apply to your systems. The resulting simplification facilitates both designing for compliance with the code and code enforcement.

Round buttons (radio buttons) permit only one selection from each group, square boxes (checkboxes) permit multiple selections from a group of inputs, and gray text indicates that the option is unavailable because it is incompatible with other selection(s) that have been made on the current or a previous screen.

When multiple different HVAC systems are used within a single building, you may select the *HVAC System* button multiple times to enter more than one system. When multiple identical (or nearly identical) systems are used, describe them once and use the quantity field to indicate the number of such systems present.

Note that some of the inputs are interdependent. If you select **Heat Pump** as the Heating Equipment Type, you will not be able to select a Cooling Equipment Type because it is assumed to be DX (direct expansion). If you select *Unit Heater* for *Heating Equipment Type* or *Packaged Terminal DX Unit* for *Cooling Equipment Type*, you will not be able to select **Multiple Zone** or check the *Perimeter System* box under *Zoning Category* because these equipment types are not compatible.

Heating Equipment Type

Central Furnace - A central furnace is a self-contained, indirect-fired or electrically heated furnace supplying heated air through ducts to spaces. A central furnace can be a stand-alone unit, but is typically integral to a rooftop-DX (direct expansion) system or split DX system air conditioner. Though less common, a central furnace may also contain a hydronic coil that would be used for air conditioning.

Duct Furnace - A duct furnace is a furnace normally installed in distribution ducts of air-conditioning systems to supply warm air. A duct furnace usually does not have its own supply fan and uses air supplied through the ducts by other supply fans such as a fan for a central air conditioner.

Hydronic or Steam Coil - A hydronic coil is an array of tubing, placed in a supply air stream, through which hot or cold water passes, heating or cooling the supply air stream to provide heating or air conditioning to a space. Hydronic coils, central furnaces, and DX coils are used in various configurations of heating and air-conditioning systems. A steam coil is an array of tubing, placed in a supply air stream, through which steam passes to provide heat to a space.

Heat Pump - A **heat pump** is a DX air conditioner with a reversing valve, allowing it to operate in two refrigeration modes. When the refrigeration system is reversed, the heat pump absorbs heat from the outdoor air and rejects it to the indoor environment, providing heat to the space. Heat pumps are manufactured in several configurations, including packaged terminal, rooftop package, **split system**, water loop, and ground coupled.

Packaged Terminal Unit – A packaged terminal heat pump (PTHP) is a self-contained heat pump typically installed through a **wall**. It discharges warm or cool air directly to the space without the use of ducts for distribution.

Rooftop Packaged Unit – A rooftop packaged heat pump is also known as a unitary single-packaged heat pump. This unit is a self-contained heat pump, typically installed on the **roof** of a building using ducts to distribute cool air to the **conditioned space**. It can be used in single-zone and multiple-zone applications, and can also be equipped with a constant-volume or variable-volume fan. Depending on the cooling capacity and climate, rooftop packaged DX units may be equipped with an air **economizer**.

Split System – A split system heat pump is also known as a unitary split system heat pump. It consists of two factory-made assemblies: a condensing unit that uses outside air as the heat sink (during cooling) and heat source (during heating), and an indoor DX coil with integral supply fan. Because the indoor unit is usually located a long distance from outside walls, it is difficult to equip a split system with an air economizer.

Water Loop Heat Pump – A water loop heat pump is a heat pump with a refrigerant-to-water heat exchanger. During cooling mode, the heat exchanger serves as the condenser, rejecting heat from the refrigerant to the water. During heating, the heat exchanger serves as the evaporator, absorbing heat from the water. The refrigerant-to-water heat exchanger is typically connected to a circulating water loop that also serves many other water loop heat pumps. A **boiler** and cooling tower maintain the temperature range of the circulating water loop. The boiler turns on when the temperature falls below the setpoint. The cooling tower turns on when the temperature rises above the setpoint.

Other – Any type of heat pump, which is not described by one of the types listed above, is classified as *Other*.

Radiant Heater - A radiant heater is a heater that transfers heat to objects and surfaces within the **heated space** primarily (>50%) by infrared radiation. Radiant heaters can be direct- or indirect-fired with a heating fuel, have electric heating elements, or use hydronic coils or steam coils.

Unit Heater - A unit heater is a self-contained piece of heating equipment that requires connections only to energy sources. Unit heaters are installed in the spaces they are intended to heat and do not use ductwork to distribute heat. They are sometimes controlled in sequence with a separate air conditioner serving the same space. Unit heaters can be direct- or indirect-fired with a heating fuel, have electric heating elements, or use hydronic coils or steam coils.

Other – any other type not represented in the above choices.

Cooling Equipment Type

Field-Assembled DX System – This type is used for DX systems that are not manufactured (and rated) as single packages but rather are assembled at the building site from separately manufactured components. DX stands for direct expansion cooling. In DX cooling equipment, a refrigerant coil is placed directly in the supply air stream. As the refrigerant evaporates and expands, it removes energy, lowering the temperature of the supply air stream.

Hydronic Coil - A hydronic coil is an array of tubing, placed in a supply air stream, through which hot or cold water passes, heating or cooling the supply air stream to provide heating or air conditioning to a space. Hydronic coils, central furnaces, and DX coils are used in various configurations of heating and air-conditioning systems.

Packaged Terminal DX Unit – A packaged terminal DX air conditioner (PTAC) is a self-contained air-conditioning unit typically installed through a **wall**. It discharges cool air directly to the space without the use of ducts for distribution. PTACs are often equipped with electric resistance heating elements and sometimes are equipped with hydronic coils or steam coils for heating.

Rooftop Package DX Unit – A rooftop packaged DX unit is also known as a unitary single-packaged air conditioner. This unit is a self-contained DX air conditioner, typically installed on the **roof** of a building using ducts to distribute cool air to the conditioned space. It can be used in single-zone or multiple-zone applications, and can also be equipped with a constant-volume or variable-volume fan. These units are often combined, within the same assembly, with a central furnace, hydronic coils, or steam coils. Depending on the cooling capacity and climate, rooftop packaged DX units may often be equipped with an **air economizer**.

Split DX System – A split DX system is also known as a unitary split system air conditioner or **split system**. It consists of two factory-made assemblies: a condensing unit that uses outside air as the heat sink, and an indoor DX coil with integral supply fan. The indoor unit is often combined, within the same assembly, with a central furnace or hydronic coils or steam coils. Because the indoor unit is usually located a long distance from outside walls, it is difficult to equip a split system with an air economizer.

Other – any other type not represented in the above choices.

Zoning Category

Single Zone – A single-zone system serves only one thermostatic control zone. The system is usually controlled by a single thermostatic control, and only maintains comfort conditions for the space where the temperature control is located.

Multiple-Zone – A multiple-zone system is designed to meet space-conditioning loads in multiple thermostatic control zones at the same time. Multiple-zone systems usually use a common air distribution system and employ terminal units to vary the flow and temperature of air to meet the differing space-conditioning loads of each zone.

Perimeter System – A perimeter system is designed to offset only envelope heat losses and gains.

HVAC System Software Inputs

Equipment Capacity

Select the cooling capacity range for the cooling equipment selected and the heating capacity range for the heating equipment selected.

Fuel Type/Heat Source

Select the *Fuel Type* or the *Heat Source* for the heating equipment. If you select *Hydronic* or *Steam Coil* as the *Heating Equipment Type*, select the *Heat Source* for this equipment. If you select *Central Furnace* or *Duct Furnace*, select the *Fuel Type* for this equipment. If you select *Radiant Heater* or *Unit Heater*, you may choose from either the *Fuel Type* or *Heat Source* options.

Condenser Type

The condenser of an air conditioner is where refrigerant rejects heat absorbed during the process of cooling indoor spaces. As the refrigerant passes through the heat exchanger it rejects heat to the surrounding fluid, usually air or water. If the equipment is a **heat pump**, the condenser becomes an evaporator during heating mode. As the refrigerant passes through the heat exchanger, it absorbs heat from the surrounding fluid, causing the refrigerant to change from a liquid to a gas (or evaporate).

Air Cooled – An air-cooled condenser is a refrigerant-to-air heat exchanger exposed to outdoor conditions. As refrigerant passes through the coils of the heat exchanger, heat is rejected to outdoor air (during cooling) and absorbed from outdoor air (during heating).

Evaporatively Cooled – An evaporatively-cooled condenser is similar to an air-cooled condenser with the exception that during cooling, the heat exchanger is sprayed with water, increasing the heat rejection. Heat pumps and air conditioners equipped with evaporatively cooled condensers are typically more efficient than their air-cooled counterparts.

Groundwater Coupled – A groundwater-coupled condenser is similar to a water-cooled condenser except that groundwater will always be the heat source (or sink) for the condenser. As refrigerant passes through the coils of the heat exchanger, heat is rejected to groundwater (during cooling) and absorbed from groundwater (during heating).

Water Cooled – A water-cooled condenser is a refrigerant-to-water heat exchanger. As refrigerant passes through the coils of the heat exchanger, heat is rejected to the water (during cooling) and absorbed from the water (during heating). Heat pumps with water-cooled condensers are typically connected to a central circulating water loop with other water loop heat pumps.

HVAC System Details

The **HVAC** *System Details* screen is accessed from the *Multi-Zone/Fan System Details* column. The screen will only be available if you have selected **Multiple Zone** for the *Zoning Category* on the *HVAC System* screen.

Multiple Zone Details

Select the *Distribution Type*, *Terminal Unit Type* (if applicable), and *Reheat Type* (if applicable).

Note that some of the input fields are interdependent. If you select *Single Duct* as the *Distribution Type*, you will not be able to select *VAV Mixing Box* or *CV Mixing Box* for *Terminal Unit Type*, because they are only applicable to dual-duct systems. If you select *Three Duct* as the *Distribution Type*, *Terminal Unit Type* options and *Reheat Type* options will be disabled, because they are not applicable to this distribution type.

Distribution Type

Single Duct – Single-duct systems are the most common types of multiple-zone air distribution systems. A single-duct system uses a single fan to supply cool or warm air to zone terminal units. The zone terminal units will then modulate the amount of supply air and sometimes reheat the supply air to meet the specific heating or cooling requirements of the zone. Some systems will recool the supply air, but reheating is more standard practice.

Single Fan, Dual Duct – A single-fan, dual-duct system uses a single fan to supply air through two primary air ducts, supplying cool air and warm air. Air

from each of these ducts is then mixed in a terminal unit (VAV mixing box or CV mixing box) and supplied to the zone as a single air stream.

Dual Fan, Dual Duct – A dual-fan, dual-duct system uses two fans to supply air through two primary air ducts, supplying cool air and warm air. One fan serves the warm air duct, and the other serves the cool air duct. Air from each of these ducts is then mixed in a terminal unit (VAV mixing box or CV mixing box) and supplied to the zone as a single air stream.

Three Duct – A three-duct system uses a single fan to supply three primary air ducts, supplying cool air, warm air and return (or neutral) air. A three-duct system is typically constant volume and uses CV mixing boxes to mix warm air and return air or cool air and return air (but never warm and cool air) to meet individual zone loads.

Terminal Unit Type

VAV Box – A standard VAV box includes a damper, a connection to the supply air duct, and sometimes a hydronic or electric resistance reheat coil. Because the zone **thermostat** calls for less cooling, the damper begins to close and reduce the amount of supply air to the zone. The reheat coil turns on and reheats the supply air only when the damper is at its minimum position.

Standard VAV boxes are used in both single-duct and dual-duct systems.

Fan Powered VAV Box – A fan-powered VAV box typically consists of a fan configured to draw air from a return air **plenum**, a connection to the supply air duct, dampers to regulate the flow of air from the supply air duct and the flow of air from the plenum to the fan, and a hydronic or electric resistance reheating coil. There are many configurations of fan-powered VAV boxes, but there are only two typical operation sequences: series and parallel.

In series operation, the fan operates continuously, resulting in a constant air supply to the zone. As the zone thermostat calls for less cooling, the dampers modulate to reduce the amount of supply air and increase the amount of plenum air delivered to the zone. The reheat coil turns on and reheats the supply air only when the damper is at its minimum position.

In parallel operation, the fan does not operate as long as the zone calls for cooling. If the main supply air is reduced to a minimum and the zone still requires heating, the fan will come on, supplying additional warmer plenum air to the zone. If the zone requires additional heating after the fan has come on, the reheat coil is activated.

VAV Mixing Box – A VAV mixing box mixes air from the warm and cool air ducts of a dual-duct system. The operation sequence of a mixing box terminal depends on several other conditions such as if the air **economizer** is operating or if the building is primarily requiring cooling or heating.

If an air economizer or the mechanical cooling plant is operating, the warm air supply to the zones is shut off by the mixing boxes. The mixing box modulates the flow of cool air to the zone to meet the required space conditioning. When the cool air damper has closed to its minimum position, the mixing box will then modulate open to allow warm air to be mixed with the cool air and simultaneous heating and cooling begins. At some point, the mixing box may completely close the cool air supply to the zone. Care must be taken when controlling mixing boxes to ensure that supply air is never completely shut off to a zone. This would prevent adequate outdoor ventilation air from being supplied to the space.

In some cases an entire building may be in heating mode, beyond what can be met by unheated return air alone. In this case, the mixing boxes will shut off the supply of cool air to the zones. The mixing box modulates the flow of warm air to the zone to meet the required space conditioning. When the warm air damper has shut to its minimum position, the mixing box will modulate open to allow cool air to be mixed with the warm air. Like in the primary cooling mode, the warm air damper may totally close at some point, but supply air to the zone must never be completely shut off.

CV Mixing Box – A CV mixing box (or constant-volume mixing box) mixes necessary amounts of cool air and warm air to maintain space conditions. The amount of cool air or warm air will vary, but the total flow of cool and warm air through a CV mixing box will remain constant. Except under special conditions, the code does not allow the use of CV mixing boxes.

Reheat/Recool Coil – A reheat/recool coil is placed in a branch line to a zone of a building and is usually controlled from a thermostat located in the space the branch is serving. Reheat/recool coils are usually found only in single-duct VAV systems. For example, if a reheat coil is installed in a duct, it would provide heating to a zone if the system were in cooling mode and supplying cool air through the distribution system. Reheat coils can be electric resistance elements, hydronic coils, or steam coils. Recool coils are not very common and are almost always hydronic. (COMcheck-EZ assumes recool coils are hydronic.)

Reheat Type

Electricity – When *Electricity* is used as the reheat type, electric resistance heating elements are installed in the terminal units and are turned on and off by zone thermostatic controls.

Hydronic – Hot water coils are hydronic coils installed in the terminal units. They are equipped with valves, which modulate the flow of hot water, and are controlled by zone thermostatic controls.

Steam – Steam coils, used as a reheat source, are installed in terminal units. They are equipped with valves, which modulate the flow of steam, and are controlled by zone thermostatic controls.

Fan System Details

Check the applicable boxes under *Fan System Details*. If you select *Supply Fan HP >25 hp* or *Return Fan HP >25 hp*, select the *Fan Variable Flow Control* on your system. If you only select *Supply Static Pressure >3 in. water*, the *Fan Variable Flow Control* options are disabled.

Supply Fan HP >25 hp – The supply fan hp is the horsepower listed on the supply fan motor nameplate. The supply fan is the fan that provides air to the distribution ducts of the **mechanical system**. Select this option if the listed horsepower is >25 hp.

Supply Static Pressure >3 in. water – Static pressure is the total amount of pressure exerted by the supply or return air stream on the ductwork. In air distribution and return systems, this pressure is measured in inches of water column (in. water). Most large supply air distribution systems and multiple-zone systems operate at static pressures exceeding 3 in. water. Occasionally, static pressure in return air systems exceeds 3 in. water, in which case this option should be selected.

Return Fan HP >25 hp - The return fan hp is the horsepower listed on the return fan motor nameplate. Select this option if the return fan horsepower exceeds 25 hp.

Fan Variable Flow Control

Vane-Axial Fan w/Variable Pitch Blades – A vane axial fan resembles a propeller. When equipped with variable pitch blades, the blades are rotated or twisted (thus varying the pitch of the blades) to modulate the air flow from the fan.

Mechanical Adjustable-Speed Drive – A mechanical adjustable-speed drive uses mechanical devices to vary the speed of the fan—and therefore vary the flow of air—without varying the speed of the fan motor. One of the most common approaches is to vary the diameter of the shieves in the belt-drive.

Electrical Adjustable-Speed Drive - An electrical adjustable-speed drive is an electrical control system that will vary the speed of the fan motor, which will vary the flow of air. The most common type of electrical adjustable speed drive is the variable-frequency drive (VFD). A VFD is usually the most efficient approach to varying air flow from a fan.

Other Control – Many different types of fan air flow controls are available. Designers must use a combination of calculations, manufacturer's literature, and actual design conditions to determine the energy performance of different fan air flow controls.

Economizer Details

The **Economizer Details** screen is accessed from the *System Details* column. The screen will only be available if the building location entered in the *Project* screen is located within a climate **zone** requiring an air economizer. The *Economizer Details* screen will not appear if:

- your building is located in climate zones 1, 2, 3b, or 3c; or
- the cooling capacity for the **mechanical system** is <90 kBtu/h.

Select the *Economizer Type*. If you do not have an economizer, select *None* for the *Economizer Type* and choose an *Economizer Exception*.

The input fields have the following interdependencies:

- Air economizers are not allowed if you selected *Single Fan*, *Dual Duct*, or *Three Duct* as the *Distribution Type* on the *Multiple-Zone Details* screen. An air economizer is not allowed with these system types.
- If you selected the *Water-Cooled condenser*, you will not be able to select *Filtration Requirements* or *Open Case Refrigeration* as an economizer exception.
- You will not be able to select *High Efficiency Equipment* as an *Economizer Exception* in climate zones 6a, 9a, 10a, 11a, 12a, 12b, 13a, 13b, 14a, 14b, 15, 16, 17, 18, or 19.

Economizer Type

Air – An air economizer consists of a set of interlocked dampers on return air, exhaust air, and outside air ducts. During favorable weather conditions, the air economizer is controlled to use up to 100% outside air to cool the space instead of using mechanical refrigeration.

Water – A water economizer is a system by which the supply air of a cooling system is cooled indirectly with water that is itself cooled by heat or mass transfer to the environment without the use of mechanical cooling. Typically, water is first passed through a cooling tower, then through a hydronic coil in the supply air stream.

None – Select this option if an economizer will not be installed. Selecting this option will activate some or all of the *Economizer Exception* options. The *High Efficiency Equipment* exception will only be activated if the building resides in a climate zone for which the exception is allowed.

Economizer Exception

High Efficiency Equipment – In some cases, a high-efficiency air conditioner may use no more cooling energy than an air conditioner equipped with an air economizer that just meets the requirements. In these cases, the economizer may be omitted. The efficiency required to take this exception will be included in the requirements list.

Open Case Refrigeration – Air economizers can adversely affect the operation of open case refrigeration equipment such as that used in grocery stores to display refrigerated and frozen foods. This exception is not available if the cooling equipment has a water-cooled condenser, where a water economizer would be feasible.

Filtration Requirements – In some cases, unusual outdoor air pollutants necessitate extensive filtration of outdoor air. When an air economizer is installed, filtration equipment must be capable of purifying 100% outdoor air supply and would be prohibitively expensive. This exception is not available if the cooling equipment has a water-cooled condenser, where a water economizer would be feasible.

Plant Screen

The *Plant* button enables you to identify key characteristics of the plant equipment in your building. The term, "Plant," refers to primary **HVAC** system components, including boilers, chillers, cooling towers, and pumps; not secondary HVAC system components such as fans, terminal boxes, radiators, coils, and package HVAC equipment.

The *Plant* screen allows you to describe the features of the building's plant(s) in sufficient detail to exclude requirements that do not apply to your building. The resulting simplification helps in designing the building to comply with the code and in code enforcement.

Round buttons (radio buttons) permit only one selection from each group.

Where multiple different HVAC plant components are present within the building, you may select the *Plant* button multiple times to enter more than one component. Where multiple identical (or nearly identical) plants are present, describe them once and use the *Quantity* field to indicate the number present.

Boiler Type

Hot Water – Select this option if the central **boiler** is a hot water boiler.

Steam – Select this option if the central boiler is a steam boiler.

None – Select this option if you are describing a cooling plant instead of a central boiler.

Cooling Plant Type

Condensing Unit – A condensing unit is the refrigeration system component that includes the refrigerant compressor and the condenser. Refrigerant lines are installed between the condensing unit and a refrigerant-to-water heat exchanger (creating a field-fabricated water chiller) or to a DX coil (creating a field-fabricated DX system).

Water Chiller – A water chiller is a self-contained piece of cooling equipment including, at a minimum, a refrigerant-to-water heat exchanger and a refrigeration compressor. Water is cooled in the refrigerant-to-water heat exchanger and piped to air handlers used for air conditioning throughout a building. Most water chillers include a water-cooled, air-cooled, or evaporatively-cooled condenser; however, some water chillers are manufactured without condensers.

Plant Software Inputs

If a **boiler** was selected, enter the heating capacity range in the *Equipment Capacity* column and the boiler fuel in the *Fuel Type/Heat Source* column. If a chiller or condensing unit was entered, enter the cooling capacity range in the *Equipment Capacity* column and the condenser type in the *Condenser Type* column.

Equipment Capacity

Select the heating capacity range for the boiler and the cooling capacity range for the condensing unit or chiller. Ranges for condensing units are given in kBtu/h. Ranges for chillers are given in tons.

Fuel Type/Heat Source

Gas – Select *Gas* if the boiler uses natural gas or propane.

Oil – Select *Oil* if the boiler uses new heating oil that has not been recycled or re-refined.

Residual Oil – Residual oil is fuel oil that remains after the removal of valuable distillates (such as gasoline) from petroleum and is used most often in industrial applications.

Service Water Heating Screen

The *Water Heating* button enables you to enter the **service water heating** system(s) in your building.

The selection (or deselection) of the checkboxes on the *Service Water Heating Details* screen determines which water heating requirements apply to your building.

Where multiple different water heating systems are present within the building, you may select the *Water Heating* button multiple times to enter more than one system. Where multiple identical (or nearly identical) systems are present, describe them once and use the *Quantity* field to indicate the number present.

Service Water Heating Software Inputs

System Details

Checkboxes are provided to allow more details to be noted.

System Has a Circulation Pump - A circulation pump is used in a service **water heating** system served by a continuous water loop. The circulation pump is controlled to circulate hot water from the water heating equipment as necessary to maintain a certain hot water temperature at all times in the circulation loop.

Heat Trace Tape Installed in the System - Heat trace tape is tape with embedded electric resistance heating elements. Heat trace tape is adhered to hot water piping. It is energized as necessary to deliver hot water at the desired temperature.

Building Use Types

The Whole Building types and the Area Categories available in the software are defined below.

Whole Building Types

Assembly – A building or structure for the gathering together of persons, such as auditoriums, churches, dance halls, gymnasiums, theaters, museums, passenger depots, sports facilities, and public assembly halls. (This building type cannot be used to demonstrate lighting compliance and will be disabled if the *Envelope and/or Mechanical Compliance Only* checkbox is not selected.)

Exercise Center – A building or structure used for recreational activities involving physical exertion designed to promote physical fitness and well-being.

Grocery Store – A building or structure that has as its primary purpose the sale of foodstuffs requiring additional preparation prior to consumption.

Hotel/Motel – A building or structure for transient occupancy, such as resorts, hotels, motels, barracks, or dormitories.

Library – A building or structure in which literary and artistic materials, such as books, periodicals, and audiovisuals, are kept for reading, reference, and loan.

Medical/Clinical Care – A building or structure for the purpose of providing medical treatment, confinement or care, and sleeping facilities such as hospitals, sanitariums, clinics, orphanages, nursing homes, mental institutions, and reformatories.

Multifamily – A building or structure containing three or more dwelling units. (This building type cannot be used to demonstrate lighting compliance and will be disabled if the *Envelope and/or Mechanical Compliance Only* checkbox is not selected.)

Museum – A building used for the display and preservation of objects of artistic, scientific, or cultural interest.

Office – A building or structure for office, professional, or service type transactions such as medical offices, banks, libraries, and government office buildings.

Restaurant – A building or structure for the preparation and consumption of food or drink, including coffee shops, cafeterias, bars, and fast food and leisure restaurants.

Religious Worship – A building for worship, religious services, and associated social and educational functions.

Retail Sales/Wholesale Showroom – A building or structure for the display and sale of merchandise such as shopping malls, food markets, auto dealerships, department stores, and specialty shops.

School – A building or structure for the purpose of instruction, such as schools, colleges, universities, and academies.

Storage Commercial/Industrial – A building or structure for storage, such as aircraft hangars, garages, warehouses, storage buildings, and freight depots.

Theater – Motion Picture – An assembly room, hall, or building with tiers of rising seats or steps for the showing of motion pictures.

Theater – Performance – An assembly room, hall, or building with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events, and similar live performances.

Others – A building or structure whose intended use is currently not known or does not match any of the above categories.

Area Categories

The following area categories are listed in the software. For area categories other than those given, select categories with similar areas and/or activities.

Auditorium – An area with fixed seats used for public meetings or gatherings not specifically for the viewing of dramatic performances.

Bank/Financial Institution – An area for conducting financial transactions including the custody, loan, exchange, or issue of money, for the extension of credit, and for facilitating the transmission of funds.

Classroom/Lecture Hall – An area where classes meet.

Convention/Conference/Meeting Center – An area used for meetings, conventions, and multiple purposes, including dramatic performances, that has neither fixed seating nor fixed staging.

Corridor/Restroom/Support – Corridor: an area used as a passageway to access compartments or rooms. Restroom: An area providing personal facilities such as toilets and washbasins. Support: An area used as a passageway, utility room, storage space, or other use associated with the building's primary function.

Dining – An area in a restaurant or hotel/motel (other than guest rooms) where meals served to the customers are consumed.

Exercise Center – A building or area used for recreational activities involving physical exertion designed to promote physical fitness and well-being.

Exhibition Hall – An area used for exhibition that has neither fixed seating nor fixed staging.

Grocery Store – An area of that building that has as its primary purpose the sale of foodstuffs requiring additional preparation prior to consumption.

Gymnasium Playing Surface – An area of a building for organized athletic games such as basketball, volleyball, racquetball, and tennis.

Hotel Function – An area such as a hotel ballroom, meeting room, exhibit hall, or conference room, together with prefunction area and other spaces ancillary to its function.

Hotel/Motel Guest Room – A room or suite of rooms in a building for transient occupancy (such as a resort, hotel, motel, barracks, or dormitory), including living and sleeping areas, private bathrooms, and kitchenettes. (Note that hotel/motel guest rooms are exempt from lighting requirements but are included in the area category list for consistency and for use in determining internal loads for envelope compliance.)

Industrial Work < 20ft ceiling height – An area of a building in which a manufacturing operation, craft, or art is performed having a ceiling height less than 20 ft above the **floor**.

Industrial Work >= 20 ft ceiling height – An area of a building in which a manufacturing operation, craft, or art is performed having a ceiling height 20 or more feet above the floor.

Kitchen – An area containing facilities for cooking and food preparation.

Library – A building or area in which literary and artistic materials, such as books, periodicals, and audiovisuals, are kept for reading, reference, and loan.

Lobby – Hotel – An area in a hotel/motel between the main entrance and the front desk, including waiting and seating areas, and other spaces encompassing the activities normal to a hotel lobby function.

Lobby – Other – An area located directly inside the main entrance of a building and includes the reception area, sitting areas, and public areas.

Mall/Arcade/Atrium – An area used as a public passageway or concourse that provides access to rows of stores or shops.

Medical/Clinical Care – An area of a building where medical treatment is provided, such as hospitals, sanitariums, clinics, orphanages, nursing homes, mental institutions, and reformatories.

Multifamily Living Unit – A private room or group of rooms for nontransient residential living that occur within a building or structure containing three or more dwelling units. (Note that multifamily living units are exempt from lighting requirements but are included in the area category list for consistency and for use in determining internal loads for envelope compliance.)

Museum – An area of a building used for the display or preservation of objects of artistic, scientific, or cultural interest.

Office – An area of a building for office, professional, or service-type transactions such as medical offices, banks, libraries, and government office buildings.

Religious Worship – An area of a building for worship or religious services.

Restaurant – An area of a building for the preparation and consumption of food or drink including coffee shops, cafeterias, bars, and fast food and leisure restaurants.

Retail Sales/Wholesale Showroom – An area of a building in which the primary activity is the sale of merchandise or the display of samples of merchandise.

Storage – Commercial/Industrial – A building or area used for storing items.

Theater – Motion Picture – A building or area with tiers of rising seats or steps for the showing of motion pictures.

Theater – Performance – A building or area with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events, and similar live performances.

Others – A building or area whose intended use is currently not known or does not match any of the above types.

Mandatory Requirements

Mandatory requirements are requirements that must be met by all buildings in addition to the requirements determined to be applicable by the software. You may view and print separate mandatory requirements for Envelope, Lighting, and Mechanical.

Envelope Requirements

Documenting Compliance

- Indicate component R-values or U-factors and the solar heat gain coefficients (**SHGC**) of windows and skylights on your project plans.
- Complete and sign the Envelope Compliance Certificate, generated using the *Print Report* or *Save Report* option under the *File* menu.

Air Leakage

- All joints and penetrations in the **building envelope** that are potential sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed in an approved manner.
- Recessed lighting fixtures must be gasketed and IC rated; i.e., rated for direct contact with insulation.
- The following areas must be sealed:
 - exterior joints around **window** and door frames
 - between **wall** sole plates, floors, and exterior-wall panels
 - openings for plumbing, electricity, and refrigerant and gas lines in exterior walls, floors, and roofs
 - openings in attic floors (such as where **ceiling** panels meet interior and exterior walls and masonry fireplaces)
 - service and access doors or hatches
 - all other similar openings in the building envelope.
- Maximum air leakage rates for manufactured windows and doors are specified in the table below. Windows and doors certified by an accredited laboratory (such as the National Wood Window and Door

Association [NWWDA] or the Architectural Aluminum Manufacturers Association [**AAMA**]) meet these requirements and are labeled. For noncertified windows and doors, check manufacturers' test reports to verify compliance with these air leakage requirements.

Maximum Allowed Air Leakage Rates

	Frame Types		
	Wood	Aluminum	PVC
Windows (cfm per ft of operable sash crack)	0.25	0.37	0.06
Sliding Doors (cfm per sq ft of door area)	N/A	0.37	0.37
Swinging Doors (cfm per sq ft of door area)	0.25	1.25	N/A

Building Component Certification

- **Insulation R-values** and **glazing** and door U-factors must be clearly marked on building plans and specifications.
- Certification of installed components is required and can be accomplished through any of the following methods:
 - product labels - for example, R-values of insulation printed directly on the insulation, striping codes, manufacturers' labels on windows
 - contractor statements certifying the products they have installed
 - check with your local building official for requirements on certifying building components in your jurisdiction.

Certifying Installed Insulation

- For blown or sprayed insulation, the initial installed thickness, settled thickness, coverage area, and number of bags used must be clearly posted at the job site.

- For components having a manufacturer's guaranteed R-value rating, thickness markers must be placed at least every 300 feet.
- For components without a manufacturer's guaranteed R-value rating, contact the Insulation Contractors Association of America for an approved way to ensure proper insulation levels are obtained.
- All insulation requirements assume the insulation is installed at its standard thickness. If insulation is compressed, the R-value is reduced and the building may not meet the requirements.

Fiberglass Batt Insulation R-Values And Standard Thicknesses

Insulation R-Value	Standard Thickness
R-11	3-1/2"
R-13	3-5/8"
R-15	3-1/2"
R-19	6-1/4"
R-21	5-1/2"
R-22	6-1/4"
R-30	9-1/2"
R-38	12"

Vapor Retarders

- Except as noted below, vapor retarders must be installed in all nonvented framed areas in ceilings, walls, and floors. The vapor retarder must have

a **perm rating** of 1.0 or less and must be installed on the warm-in-winter side of the insulation (between the insulation and conditioned space).

Exceptions

- Vapor retarders are not required where moisture or its freezing will not damage materials.
- Vapor retarder requirements do not apply to buildings located in the following climate zones:

Texas	Zones 2-5
Alabama, Georgia, North Carolina	Zones 4-6
Oklahoma, South Carolina	Zones 4-6
Arkansas, Tennessee	Zones 6-7
Florida, Hawaii, Louisiana, Mississippi	All Zones

The climate **zone** for your location is printed on the output report generated using the File->Print Report or File->Save Report options.

Lighting Requirements

Documenting Compliance

- Indicate switching schemes, fixture types, and lamp/**ballast** types that comply on your project plans.
- Complete and sign the Lighting Compliance Certificate, generated using the Print Report or Save Report option under the File menu.

Control, Switching, And Wiring Requirements

All lighting systems must have controls or switches that allow occupants to manually or automatically dim lights or turn them on and off.

Interior-Lighting Controls

Independent interior-lighting controls are required for each area enclosed by ceiling-height partitions. These controls can be any of the following:

- a switch located so the occupant can see the area controlled by the switch
- a switch that indicates whether the lights are on or off when it is impossible to see the controlled area from the switch location
- an **occupant-sensing device**.

Exceptions

- areas that must be continuously illuminated for building security or emergency exits - These areas must be designated as security or emergency exit areas on the plans, and the lights must be controlled by switches accessible only to authorized personnel.
- public areas, such as building lobbies and retail stores - These lights can be controlled by a single switch for the entire area.

Master Switches In Hotel And Motel Guest Rooms

One or more master light switches are required at the entry door of hotel and motel guest rooms. Master switches operate all **permanently wired luminaires** and **switched receptacles**. These switches are usually three-way devices wired in combination with local controls. In multiple-room suites, a standard control device is required at the entrance to each separate room. Exception - Bathroom lighting systems in hotel and motel guest rooms.

Bi-Level Switching

Lighting within a space must be switched so the occupant can reduce the **connected lighting load** by at least 50 percent in a reasonably uniform illumination pattern. Bi-level switching requirements may be met by

- switching alternate luminaires in a row or alternate rows of luminaires
- separately switching half of the lamps in each luminaire or two lamps in three-lamp luminaires
- using dimming controls on all lamps or luminaires.

Exceptions - Bi-level switching is not required if

- the area has only one luminaire

- an occupant-sensing device controls the area
- the area is a corridor, storage area, restroom, or main lobby.

Exterior-Lighting Controls

Automatic controls are required for all exterior lights. The control may be a directional **photocell**, an astronomical time switch, or a building automation system with astronomical time switch capabilities. The control must automatically turn off exterior lighting when daylight is available.

Exception

- Lights in parking garages, tunnels, and other large covered areas that must be on during daylight hours are exempt from this requirement.

Tandem Wiring

The following types of one-lamp or three-lamp fluorescent fixtures must be tandem-wired:

- pendant- or surface-mounted luminaires in continuous rows
- recess-mounted luminaires located within 10 feet of each other and served by the same switch.

Exceptions

- luminaires that use electronic high-frequency ballasts or three-lamp ballasts
- luminaires that are not on the same switch control or in the same area., or luminaires that are on emergency circuit

Interior-Lighting Requirements

Interior lighting must not exceed the allocated wattage determined on the lighting screen. Interior lighting includes all permanently installed general and task lighting shown on the plans. It does not include emergency lighting that is usually off, specialized lighting for medical or research purposes, lighting for museum or gallery displays, or lighting for plant growth.

Exterior-Lighting Requirements

Exterior lighting must meet the following criteria to comply with the following requirements:

- The power for all lighting must be supplied through the building electrical service.
- Energy-efficient lighting must be used when illuminating paths, walkways, and parking areas. Qualifying types of energy-efficient lighting sources include **fluorescent lamps** and ballasts, **compact fluorescents**, **metal halide lamps** and ballasts, and high-pressure sodium lamps and ballasts. Any lighting source that has an efficacy of 45 lumens per watt or greater is allowed for exterior lighting.

Exceptions - These criteria do not apply to

- specialized signal, directional, and marker lighting associated with air, rail, water, and road transportation
- lighting used to highlight features of registered historic landmark structures or buildings
- lighting integral to advertising signage
- lighting used for safety or security specifically designed to meet health or life safety requirements
- low-voltage lighting used exclusively for landscaping

Mechanical Requirements

Demonstrating Compliance

- Indicate equipment efficiencies, system controls, outdoor-air ventilation rates, duct insulation levels, duct sealing, and water-heating components that comply on your project plans.
- Complete and sign the Mechanical Compliance Certificate, generated using the *Print Report* or *Save Report* option under the *File* menu.

Heating and Cooling Loads

- Design heating and cooling loads for the building must be determined using procedures equivalent to those in Chapters 27 and 28 of the ASHRAE Handbook of Fundamentals or an approved equivalent computation procedure.
- All equipment and systems must be sized to be no greater than needed to meet calculated loads. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity

for the other function as small as possible, within available equipment options.

Exceptions:

- The equipment and/or system capacity may be greater than calculated loads for standby purposes. Standby equipment must be controlled to be automatically off when the primary equipment and/or system is operating.
- Multiple units of the same equipment type whose combined capacities exceed the calculated load are allowed if they are provided with controls to sequence operation of each unit as the load increases or decreases.

System Controls

- Each humidification system must have its own humidity control device.
- Each heating or cooling system serving a single **zone** must have its own temperature control device.
- Thermostats controlling both heating and cooling must be capable of having a 5 deg. F deadband, or range of temperature where no heating or cooling is available.

Exception:

- Deadband capability is not required if the **thermostat** requires manual changeover between heating and cooling and does not have automatic changeover capability.
- The system or zone control must be a programmable thermostat or other automatic control meeting the following criteria:
 - capable of automatically setting back or shutting down systems during unoccupied hours for seven different day schedules
 - have an accessible 2-hour occupant override
 - have a battery back-up capable of maintaining programmed settings for at least 10 hours if power is lost.

Exceptions:

- A setback or shutoff control is not required on thermostats controlling systems serving areas that operate continuously.
- A setback or shutoff control is not required on systems with a total energy demand of 2kW (6,826 Btu/h) or less.

Outdoor-Air Ventilation

- The system must supply outside ventilation air as required by Chapter 4 of the International Mechanical Code. If the ventilation system is designed to supply outdoor air quantities exceeding minimum required levels, the system must be capable of reducing outdoor-air flow to the minimum required levels.
- Outdoor-air supply systems with design air flow rates greater than 3,000 cubic feet per minute of outdoor air and all exhaust systems must have dampers that automatically close while the equipment is not operating.

Duct Construction and Insulation

- Supply and return air ducts for conditioned air located in unconditioned spaces (spaces neither heated nor cooled) must be insulated with a minimum of R-5. Unconditioned spaces include attics, crawl spaces, unheated basements and unheated garages.
- Supply and return air ducts and plenums must be insulated to a minimum of R-8 when located outside the **building envelope**.
- When ducts are located in exterior components (e.g., floors or roofs), minimum R-5 insulation is required only between the duct and the building exterior.
- All joints, longitudinal and transverse seams and connections in ductwork must be securely sealed using weldments, mechanical fasteners with seals or gaskets or mastics, mesh and mastic sealing systems or tapes. Tapes and mastics must be listed and labeled in accordance with **UL 181A** or **UL 181B**.
- Ducts must be connected to fans and other air distribution equipment including multi-zone terminal units using mechanical fasteners with seals, mastics or gaskets.
- Each supply air outlet or diffuser and each zone terminal device (such as VAV or mixing boxes) must have its own balancing device. Acceptable balancing devices include adjustable dampers located within the ductwork, terminal devices or supply air diffuser.

Pipe Insulation

- All pipes serving space conditioning systems must be insulated to the following levels:

	Pipe Diameter	
	<= 1.5"	> 1.5"
Hot water	1.0"	2.0"
Steam	1.5"	3.0"
Chilled water, brine, refrigerant	1.0"	1.5"

Exceptions:

- Piping that conveys fluids that have a design operating temperature range between 55 deg. F and 105 deg. F.
- Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
- Runout piping not exceeding 4 ft in height and 1 in. diameter between the control valve and **HVAC** coil.

Materials and Equipment Information

- Operation and maintenance documentation must be provided to the owner that includes at least the following information:
 - Equipment input and output capacity and required maintenance actions.
 - Equipment operation and maintenance manuals.
 - HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined set points must be permanently recorded on control drawings, at control devices, or, for digital control systems, in programming comments.
 - A complete narrative of how each system is intended to operate.

Glossary

A

AAMA: Architectural Aluminum Manufacturers Association

addition: Newly conditioned spaces or previously unconditioned spaces after heating or cooling equipment has been installed

Air Economizer Systems: Ducting arrangements and automatic control systems that allow a cooling supply fan system to supply outdoor (outside) air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather

ASHRAE/IES Standard 90.1-1989: The American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illumination Engineering Society Standard 90.1-1989

ASHRAE/IESNA Standard 90.1-1999: The American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illumination Engineering Society Standard 90.1-1999

ASHRAE/IESNA Standard 90.1-2001: The American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illumination Engineering Society Standard 90.1-2001

automatic time-switch controls: Controls that automatically switch lights or equipment on and off

automatically operated control damper: A damper which automatically opens and closes

B

ballast: A device used to operate fluorescent and HID lamps. The ballast provides the necessary starting voltage, while limiting and regulating the lamp current during operation

below-grade wall: Portions of the wall below grade

boiler: A pressurized system in which water is vaporized to steam by heat transferred from a source of higher temperature, usually the products of combustion from burning fuels. Steam thus generated may be used directly as a heating medium, or as the working fluid in a prime mover to convert thermal energy to mechanical work, which in turn may be converted to electrical energy

building envelope: The elements of a building that enclose conditioned spaces through which thermal energy may be transferred to or from the exterior or to or from unconditioned spaces

C

cavity insulation: Insulation installed between structural members, including all blown insulation

ceiling: Those portions of the building envelope, including all opaque surfaces, fenestration, doors, and hatches, that are above conditioned space and are horizontal or titled at less than 60 degrees from horizontal

circulating water heater: Hot water continuously circulates through the distribution system

circulation pumps: Pumps that are used to keep hot water circulating through the distribution system

commercial building: Includes but is not limited to occupancies for assembly, business, education, institutions, merchants, and storage

compact fluorescents: Small fluorescent lamps that are often used as an alternative to incandescent lighting. The lamp life is about 10 times longer than incandescent lamps and is 3-4 times more efficacious

concrete masonry unit walls: Concrete masonry unit walls may be insulated by filling the empty core with perlite, vermiculite, or some other insulative material. In some cases, even with filled cores, these wall types require additional insulation

conditioned floor area: The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy-using system

conditioned space: A cooled or heated space, or an indirectly conditioned space

connected lighting load: The sum of all non-exempt interior lighting power, measured in watts

continuous insulation: Insulation that runs continuously over structural members and is free of significant thermal bridging, such as rigid foam insulation

cooled space: An enclosed space within a building that is cooled by a cooling system whose capacity (a) exceeds 6 Btu per hour per square foot or (b) is capable of maintaining a space dry-bulb temperature of 90 degrees F or less at design cooling conditions

D

domestic water heating system: DHW systems may be circulating or non-circulating

E

economizer: A ducting arrangement and automatic control system that allow a cooling supply fan system to supply outdoor air to reduce or eliminate the need for mechanical refrigeration during mild or cold weather

EER: The energy efficiency ratio is the ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. When consistent units are used, this ratio becomes equal to coefficient of performance

efficacy: A metric used to compare light output to energy consumption. Efficacy is measured in lumens per watt. Efficacy is similar to efficiency, but is expressed in dissimilar units. For example, if a 100-watt source produces 9000 lumens, then the efficacy is 90 lumens per watt

electronic high-frequency ballasts: Electronic ballasts improve fluorescent system efficacy by converting the standard 60 Hz input frequency to a higher frequency, usually 25,000 to 40,000 Hz. Lights operating on these frequencies produce about the same amount of light, while consuming up to 30% less power than a standard magnetic ballast

enclosed space: A volume substantially surrounded by solid surfaces such as walls, floors, roofs, and openable devices such as doors and operable windows. Spaces not meeting these criteria for enclosure are considered to be exterior to the building for purposes of determining envelope requirements. For example, most parking garages do not qualify as enclosed space

envelope components: The building assemblies that provide a barrier between conditioned space and unconditioned space. This includes the floors, walls, and ceiling/roof assemblies of the building

F

fan coil: A fan-coil terminal is essentially a small air-handling unit which serves a single space without a ducted distribution system. One or more independent terminals are typically located in each room connected to a supply of hot and/or chilled water. At each terminal, a fan in the unit draws room air (sometimes mixed with outside air) through a filter and blows it across a coil of hot water or chilled water and back into the room

fenestration: The terms "fenestration", "window", and "glazing" are often used interchangeably. However, fenestration refers to the design and position of windows, doors and other structural openings in a building

floor: A horizontal exterior partition, or a horizontal demising partition, under conditioned space which separates conditioned space from unconditioned space

fluorescent lamps: A light source consisting of a tube filled with argon, along with krypton or other inert gas. When electrical current is applied, the resulting arc emits ultraviolet radiation that excites the phosphors inside the lamp wall, causing them to radiate visible light

fuel-fired furnace: A self-contained, indirect-fired furnace that supplies heated air through ducts to spaces that require it

G

glazing: The terms "fenestration", "window", and "glazing" are often used interchangeably. However, glazing is the transparent component of glass or plastic windows, doors, clerestories, or skylights

glazing U-factor: Based on the interior-surface area of the entire assembly, including glazing, sash, curbing, and other framing elements. Center-of-glass U-factors cannot be used

gross wall area: Includes the opaque area of all above-grade exterior walls enclosing conditioned spaces (including above-grade portions of below-grade wall assemblies but excluding walls separating conditioned from unconditioned space); the area of the band joist and subfloor between floors; and the area of all doors and windows

gross window area: Includes the rough-opening area of the window, not just the transparent-glass area

H

heat pump: One or more factory-made assemblies which include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions

heat traps: Devices or piping arrangements that effectively restrict the natural tendency of hot water to rise in vertical pipes during standby periods. Examples are the U-shaped arrangement of elbows or a 360-degree loop of tubing

heated space: An enclosed space within a building that is heated by a heating system whose output capacity (a) exceeds 10 Btu per hour per square foot and (b) is capable of maintaining a space dry-bulb temperature of 50 degrees F or more at design heating conditions. (90.1-1999 definition: 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 in the ASHRAE/IESNA Standard 90.1-1999

HID: High intensity discharge. Generic term describing mercury vapor, metal halide, high pressure sodium, and (informally) low pressure sodium light sources and luminaires

high-pressure sodium lamps: High-intensity discharge (HID) lamps whose light is produced by radiation from sodium vapor (and mercury)

high-rise residential buildings: Hotels, motels, apartments, condominiums, dormitories, and other residential-type facilities that provide complete housekeeping or transient living quarters and are over three stories in height above grade. Hotels, motels, and other buildings with itinerant occupancies are covered by the "commercial" code regardless of height

HVAC: Heating, ventilating, and air-conditioning

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

I

ICAA: Insulation Contractors Association of America

ICC: International Code Council

IMC: International Mechanical Code

indirectly conditioned space: An enclosed space within a building that is not a heated or cooled space, whose area-weighted heat transfer coefficient to heated or cooled spaces exceeds that to the outdoors or to unconditioned spaces; or through which air from heated or cooled spaces is transferred at a rate exceeding three air changes per hour. (Also see Heated Space, Cooled Space, and Unconditioned Space.)

insulation R-values: R-values are used to rate insulation and are a measurement of the insulation's resistance to heat flow. The higher the R-value, the better the insulation

integrated-control economizers: Allows the cooling load of a building or space to be partially met by supplying outside air while the rest of the load is met by the refrigeration equipment within an HVAC system. Field- and factory-installed economizers supplied by major equipment manufacturers include integrated controls

interior-lighting controls: Offer the ability for systems to be turned on and off either manually or automatically and include switches, time clocks, occupancy sensors and other devices that regulate a lighting system

interior lighting power limits: The maximum total wattage for a building or space that can be installed to meet the provisions of the energy code

L

longitudinal seam: A duct seam that is parallel to the direction of air flow

luminaire: A complete lighting unit consisting of a lamp or lamps, along with the parts designed to distribute the light, hold the lamps, and connect the lamps to a power source. Also called a fixture

M

mechanical system: The system and equipment used to provide heating, ventilating, and air conditioning functions as well as additional functions not related to space conditioning, such as, but not limited to, freeze protection in fire protection systems and water heating

metal building walls and roofs: Special attention to the design and construction of metal buildings is required to ensure these buildings meet the COMcheck-EZ requirements. Two key elements exist in metal buildings that are not found in other building classes - thermally broken connections between the purlin and metal roof sheet and compression of insulation behind wall girths and roof purlins. COMcheck-EZ includes requirements for metal building walls and roofs. These requirements are specified in the "Walls Framed - Metal Framing" category and in the "Roofs Metal Purlin" category in the Prescriptive Packages. There are two classes of metal building roofs. One class uses traditional techniques that drape the insulation over the purlin and fasten the metal roof sheets through the insulation directly to the purlin. The second class requires that a thermal block be placed between the metal roof sheet and purlin. A thermal block consists of foam blocks or other materials/techniques that prevent heat from migrating from the purlin directly to the metal roof sheet. Compressed fiberglass batt insulation does not qualify as a thermal block

metal halide lamps: A type of high intensity discharge (HID) lamp in which most of the light is produced by radiation of metal halide and mercury vapors in the arc tube. Available in clear and phosphor-coated lamps

O

occupancy type: The type of activity occurring within a building

occupant-sensing device: A device that detects the presence or absence of people within an area and causes any combination of lighting, equipment, or appliances to be adjusted accordingly

P

packaged boiler: A self-contained unit that generally requires little maintenance

packaged terminal air conditioner: A factory-selected wall sleeve and separate unencased combination of heating and cooling components, assemblies, or sections (intended for mounting through the wall to serve a single room or zone). It includes heating capability by hot water, steam, or electricity

packaged terminal heat pump: A packaged terminal air conditioner capable of using the refrigeration system in a reverse cycle or heat pump mode to provide heat

perm rating: The amount of water vapor that passes through an area in a certain period of time

permanently wired luminaires: Light fixtures physically attached to a surface (e.g. ceiling or wall) using a permanent mounting system and wired directly to a power source. Examples include fluorescent fixtures located in a ceiling grid and wall sconces

photocell: A light sensing device used to control luminaires and dimmers in response to detected light levels

plenum: An enclosure that is part of the air-handling system and is distinguished by having a very low air velocity. A plenum often is formed in part or in total by portions of the building

projection factor: The exterior horizontal shading projection depth divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the external shading projection in units consistent with the projection depth

R

R-value: Thermal resistance to heat flow. A larger number means less heat flow

residential buildings: Detached one and two family dwellings. A building containing multiple (i.e., three or more) dwelling units where the occupants are primarily permanent in nature, such as townhouses, row houses, apartment houses, convents, monasteries, rectories, fraternities and sororities, dormitories, and rooming houses, all of which are three stories or less in height above grade

roof: Those portions of the building envelope, including all opaque surfaces, fenestration, doors, and hatches, that are above conditioned space and are horizontal or tilted at less than 60 degrees from horizontal

S

semiheated space: 90.1-1999 only: 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

service water heating: The supply of hot water for purposes other than comfort heating and process requirements

shading coefficient: The ratio of solar heat gain through fenestration, with or without integral shading devices, to that occurring through unshaded 1/8-in.-thick double-strength glass

SHGC: solar heat gain coefficient

single-zone, unitary HVAC systems: Unitary HVAC systems that serve a single zone. Single zone systems can provide either heating or cooling, but provide supply air at the same volume and temperature to the entire zone which they serve

skylight: Glazing that is horizontal or tilted less than 60 degrees from horizontal

solar heat gain coefficient: The glazing's effectiveness in rejecting solar heat gain. SHGC is part of a system for rating window performance used by the National Fenestration Rating Council (NFRC). SHGC is gradually replacing shading coefficient (SC) in product literature and design standards

split system: Split-system HVAC equipment has the indoor and outdoor coils within separate cabinets. For a cooling only system, the outdoor cabinet would contain the condenser coil and the indoor cabinet would contain the evaporator coil

structural masonry wall: (not a wall type in 90.1-1999) A wall construction category used with masonry, precast and poured-in-place concrete, and concrete masonry units. You can select from among six specific types of masonry wall constructions by clicking the Ext. Wall button and selecting Structural Masonry Wall or by clicking the Basement button

switched receptacles: The ability to turn power on and off to an electrical outlet by using a control switch

T

tandem wiring: Pairs of luminaires operating with lamps in each luminaire powered from a single ballast contained in one of the luminaires. This reduces labor, materials, and energy costs

temperature reset controls: Controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outside air temperature

thermostat: An automatic control device responsive to temperature

thermostat set back: Usually done at night to reduce the amount of conditioning provided at night by allowing the interior temperature to drift naturally to a marginal temperature during the night and then to recondition it to normal conditions in the morning

transverse seam: All duct seams other than the longitudinal seam (which runs parallel to the direction of air flow)

U

U-factor: The amount of heat in Btu that flows each hour through one square foot, when there is a 1 degree F temperature difference across the surface. The smaller the number, the less heat flow

UL 181A: A test procedure for tapes and mastics used to seal ductwork

UL 181B: A test procedure for tapes and mastics used to seal ductwork

unconditioned space: An enclosed space within a building that is not a conditioned space

unitary-packaged: Each package is a standalone system which provides all of the heating and cooling requirements for the area of the building which it serves

V

vapor retarder: A component that retards water vapor diffusion, but does not totally prevent its transmission. Vapor retarder material is usually a thin sheet or coating. However, a construction of several materials, some perhaps of substantial thickness, could also constitute a vapor retarder system

variable-air volume (VAV) system: HVAC system that controls the dry-bulb temperature within a space by varying the volume of heated or cooled supply air to the space

variable-frequency drive: Changes the speed of the motor by changing the voltage and frequency of the electricity supplied to the motor based upon system requirements

ventilated mechanically: The process of supplying or removing air by mechanical means to or from any space. Such air may or may not have been conditioned

ventilated naturally: The process of supplying or removing air by natural means to or from any space

visible light transmittance: The fraction of solar radiation in the visible light spectrum that passes through the fenestration

W

wall: Opaque portion of the building envelope

water heating: The process or system used to heat service water

water temperature reset: Temperature shall be reset by at least 25% of the design supply-to-return water temperature difference

WDMA: Window and Door Manufacturers Association

window: The terms "fenestration", "window", and "glazing" are often used interchangeably. However, window actually describes a system of several components. Window is the term given to an entire assembly comprised of the sash, glazing, and frame

window wall ratio: The gross window area divided by the gross wall area

Z

zone: A space or group of spaces within a building with any combination of heating, cooling, or lighting requirements sufficiently similar so that desired conditions can be maintained throughout by a single controlling device

Index

A

Area Category..... 62

B

Basements..... 34, 35

Building Use Types..... 61, 62

C

Code Menu 15

Context Menu 13

D

Daylight Control Factor 11

Doors 32, 33

E

Edit Menu..... 7

Envelope.. 21, 23, 25, 29, 32, 34, 37,
65

Exemptions 12

F

File Menu 5

Floors..... 37

H

Help Menu 17

HVAC Systems 48

L

Lighting..... 41, 42, 43, 68

M

Mandatory Requirements 65

Mechanical 47, 71

O

Options Menu..... 11

Orientation..... 11

P

Plant Screen..... 58

Project Screen..... 19

R

Roofs..... 21, 22

S

Service Water Heating 60

Skylights..... 23

V

Visible Light Transmittance 11

W

Walls 25, 26, 29

Whole Building Types..... 61

Windows..... 29