

DOE-2.2

Building Energy Use and Cost Analysis Program
Supplemental Manual: LEED Compliance Analysis
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DOE-2.2 BUILDING ENERGY USE AND COST ANALYSIS PROGRAM

Supplemental Manual: LEED Compliance Analysis

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Performing LEED Compliance Analysis

OVERVIEW

This Supplement describes the procedures for using a new eQUEST compliance module that aids energy modelers in generating a Leadership in Energy and Environmental Design (LEED®) Version 3.0 for New Construction and Renovations (LEED-NC v3.0) compliant baseline energy model.

United States Green Building Council's (USGBC) new LEED-NC v3.0 Standard adopts ASHRAE 90.1-2007 Appendix G: Performance Rating Method as one method for determining the minimum and above standard performance rating for its Energy and Atmosphere Prerequisite 2 (EA_p2) and Credit 1 (EA_c1). Appendix G outlines the fundamental assumptions used in preparation of energy models for making the performance rating. This new software module automatically converts a valid DOE-2.2 proposed building energy model to be minimally compliant with the Appendix G rating standard. Therefore, it is hoped this tool is of value to eQUEST user's pursuing the LEED-NC v3.0 certification.

The compliance module described in this manual uses existing and new enhancements to the Compliance Analysis rules processor capabilities, originally developed for determining compliance with the California's Energy Efficiency Standards for Nonresidential Buildings. In this case, the rules processor has been tailored to target the Methods and Standards (ASHRAE 90.1-2007) referenced for LEED-NC v3.0 energy performance analyses. Therefore, in this manual, this new tool is commonly referred to as the LEED rules processor or ruleset, and similar variations.

The current version of the LEED rules processor is capable of taking an eQUEST user's proposed building inputs for space conditioning, occupancy and climate to generate a valid DOE-2.2 input file with the minimally compliance 90.1-2007 Appendix G baseline envelope and space lighting performance specifications. The tool is not currently able to perform a complete conversion of the proposed model input to a 90.1-2007 Appendix G compliant model. This manual outlines the required user inputs and scope of model components manipulated by the rules processor. It is assumed the user of this new tool is comfortable using and specifying DOE-2.2 inputs with eQUEST's "Detailed Interface" and is well-versed in the ASHRAE 90.1-2007 (including Appendix G) and LEED-NC v3.0 Standards. Modeling topics not addressed in this manual, such as HVAC, central plant and service water heating components, should be assumed unchanged from the user's proposed building input.

The topics addressed in this manual include:

Specifying project site location and climate information
 Assigning space conditioning and occupancy
 Specification of exterior, underground, and interior walls performance
 Calculation of lighting power allowances
 Creation of baseline HVAC systems

The following table provides a rough outline of what features and capabilities are included in the current or planned versions of the LEED rules processor. The current release has basic capabilities for manipulating proposed building LOADS input, i.e., envelope, lighting and HVAC specifications. As funding becomes available and interest in this product increases, these capabilities will be expanded over time.

Task	Current Version	Future Versions
Site Data		
Create LEED compliance analysis project from Wizard	X	
Determine climate zone for U.S. locations	X	
Determine climate zone for International locations.		X
Create design days for project location		X
Create parametric runs for 90°, 180°, and 270° building runs.	X	
Envelope		
Ability to specify 90.1 space use and conditioning categories	X	
Modify opaque envelope to meet baseline performance	X	
Modify windows and skylights to meet baseline performance	X	
Adjust fenestration area to meet baseline allowance	X	
Quality checks of proposed building envelope inputs.		X
Lighting		
Calculation of baseline lighting power allowance using “Space-by-Space” method	X	
Calculation of baseline lighting power allowance using “Building Area” method		X
Adjustment of lighting power for lighting power exceptions and automatic lighting controls (occupancy sensors, programmable timers).		X
HVAC, Central Plant, and DHW		
Creation of baseline HVAC systems, including spaces that meet the user specification of Section G3.1.1., Exceptions a), b), c), and d)	X	
Automatic capability to determine Section G3.1.1. Exceptions.		X

Creation of baseline central plant, including pumps and control setpoints.	X	
Baseline sizing runs to determine baseline equipment capacities and capacity specific inputs (fan power, heating/cooling efficiencies).		X
Quality checks of proposed building HVAC inputs.		X
Calculation of baseline DHW equipment efficiency.		X
Reports		
Creation of LEED EAc1 template.		X
Plotting of user-selected simulation schedules.		X
Plotting of user-selected HVAC performance curves.		X

GETTING STARTED

Model Creation Methods

Using the eQUEST Building Creation Wizard

The building creation wizard enables the user to quickly generate a proposed building input file. Refer to the “Building Wizard” section of the eQUEST Tutorial for instructions on using the Wizard to create a proposed building input file. Generally, wizard inputs will be translated to detailed interface values representing minimally compliant Title 24 values, however, users should review the detailed interface to make sure all inputs represent the actual design prior to continuing with the compliance analysis.

Using the Detailed User Interface

The detailed interface may be used to create a building from scratch or to edit a building created by the wizard or imported from an existing BDL input file. Each of these three methods is described below:

Creating a Building from Scratch: When starting eQUEST, select “Create Building from Scratch.” If eQUEST is already running, select New/”Blank Slate Building Description.” Components of the building can then be created individually. Generally, eQUEST will default individual properties not input by the user to minimally compliant Title 24 values, however, users should review the detailed interface to make sure all inputs represent the actual design prior to continuing with the compliance analysis. In particular, each property on the “Compliance” tab for a component should be carefully reviewed to ensure it accurately reflects information in the construction documents for the proposed building.

Editing a Wizard Created Building: The wizard will create a complete and fully valid (i.e. no errors will occur during simulation or compliance analysis) building input file. This file can be edited by selecting any individual component and modifying their properties.

Editing an Imported BDL File: Once a valid BDL input file has been successfully imported into eQUEST (see next topic), individual components may be selected and edited.

Writing a DOE-2.2 BDL Input File and Reading Into eQUEST

At this time, the only way to perform compliance analysis on a DOE-2.2 BDL input file is to open it into eQUEST. Compliance analysis may be performed on an existing BDL input file within the limitations of the rules processor. In addition to DOE-2.2 documentation, users should refer to Section 2, Compliance BDL Elements, of this document for proper use of compliance analysis keywords.

When starting eQUEST, use the following procedure to open a BDL input file:

- a) select “Select an Existing Project to Open”
- b) set the file type to “DOE-2.2 BDL Input Files (*.inp)”
- c) select the input file to import into eQUEST

If eQUEST is already open, use the following procedure to open a BDL input file:

- a) select File/Open or click the open icon.
- b) set the file type to “DOE-2.2 BDL Input Files (*.inp)”
- c) select the input file to import into eQUEST

Generally, eQUEST will default individual properties not input by the user to minimally compliant Title 24 values, however, users should review the detailed interface to make sure all inputs represent the actual design prior to

continuing with the compliance analysis. In particular, each property on the “Compliance” tab for a component should be carefully reviewed to ensure it accurately reflects information in the construction documents for the proposed building.

BUILDING MODELING TOPICS

Step 1: Open or Create A New Compliance Project

The first step is to open the proposed building project in eQUEST. New projects created with the current eQUEST v3.63 release will now include keywords relevant for both the T24 and LEED rules processors. This enables the user to elect to do either a T24 compliance analysis or create LEED baseline building without returning to the Wizard if the user failed to select a Compliance method initially.

The LEED rules processor was developed as a stand-alone application, however, numerous BDL keywords utilized by the LEED rules processor are either the same or have analogous meanings as keywords used in T24 Compliance analysis. Identification of these relationships leads to one highlight of the LEED rules processor, which is that much of the user-defined T24-2005 compliance analysis input is translated to input for the LEED rules processor.

LEED keywords analogous to T24 keywords typically begin with “C-901-“, followed by similar abbreviations representing the significance of the keyword. For example, the space conditioning category for a T24 analysis is specified using the C-CONDITIONING keyword, while the analogous LEED keyword is C-901-CONDITION. The symbol values for this keyword are not the same, and therefore a BDL default expression is used to “map” the T24 values to the LEED values.

Appendix A includes reference tables that outline keyword mapping assumptions. However, due to slight differences in definitions of compliance inputs, both within the Standards and the ruleset, users should not assume the translation is perfect, and therefore verify the default LEED-related keyword values. Finally, it is important to understand this BDL keyword defaulting works in only one direction. That is, LEED keyword values will not automatically “map” to T24 keyword values. Ultimately, however, we believe this capability is expected to save time for users who are performing T24 Compliance analysis, and wish to evaluate their design using the ASHRAE 90.1 Appendix G criteria.

Step 2: Enter Compliance and Site Parameters Information

Before inputting detailed LEED rules processor data, the user should specify the necessary COMPLIANCE and SITE-PARAMETERS information.

Compliance Data

In the Compliance Analysis Data dialog, the required inputs are:

1. Building Type (C-901-BLDG-TYPE)
2. Number of Floors (C-901-NUMFLRS)
3. Heating Source (C-HTG-SYS-CLASS)

The screenshot shows a software dialog box titled "Compliance Analysis Data". It contains several input fields and dropdown menus. The "Compliance Component Name" field is filled with "Compliance Data". Under the "Compliance Analysis Data" section, the "Building Type" dropdown is set to "Office", "Num. Floors" is "6", and the "Heating Source" dropdown is set to "Electric and Other". The "Compliance Reporting" section has empty text boxes for "Project Name", "Project Address", "Documentation Author", and "Phone". A "Done" button is located at the bottom right of the dialog.

The building type should describe the predominant use of the proposed LEED project. The building types correspond to the ASHRAE building area method descriptions listed in Table 9.5.1 of the Standard. Specification of the building type at the compliance level defaults analogous inputs at both the DOE-2 floor and space commands, where it ultimately is used to aid in specification of applicable occupancy types in each space.

The number of floors should reflect the total number of stories in the project with conditioned space. This includes both above and below-grade floors. It is essential the user define this value correctly, as it is used as one criteria for determining the baseline HVAC systems, and the rules processor is currently not capable of accurately determining this value for all projects.

Finally, the heating source should reflect the predominant source of the proposed LEED project. Similar to building type, specification of the heating source at the compliance level defaults analogous inputs at both the DOE-2 floor and space commands, where it ultimately is used to determine the appropriate baseline HVAC system for each floor/space.

Site Properties

In the Site Properties dialog, the relevant inputs are:

1. Country (C-COUNTRY)
2. State / Province (C-STATE)
3. City / Location (C-LOCATION)
4. Weather File (C-WEATHER-FILE)
5. Climate Zone Number (C-901-CZ-NUMBER)
6. Climate Zone Letter (C-901-CZ-LETTER)

The screenshot shows the 'Site Properties' dialog box with the following values:

- Site Name: Site Data
- Country: United States & Territories
- State: Washington
- City / Location: Seattle
- Altitude: 20 ft
- Time Zone: 8
- Latitude: 47.65 deg
- Climate Zone Number: 4
- Longitude: 122.30 deg
- Climate Zone Letter: C
- Daylight Savings: Yes
- Weather File: TMY2\SEATTLWA.bin

When specifying the project country as “United States and Territories”, the user is required to also specify the project state and city/location. The list of available states and locations correspond to those available in the eQUEST wizard, and for new LEED compliance projects created using the wizard, the state, location and weather file information will be automatically populated from the Wizard. Based on the Wizard or user-defined US location properties, the LEED rules processor will automatically default the appropriate ASHRAE climate zone number, major climate type letter, and weather file for the project. Please note, the site parameter values for latitude and longitude should be defined within X degree tolerance of the weather data file location, otherwise, an error will occur during execution of LEED rules processor.

If C-COUNTRY is specified to be “International -or- User-defined”, the user must enter the appropriate climate zone number and letter for the project, as well as specify the weather data file. Again, the latitude and longitude properties should be within tolerance of the weather data file information.

Step 3: Specify Floor and Space Properties

Space conditioning and occupancy are essential inputs used to determine a multitude of baseline performance inputs, including envelope performance, lighting allowances, and HVAC system type (future versions). Therefore, understanding the definitions of the inputs and Appendix G interpretations established within the rules processor are fundamental to creating the appropriate LEED baseline building from your proposed building input.

Floor Properties

As mentioned in the compliance data section above, there are two inputs that cascade down from the compliance level to the space level via keyword defaulting.

These inputs are the building type (C-901-BLDG -TYPE) and heating source (C-HTG-SYS-CLASS). The FLOOR commands provide flexibility for changing the default building description for all space “children” to the floor, as is the typical case in actual buildings. This is behavior is best described by Example 1 below.

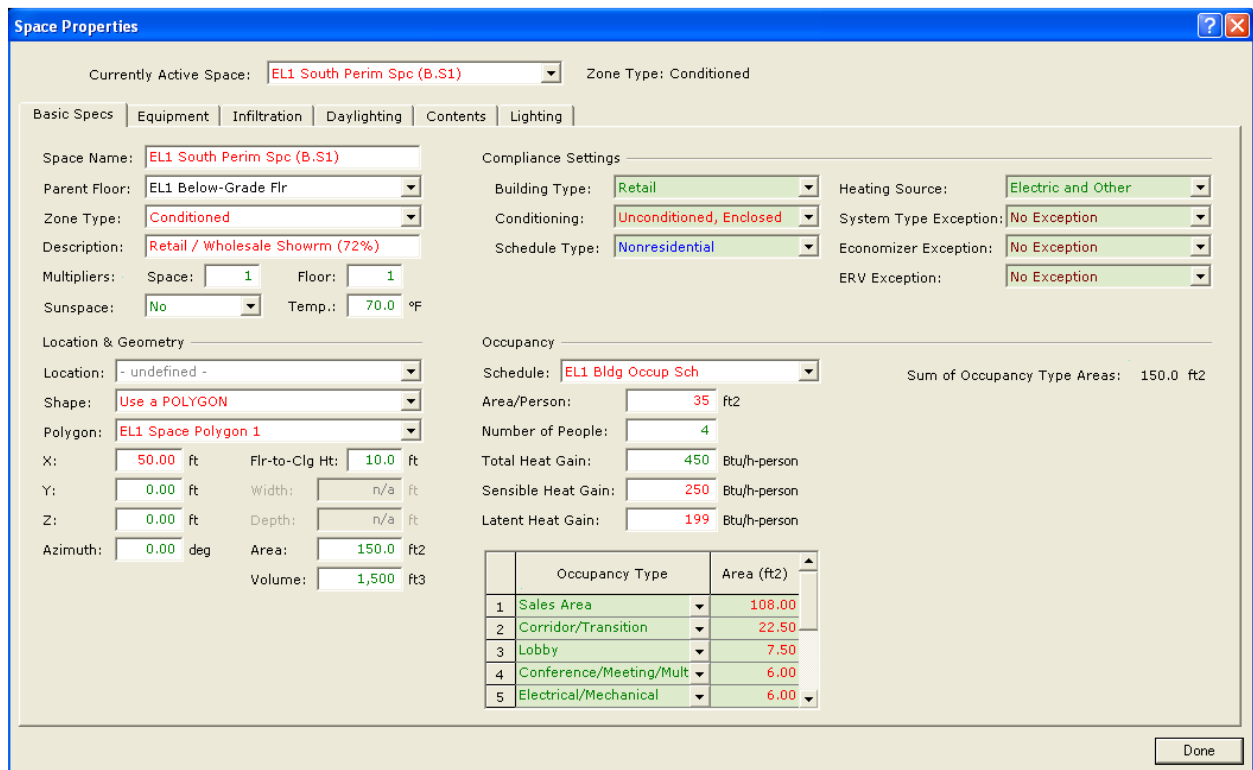
Example 1: Consider a proposed, 14 story mixed-use project, where the first floor contains retail space and the second story contains offices. Above the offices are nine levels of apartments, and below the retail space are two floors of below-grade parking. Each floor has the same footprint area of 10,000sf. The retail spaces are served by four-pipe fan coil units. A VAV system with chilled and hot water coils serves the office floors. Each apartment is conditioned by individual two-pipe fan coil units with electric resistance heating.

In this case, the user would be advised to specify the building type as “Multifamily” and the predominant heating source to be “Electric and Other” in the compliance data dialog. Then, the user would modify the non-predominant floor building types to be office, retail, and parking. At the same time, the heating type for the office and retail floors would be revised to “Fossil Fuel/Hybrid/Purchased Heat”. This would default building type and heating source inputs of child spaces to match the floor, ultimately reducing the number of user inputs for each individual space.

Space Properties

In the Space, Basic Specs dialog, the relevant inputs for conditioning and occupancy are listed:

1. Conditioning (C-901-CONDITION)
2. Building Type (C-901-BLDG-TYPE)
3. Schedule Type (C-901-SCH-TYPE)
4. Sub-Occupancy Type (C-901-OCC-TYPE, 10 value keyword array)
5. Sub-Occupancy Area (C-SUB-AREA, 10 value keyword array)
6. Heating Source (C-HTG-SYS-CLASS)
7. Baseline HVAC System Exceptions
 - a. System Type (C-SYS-EXCEPTION1)
 - b. Economizer (C-SYS-EXCEPTION2)
 - c. Energy Recovery Ventilator or ERV (C-SYS-EXCEPTION3)



Conditioning

The conditioning specifications are based on ASHRAE classifications for a “space”, as listed on page 13 of the standard. In the context of the LEED Compliance Analysis tool, the space conditioning categories are:

- 1) Conditioned -or- Indirectly Conditioned
- 2) Plenum -or- Enclosed Ceiling
- 3) Semiheated
- 4) Unconditioned, Enclosed
- 5) Ventilated Parking/Crawl(space)/Attic
- 6) Not Included

“Conditioned -or- Indirectly Conditioned” and “Plenum -or- Enclosed Ceiling” are both considered within the conditioned envelope, however, these designations allow the rules processor to differentiate between these spaces for calculation of building floor areas. “Semiheated” spaces meet the conditioning requirements set forth in the Standard, and these areas are included in the overall conditioned floor area calculations. “Unconditioned, Enclosed” spaces within the building but are neither conditioned nor semiheated. The designation of “Ventilated Parking/Crawl(space)/Attic” allows the user to explicitly simulate spaces outside the conditioned envelope, while enabling the rules processor to determine envelope performance between these and adjacent spaces. In the circumstance a modeled space is outside the scope of the LEED analysis, the user can designate the space as “Not Included”. In this case, the area of the space and the attached surfaces will not be included in envelope calculations, and all other proposed DOE-2.2 LOADS inputs are assumed to be the same as the proposed.

Building Type

As mentioned in the “Floor Characteristics” section above, the space classification of the C-901-BLDG-TYPE keyword is defaulted based on the parent floor value. The space building type designation ultimately governs the occupancy types available to the user, which are also dependant on schedule type. As mentioned in the “Compliance Data” section, the building types correspond to the ASHRAE building area method descriptions listed in Table 9.5.1 of the Standard. The space building type assignment is restricted by the space’s schedule type, as discussed below.

Schedule Type

The schedule type simply refers to “Nonresidential” and “Residential” classifications. The space schedule type (C-901-SCH-TYPE) options are limited by the space buildings type (C-901-BLDG-TYPE). Spaces assigned any of the available building types can have schedule type of “Nonresidential”, as it is assumed even residential build types covered by the Standard often also contain nonresidential spaces. However, a “Residential” schedule type is limited to spaces with building type designations of “Dormitory”, “Hotel”, “Motel”, “Fire Station”, “Police Station”, and “Multifamily”. Residential building types with a “Nonresidential” schedule type can contain spaces that are classified by both schedule types, however, nonresidential and residential occupancies (discussed below) cannot be combined in the same space.

Ultimately, the space schedule type, in addition to the conditioning and climate specifications, are used to determine the required envelope performance.

Occupancy Type and Area

Space occupancy types are based on the categories listed in Table 9.6.1 of the Standard. The occupancy type input allows the rules processor to determine the baseline lighting power allowance for the space. These space occupancy types can be classified into three categories:

- 1) Nonresidential, Common
- 2) Nonresidential, Building Specific
- 3) Residential, Building Specific

Table 4, lists the common and building specific space occupancy categories, and highlights residential building specific types. The table also identifies which occupancy types are available based on the local *space* building type designation.

In general, spaces with a “Nonresidential” schedule type and any of building designations can contain any fraction of common, nonresidential occupancy types. Spaces with a “Residential” schedule type and any of the building designations classified as residential can contain only the respective building specific occupancy types. These occupancy types include Hotel/Motel “Guest Rooms”, Dormitory “Living Quarters”, Fire Station/Police Station “Sleeping Quarters”, and Multifamily “Private Living Space”.

A nonresidential, “-undefined-” building space is limited to only specifying common occupancy classifications. A residential, “-undefined-” building type is limited to contain only the generic “Living Spaces” occupancy type. This space occupancy type has no lighting allowance under the Standard, and is therefore assumed to have the same lighting power as the proposed.

The LEED rules processor allows the simulation of individual spaces with a mix of up to ten occupancy types, provided they all have the same schedule classification (nonresidential/residential).

The areas of all sub-occupancies in the space must sum to the value input in the area property for the space component. The rules processor will automatically check to see that the sum of all sub-spaces matches the area of the space. If not, the rules processor will automatically terminate the LEED baseline model conversion and post an error message to the computer screen.

Heating Source

As mentioned above, the heating source classification is defaulted based on the parent floor designation. The heating source ultimately is one factor in determining the baseline system type.

System Exceptions

Per Appendix G guidelines, there are certain exceptions to for baseline system type (Section G3.1.1) economizer requirements (Section G3.1.2.6) and exhaust air energy recovery (Section G.3.1.2.10). These exceptions allow identification of spaces served by a proposed HVAC system that meets the exceptions, as determined by the user. Since these exceptions are not entirely dependent on DOE-2 inputs, the LEED rules processor requires the user to make the determination if these exceptions are applicable.

T24 Input Defaulting

As indicated in Step 1, numerous keyword values included in a T24-2005 compliance project are used to default keyword values in a LEED compliance project. Table 1 below lists the LEED compliance keywords for spaces which are defaulted based on T24 compliance keywords. Appendix A includes tables which illustrate these translations.

Table 1. Analogous LEED and T24 Compliance Analysis Keywords for WINDOW command.

LEED Compliance Keyword	T24 Compliance Keyword
C-901-CONDITION	C-CONDITIONING
C-901-SCH-TYPE	C-SCHEDULE-TYPE
C-901-OCC-TYPE	C-OCC-TYPE

In the absence of T24 compliance keywords, the LEED space conditioning type is defaulted based on Wizard populated or BDL required keywords. C-901-CONDITION is defaulted using the space “ZONE-TYPE” and “Z” keywords. The BDL default assumes spaces with Z > 0 feet and ZONE-TYPE = UNCONDITIONED are “Plenum -or- Enclosed Ceiling” spaces, and therefore are within the conditioned envelope.

By default, the space schedule classification is assumed to be “Nonresidential” if not defined by the user.

Finally, if the project was created using the Wizard of the current eQUEST program, the 90.1 space occupancy types will automatically be included in the project input file. The translation of Wizard activity areas to 90.1 space occupancy categories is also included in Appendix A.

Step 4: Specify Wall Characteristics

The baseline opaque wall performance is based on the space conditioning and schedule type, climate zone, and the building surface orientation.

Surface Orientation

The LEED rules processor uses the DOE-2 TILT keyword value of an envelope surface to determine its primary orientation. Following ASHRAE definitions, the following ranges for TILT define the three primary surface types:

- 1) Wall: $\pm 60^\circ \leq \text{TILT} \leq \pm 120^\circ$
- 2) Roof: $-60^\circ < \text{TILT} < +60^\circ$
- 3) Floor: $-120^\circ < \text{TILT} < +120^\circ$

In the context of the Standard, underground, vertical walls are considered below-grade walls, and underground floors are considered slab-on-grade floors.

Construction Assemblies

In eQUEST and DOE-2.2, interior and exterior walls, roofs and floors as well as underground walls and floors must reference a “Construction”, which defines the layers of materials that make up the wall, roof or floor components.

To define the baseline envelope surface constructions, the LEED rules processor does not modify the proposed building construction components. Instead, new constructions, layers and materials for the baseline building are created. The construction assembly definitions listed in Normative Appendix A of the ASHRAE 90.1-2007 Standard were used as templates for the LEED baseline wall assemblies, however, some deviations were made for modeling purposes. With the exception of an insulating material layer, these assemblies are the same across all climate zones. The rules processor adjusts the value of the insulation layer to achieve the overall assembly U-factor, F-factor, or C-factor requirements for the appropriate project climate zone and schedule/conditioning type (nonresidential, residential, or semi-heated). Table 2 below describes the components of the baseline construction layers.

Table 2. LEED Baseline Exterior and Underground Wall Assemblies.

Roofs: Insulation Entirely Above Deck (§A2.2.1)	Inside Film Resistance: R=0.61 Material 1: Built-up Roof, 3/8in Material 2: Steel Decking Material 3: Roof Insulation Layer Material 4: Gypsum board, 5/8in
Above-grade Walls: Steel-framed (§A3.3.1)	Inside Film Resistance: R=0.68 Material 1: Stucco, 3/8in Material 2: Gypsum board, 5/8in Material 3: Above-grade Wall Insulation Layer Material 4: Gypsum board, 5/8in
Floors: Steel-joist (§A5.3.1)	Inside Film Resistance: R=0.92 Material 1: Carpet & Rubber Pad Material 2: Concrete, 4in, 140lb Material 3: Steel Decking Material 4: Floor Insulation Layer
Slab On-Grade Floors: Unheated	Inside Film Resistance: R=0.61 Material 1: Slab-on-grade Floor Insulation Layer Material 2: Concrete, 6in, 140lb Material 3: Light, Damp Soil, 12in
Below-grade Walls	Inside Film Resistance: R=0.68 Material 1: Below-grade Wall Insulation Layer Material 2: Concrete, 6in, 140lb Material 3: Light, Damp Soil, 12in

Exterior Surfaces

Proposed building exterior and semi-exterior walls, floors and roof surfaces, as defined below, are covered by the Standard, and therefore will be revised by the rules processor to the baseline wall performance.

Exterior surfaces have the following characteristics:

- 1) Separate conditioned, indirectly conditioned, and plenum/enclosed ceiling space from the exterior.
- 2) Separate conditioned, indirectly conditioned, and plenum/enclosed ceiling space from enclosed, unconditioned space.
- 3) Separate conditioned, indirectly conditioned, and plenum/enclosed ceiling spaces from a mechanically or naturally ventilated parking garage, attic, or crawlspace.

Semi-exterior surfaces have the following characteristics:

- 1) Separate conditioned, indirectly conditioned, and plenum/enclosed ceiling space from a semiheated space.
- 2) Separate semiheated space from the exterior, unconditioned enclosed space, or a mechanically or naturally ventilated parking garage, attic, or crawlspace.

Both exterior and semi-exterior surfaces are included in calculations of the window-to-wall and skylight-to-roof ratios. All other surfaces, such as walls that separate an unconditioned, enclosed space or a parking garage, attic, or crawlspace from the exterior, are not covered by the standard, and therefore are assumed the same in both the proposed and baseline models and not included in the fenestration-to-opaque surface area ratios.

Demising partitions should not be modeled as exterior walls. The LEED rules processor assumes demising walls are modeled as interior walls. If a space should be designated as “Not Included” in the LEED analysis, the demising partitions should be modeled in the proposed building as an adiabatic partition, which will also be the assumption in the baseline building model.

Interior Surfaces

Interior walls, ceilings, and floors are generally assumed to have the same construction characteristics as the proposed building, and therefore, ignored by the rules processor. However, if an interior surface meets the conditions of being an exterior or semi-exterior surface, as identified above, the interior surface performance falls under the Standard and therefore is addressed by the rules processor in the same way as exterior surfaces. In this case, proposed building input identifying the interior surface as “Air” or “Adiabatic” are ignored, and the rules processor adjusts the baseline wall performance to be a “Standard” partition type and assigned a construction that meets the requirements for the space conditioning. Similar to exterior surfaces, interior surfaces determined to be exterior or semi-exterior are included in the fenestration-to-opaque surface area ratios.

Underground Surfaces

Underground walls and slab-on-grade floors that are attached to conditioned or semi-conditioned space are covered by the Standard. The LEED compliance tool relies on user-input to determine the appropriate heat transfer characteristics of underground surfaces.

To calculate the baseline underground surface performance, the LEED rules processor uses the convention outlined in the DOE-2.2 manual, Volume 3: Topics, UNDERGROUND-WALL and UNDERGROUND-FLOOR. This method assumes heat transfer through underground surfaces is proportional to a surface’s exposed perimeter length and a perimeter conduction factor. For slab-on grade surfaces, ASHRAE defines this perimeter heat loss factor as F-factor (Btu/hr-ft-°F). However, DOE-2.2 surface conduction algorithms assume heat transfer is proportional to a surface’s area and an area conduction factor, or U-factor (Btu/hr-ft²-°F). Therefore, adjustments to the DOE-2 surface construction U-factor are needed to obtain equivalent performance.

The inputs used for determining the baseline performance of an underground surface are:

- 1) Exposed Length (C-EXPOSED-PERIM)
- 2) Fraction Below-Grade (C-FRAC-BELOW-GRD)
- 3) Slab/Below-grade Wall F-factor (C-FFACTOR)
- 4) Below-grade Wall C-factor (C-CFACTOR)

Underground Surface Properties

Currently Active Surface: **EL1 West Wall (B.NNW4.U10)**

Basic Specifications | Daylighting - Solar

Surface Name: **EL1 West Wall (B.NNW4.U10)**
Wall

Parent Space: **EL1 NNW Perim Spc (B.NNW4)**

Construction: **EL1 UWCons (B.NNW4.U10)**

U-Effective: Btu/h-ft2-°F

Multiplier: **1**

Slab-on-Grade Exposed Perimeter: **10.00** ft

Fraction of Wall Below-Grade: **0.8000** ratio

Slab-on-Grade F-Factor: **1.94** Btu/h-ft-°F

Below-Grade Wall C-Factor: **1.14** Btu/h-ft2-°F

Location & Geometry

Location: **V1 of Space Polygon**

Polygon: **- undefined -**

X: **0.00** ft Area: **150.00** ft2

Y: **0.00** ft Height: **10.00** ft

Z: **0.00** ft Width: **15.00** ft

Azimuth: **-180.00** deg Tilt: **90.00** deg

Done

The exposed length (C-EXPOSED-PERIM) is the amount of a slab-on-grade surface perimeter that is in direct proximity to ambient conditions. The exposed length of a below-grade wall is the length of wall that is in proximity to an established grade.

The fraction below-grade (C-FRAC-BELOW-GRD) represents the fraction of a vertical underground wall height that is within 8 feet of the exterior finished ground level. Buildings with one or more underground stories often have surfaces deeper or only partly located in this region. The LEED rules processor uses the assumption that heat transfer to the surrounding earth occurs only in the first 8ft from grade. Portions of the surface located deeper than 8ft from grade are assumed more or less adiabatic. This LEED rules processor assumption is based on the available data describing the perimeter conduction factors for below-grade walls. The C-FRAC-BELOW-GRD keyword is not applicable to slab-on-grade surfaces, as its performance is assumed a function of C-EXPOSED-PERIM only.

The LEED rules processor uses the following simple rules for defaulting the C-FRAC-BELOW-GRD keyword:

- 1) If the Z coordinate of the underground surface, in the context of the building coordinate system, is greater than or equal to 0, the fraction below-grade is assumed to be 1.0.
- 2) If the Z coordinate of the underground surface, in the context of the building coordinate system, is less than 0, the fraction below-grade is calculated for each surface. All surfaces completely within 10ft of grade will have a fraction of 1.0, with the fraction decreasing as a larger portion of the wall height is deeper than 10ft.

The fraction below grade is a valid input for vertical underground walls and is used to determine the appropriate perimeter heat loss coefficient. ASHRAE Standards stipulate below-grade wall performance in terms of C-factor, which is similar to a U-factor for above-grade walls, except it does not include interior or exterior air or soil film resistances. The C-factor is based on a specific R-value of continuous interior or exterior insulation. In turn, the DOE2.2 Topics section, referenced above, lists perimeter heat loss values for 2, 4 and 8ft deep below-grade walls with varying levels of continuous, exterior wall insulation. The LEED rules processor uses the exposed underground wall height (C-FRAC-BELOW-GRD times the wall HEIGHT), as well as the insulation level corresponding to the required C-factor, to look-up, interpolating if necessary, the resulting perimeter heat loss factor for each vertical, underground wall.

In the case an underground wall's parent space conditioning exempts it from the Standard, the exposed perimeter length and fraction below-grade inputs are not used, and the baseline underground wall construction performance will be the same as the proposed.

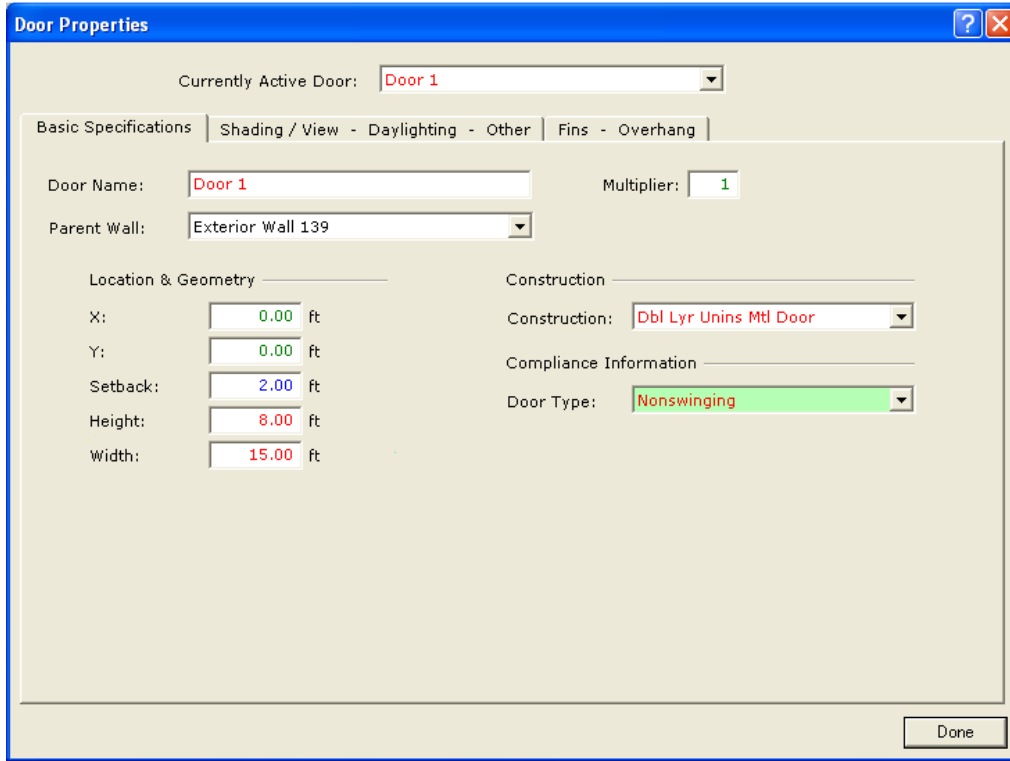
The rules processor defaults the C-EXPOSED-PERIM keyword of a slab-on-grade surface to be the sum of the exterior walls attached to the space. For below-grade walls greater than or equal to 8ft in the context of the building coordinate system, the default value is the WIDTH of the wall. For walls covered by the Standard, the user can manually define both the exposed length and fraction below-grade to suit exceptional modeling conditions. Specifying either C-EXPOSED-PERIM or FRAC-BELOW-GRD to zero indicates the underground surface is more or less adiabatic.

The Underground Surface Properties dialog displays the user inputs for exposed perimeter and fraction below-grade describe above. The dialog also displays the relevant baseline requirements for slab-on-grade F-factor and below-grade wall C-factor, as determined by the rules processor. The rules processor calculates the perimeter heat loss factor for below-grade walls, and displays this value in the slab/wall F-factor box. The below-grade wall C-factor and slab-on-grade/below-grade wall F-factor cannot be modified by the user, as they are dependent other predefined information, mainly climate zone, surface orientation, and space conditioning. If the fraction below-grade of an underground wall is changed, the rules processor will automatically adjust the calculated perimeter heat loss factor using the new exposed wall height.

Exterior Doors

Proposed building doors attached to exterior and semi-exterior walls, floors and roof surfaces, are defined below, are covered by the Standard, and therefore will be revised by the rules processor to the baseline door performance. For each door component, the user should specify the C- TYPE keyword to the available classifications:

- 1) Swinging (default)
- 2) Non-swinging



In addition to modifying the construction to meet the baseline door performance requirements, the LEED rules processor revises all of the proposed DOOR setbacks, overhangs, and vertical fins to the DOE-2 default values.

Step 5: Specify Fenestration Characteristics

Fenestration products are created as “children” of either exterior wall or exterior roof components. Windows and skylights both appear in the detailed interface as child components to exterior walls (for windows) and roofs (for skylights). Each WINDOW component typically references a GLASS-TYPE component that describes the construction and thermal characteristics of the glass used in the fenestration assembly. Additionally, each WINDOW component has several of its own unique characteristics. It is important to remember that GLASS-TYPE properties apply to any window that references the Glass Type (a one-to-many relationship) while WINDOW properties apply only to individual window components (a one-to-one relationship).

Glass Type Components

The primary methods for simulating solar and thermal transmission through fenestration use the following DOE-2.2 Glass Type specifications:

1. GLASS-TYPE-CODE or Glass Library method, where the user selects a fenestration product from an existing library of fenestration products. This code represents a data file that defines coefficients for glass performance based on weather data file parameters including solar angle of incidence, wind speed, incident direct and diffuse solar radiation and indoor and outdoor temperatures.
2. SHADING-COEF or Simplified method, where the user specifies glass conductance, shading-coefficient, and visible transmission of the glazing. These inputs can represent the entire fenestration product or glass only, and solar transmission properties are assumed for normal incident angles.

For LEED Compliance Analysis, the Simplified method is used to simulate the baseline thermal performance of glazing. Moreover, the baseline fenestration performance is for the entire assembly, glass plus frame. The rules processor will not modify the proposed building input, however it is strongly suggested that the user specify the proposed building fenestration performance be simulated using the Simplified method as well. This suggestion is based on ASHRAE and LEED guidelines for fenestration performance to be determined using NFRC test methods. The specific NFRC test methods quantify performance in the same context as the Simplified method. Using the same method for both the proposed and baseline building models will provide for a fair performance rating comparison. For additional information regarding the fundamental differences between the Glass Library and Simplified methods, please consult the “eQUEST Modeling Procedure Quick Reference Guide”.

The LEED rules processor will create Glass Types using the Simplified method and the following proposed building inputs:

- 1) Product Type (C-901-PROD-TYPE)
- 2) Frame Type (C-901-FRAME-TYPE)

In the case that the product type is one of three designations for skylights, the frame type designation is not used. The baseline fenestration performance indicated by the Standard are listed in terms of U-factor (U) and solar heat gain coefficient (SHGC). These values are converted to the following DOE-2.2 inputs for glass conductance (GC) and shading coefficient (SC):

$$GC = \frac{1}{\left(\left(\frac{1}{U}\right) - R\right)}$$

$$SC = \frac{SHGC}{0.86}$$

where:

- i. R is the exterior film coefficient, assumed to be 0.17 hr-ft²-°F/Btu. The GC adjustment for exterior film coefficient accounts for calculation of the exterior film coefficient by the DOE-2.2 simulation engine based on the hourly wind speed.
- ii. The conversion of SHGC to SC is based on the method prescribed in Section 5.8.2.5 exception a) of the Standard.

Similar to the space conditioning and occupancy inputs listed above, the rules processor will recognize analogous T24 Compliance Analysis inputs for GLASS-TYPE and default the product type and frame type. Table 3 lists the analogous keywords, while the default relationships are listed in Appendix A.

Table 3. Analogous LEED and T24 Compliance Analysis Keywords for WINDOW command.

LEED Compliance Keyword	T24 Compliance Keyword
C-901-PROD-TYPE	C-PRODUCT-TYPE
C-901-FRAME-TYPE	C-FRAME-TYPE

Window Components

Each proposed building WINDOW component requires the same product type and frame type inputs as glass types, discussed above. The required keywords are the same listed for the glass types.

The screenshot shows the 'Window Properties' dialog box with the following settings:

- Currently Active Window: Window 46
- Basic Specs:
 - Window Name: Window 46
 - Parent Wall: Exterior Wall 139
 - Type of Window: Standard Window
 - Multiplier: 1
 - Diffusing: No
- Location & Geometry:
 - X: 20.00 ft
 - Y: 1.00 ft
 - Setback: 1.00 ft
 - Height: 6.00 ft
 - Width: 30.00 ft
- Window Frame:
 - Frame Width: 0.00 ft
 - Conductance: 2.781 Btu/h-ft²-°F
 - Absorptance: 0.700
 - Spacer Type: Aluminum
- Window Glass/Layers:
 - Specification Method: Composite
 - Type of Glass: EL1 Window Type #1
- Product Type: Vertical Glazing
- Frame Type: Nonmetal framing, all

Typically, proposed building WINDOW components (including glass doors and skylights) will be specified using the GLASS-TYPE-INPUT method. In this case, each WINDOW requires definition of a GLASS-TYPE. The WINDOW component C-901-PROD-TYPE and C-901-FRAME-TYPE will default to the values of the specified GLASS-TYPE. However, if the GLASS-TYPE method is not specified or the proposed window GLASS-TYPE = GLASS-TYPE-CODE, these inputs can be specified or defaulted for each WINDOW component as well. Again, if T24 Compliance Analysis keywords are user input or defaulted, the LEED Compliance Analysis keywords will be defaulted similar to GLASS-TYPE components.

However, the available WINDOW component inputs are dependent on the orientation of the WINDOW. That is, WINDOWs attached to above-grade walls can only have a product type of “Vertical Glazing”, while skylight can only have one of three relevant product types. Similar to GLASS-TYPEs, if the WINDOW product type designation one of three available for skylights, the frame type designation is not used.

Fenestration and Building Surface Areas

During execution, the LEED rules processor calculates the total window/wall and skylight/roof areas for all spaces covered by the Standard (nonresidential, residential, and semiheated). Using these values, a window-to-wall ratio ($WWR = \text{total vertical fenestration area} / \text{total vertical wall area}$) and skylight-to-roof ratio ($SRR = \text{total roof fenestration area} / \text{total roof area}$) are calculated for the entire project. The project WWR and SRR are used, in addition to the WINDOW product type and space type designations to determine the baseline fenestration performance.

The baseline fenestration inputs for HEIGHT and WIDTH are adjusted to include any proposed window frame dimensions (FRAME-WIDTH). In the event the proposed building WWR exceeds 40% and/or the SRR exceeds 5%, the baseline fenestration valued of HEIGHT is adjusted to meet these Appendix G allowances for fenestration area.

Fenestration Shading

Similar to doors, the LEED rules processor revises all of the proposed WINDOW setbacks, overhangs, and vertical fins to the DOE-2 default values. The rules processor also re-defaults any input for interior/exterior, moveable/fixed shading or insulating window devices.

Step 6: Lighting

Interior Lighting

There are currently no specific additional inputs required for the LEED rules processor to calculate the baseline lighting allowance for each space. The current LEED compliance tool only supports the Lighting Data Input Method for Power Definition (SPACE:LTG-SPEC-METHOD = POWER-DEFINITION). This section describes how the rules processor uses the inputs for this method and space occupancy to calculate the overall space lighting power density (LPD) and schedules.

The LEED rules processor currently utilizes the Space-by-Space lighting compliance path, described in Section 9.6 of the Standard, to determine the baseline building lighting allowance. This compliance path details lighting power allowances for specific space types. The list of space types is broken down into two primary categories: common and building-specific. As mentioned in Step 3, the LEED rules processor uses the designated building type for the space (SPACE:C-901-BLDG-TYPE) to determine which sub-occupancy types (with corresponding area fractions) can be designated within each space. In general, up to 10 sub-occupancies per space are allowed, and all common space types listing in Table 9.6.1 can be specified for the “Nonresidential” spaces. However, only the relevant building specific space types are available for the designated space building type. See Step 3 for further detail on space building type, schedule type, and occupancy.

Once the space sub-occupancies have been defined, the rules processor will calculate the total baseline lighting power for the space by multiplying the LPD for each sub-occupancy type times the corresponding sub-area. If the proposed building utilizes more than one of the five general lighting and one task lighting schedules, the rules processor will use the same lighting power schedule proportions to divide the baseline lighting power among each defined schedule. The baseline lighting power will be defined as a power density (W/sf), and proposed user inputs for schedules or lighting type related keywords, such as LIGHT-TO-SPACE, LIGHT-TO-RETURN, etc, are assumed the same for the baseline building.

The rules processor currently has basic capabilities to address special lighting controls. The 90.1-2007 Standard or Appendix G does not require the baseline building to have daylighting controls. Therefore, if daylighting controls are present in the proposed building, the rules processor will disable them by simply changing the SPACE:DAYLIGHTING keyword to “NO”. The Standard does have occupancy sensor control requirements for a few particular space types, identified in Section 9.6.1.2 a). However, the current LEED compliance tool does not have capability to adjust the lighting power or schedule for required or non-required occupancy controls simulated in the proposed building model. Finally, no capabilities exist for defining additional interior lighting power allowances, discussed in Section 9.6.2 of the Standard.

Exterior Lighting

The current LEED rules processor currently has no capabilities for determining the baseline exterior lighting allowance. Therefore, if the user has defined exterior lighting power in some way, no adjustments will be made the user’s input.

Step 7: Additional LEED Compliance Analysis Inputs

There currently are no capabilities in the LEED Compliance tool to manipulate the proposed building input for the following:

- Number of occupants in spaces or loads originating from people
- Equipment or internal energy source loads and schedules
- Infiltration rates
- HVAC and central plant systems and controls

In the context of a LEED-NC v3.0 performance rating analysis, the majority of these inputs are typically assumed the same for both the proposed and baseline models. One major limitation of the current LEED rules processor is the ability to create the appropriate HVAC and central plant components for the baseline building model. Future improvements to the LEED rules processor are planned to address these limitations, at least in incremental improvements. However, for now, the user is required to complete these tasks for creating the LEED baseline building model.

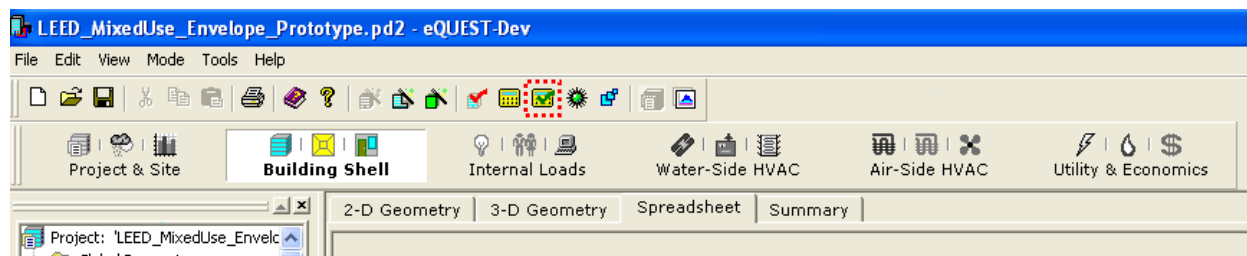
Step 8: HVAC and Central Plant Inputs

There currently are no capabilities in the LEED Compliance tool to manipulate the proposed building input for the following:

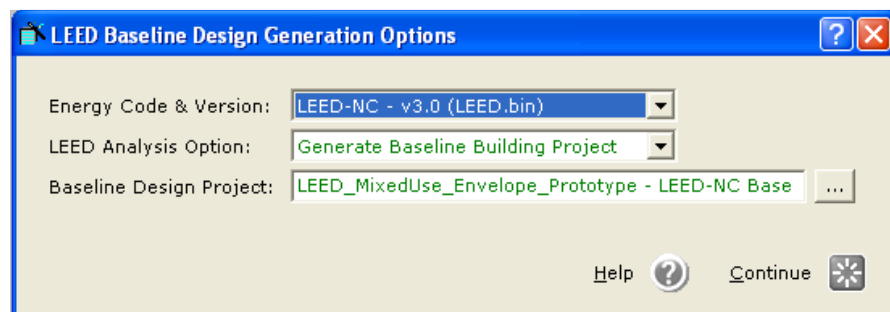
Step 9: Executing the LEED Compliance Analysis Processor

Once the required inputs have been entered, the LEED rules processor can be executed to generate the baseline building project. As indicated in the Introduction, the scope of LEED Compliance Analysis tool capabilities for converting the proposed project to the baseline performance is limited to basic loads and HVAC properties.

Provided the LEED ruleset is specified for the “Energy Code and Version” (see Step 1), the LEED rules processor can be initiated by pressing the “Perform Compliance Analysis” toolbar button or selecting this option from eQUEST -> Tools menu.



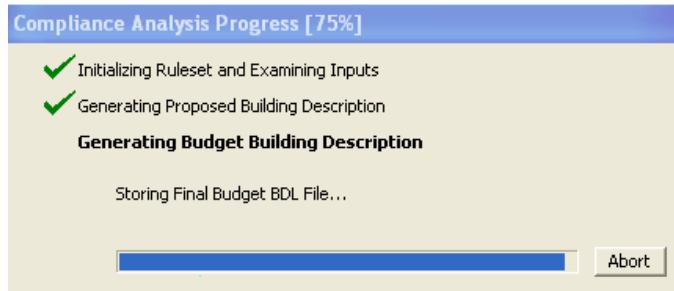
Once selected, the “LEED Baseline Design Generation Options” dialog window will appear.



The dialog will display the Compliance Analysis ruleset defined for the project (reference only), the analysis option, as well as a default baseline project file name. Currently, the “Generate Baseline Building Project” is the only analysis option is available. The baseline project name is the name and file location for a new eQUEST project that will be created for the baseline building. The project file name is defaulted to be the *CurrentProjectName* + “- LEED-NC Base Bldg”, and the default file location for the new baseline project is the proposed building project directory. Selecting the Browse button enables the user to define an alternate baseline project file name and/or directory.

Once the options above have been defined, select the “Continue” button to proceed. If a project with the same file path is already present, the user will be prompted to overwrite or select another project file name/location.

During the LEED rules processor execution, an “Initializing Ruleset and Examining Inputs” and “Generating the Budget Building Description” steps will be performed. An interim step, “Generating Proposed Building Description” is listed, however, currently, no action occurs in this step.



Finally, once the baseline building project has been created, the user will be presented with a list follow-up file options.

Envelope Commands and Keywords

This section lists the enhancements to the envelope description (LOADS) portion of DOE-2.2. The following commands have compliance analysis keywords:

COMPLIANCE

The COMPLIANCE command has been added to enable compliance analysis with DOE-2.2. All keywords of this command are intended for storage information that is pertinent to the compliance analysis. These keywords are referenced by the rules processor during compliance analysis. The COMPLIANCE command includes the following keywords:

C-901-BLDG-TYPE

An integer representing the primary ASHRAE building for the analysis. The available building types correspond to those listed in Table 9.5.1 of the Standard. This is a required input with a default value of “undefined”. Valid inputs are given in the following table:

Value	Building Type	Value	Building Type
0	- Undefined -	23	Retail
1	Automotive Facility	24	School/University
2	Convention Center	25	Sports Arena
3	Courthouse	26	Town Hall
4	Dining: Bar Lounge/Leisure	27	Transportation
5	Dining: Cafeteria/Fast Food	28	Warehouse
6	Dining: Family	29	Workshop Bldg
7	Exercise Center	30	Dormitory
8	Gymnasium	31	Hotel
9	Healthcare-Clinic	32	Motel
10	Hospital	33	Multi-Family
11	Library		
12	Manufacturing Facility		
13	Motion Picture Theater		
14	Museum		
15	Office		
16	Parking Garage		
17	Penitentiary		
18	Performing Arts Theater		
19	Police Station		
20	Fire Station		
21	Post Office		
22	Religious Building		

C-901-NUMFLRS (Beta version only)

An integer representing the total number of floors (above and below-grade) of the proposed building with conditioned space. This input is required. The default value, calculated by the ruleset, according to the following equation:

INSERT EQUATION HERE

C-HTG-SYS-CLASS (Beta version only)

An integer representing the predominant heating energy source of the proposed building. This input is required with a default value is “Electric and Other”. Valid inputs are given in the following table:

Value	Heat Source
0	- Undefined -
1	Fossil Fuel, Fossil/Electric Hybrid, or Purchased Heat
2	Electric and Other

SITE-PARAMETERS

The following compliance analysis keywords are available in the SITE-PARAMETERS command:

C-COUNTRY

For LEED Compliance Analysis, this keyword automatically is set to “United States & Territories” by the rules processor. This is currently the only country for which states/provinces and locations have been defined. For locations outside the US, specify “International”. In this case, C-901-CZ-NUMBER and C-901-CZ-LETTER, listed below, are required inputs with no default. Future enhancements to the LEED Compliance Analysis will strive to expand the site parameters database for international locations.

C-STATE

For LEED Compliance Analysis, the state or province in which the proposed building project is located. The available values are given in the following table:

Value	State	Value	State	Value	State
1	Alabama	18	Louisiana	36	Oklahoma
2	Alaska	19	Maine	37	Oregon
3	Arizona	20	Maryland	38	Pennsylvania
4	Arkansas	21	Massachusetts	39	Rhode Island
5	California	22	Michigan	40	South Carolina
6	Colorado	23	Minnesota	41	South Dakota
7	Connecticut	24	Mississippi	42	Tennessee
8	Delaware	25	Missouri	43	Texas
9	Florida	26	Montana	44	Utah
10	Georgia	27	Nebraska	45	Vermont
11	Hawaii	28	Nevada	46	Virginia
12	Idaho	29	New Hampshire	47	Washington
13	Illinois	30	New Jersey	48	West Virginia
14	Indiana	31	New Mexico	49	Wisconsin
15	Iowa	32	New York	50	Wyoming
16	Kansas	33	North Carolina	51	Puerto Rico
17	Kentucky	34	North Dakota	52	Virgin Islands
		35	Ohio	53	Pacific Islands
				54	District of Columbia

C-LOCATION

Represents the city where the project is located. This is a required input with no default. The available values for this keyword are dependent on the state defined for the analysis (C-STATE), described above

C-901-CZ-NUMBER

Represents the ASHRAE climate zone designation for C-LOCATION. For US locations, this value is automatically determined by the rules processor per based on the C-LOCATION county. For C-COUNTRY = “International or User-defined”, this keyword value is required with no default. Future enhancements to the LEED Compliance Analysis will strive to expand the climate zone database for international locations. For “United States & Territories”, these keywords, as well as C-WEATHER-FILE, are set according to the following table:

C-901-CZ-LETTER

Represents the ASHRAE major climate type designations for C-LOCATION. This value is not an input for US locations, rather is instead automatically is determined by the rules processor per based on the C-LOCATION county and per Table B-1 of the Standard. For C-COUNTRY = “International”, this keyword value is required with no default. Future enhancements to the LEED Compliance Analysis will strive to expand the climate zone database for international locations. For “United States & Territories”, this keyword, as well as C-WEATHER-FILE, are set according to the following table:

C-WEATHER-FILE

Represents the Typical Meteorological Year (TMY2) weather data file for C-LOCATION. This is a required keyword, and is not updated if the user modifies the project location via C-COUNTRY, C-STATE, or C-LOCATION. Future enhancements to the LEED Compliance Analysis will strive to expand the climate zone database for international locations. For “United States & Territories”, this value is set according to the table listed for C-LOCATION.

FLOOR

The following compliance analysis keywords are available in the FLOOR command:

C-901-BLDG-TYPE

An integer representing the primary ASHRAE building type for the current FLOOR command. This keyword is defaulted by and has the same valid values as the COMPLIANCE command version of this keyword. This keyword is used to default all the child SPACE command version of this keyword for all child spaces of the floor. Valid inputs for this keyword are listed in the table provided for this keyword in the COMPLIANCE command section.

C-HTG-SYS-CLASS (Beta version only)

An integer representing the predominant heating energy source of the proposed building. This keyword is defaulted by and has the same valid values as the COMPLIANCE command version of this keyword. This keyword is used to default all the child SPACE command version of this keyword for all child spaces of the floor. Valid inputs for this keyword are listed in the table provided for this keyword in the COMPLIANCE command section.

SPACE

The following compliance analysis keywords are available in the SPACE command:

C-901-SCH-TYPE

An integer representing the occupancy schedule type for the space. This is an integer symbol input with a value of 1, representing “Nonresidential”. Valid inputs are given in the following table:

Value	Schedule Type
1	"Nonresidential"
2	"Residential"

C-901-CONDITION

An integer representing the type of space conditioning according to definitions in Chapter 3 of the Standard. This is an integer symbol input, whose value is default based on either the T24 Compliance Analysis keyword C-CONDITIONING, or a combination of DOE-2 SPACE keywords ZONE-TYPE and Z. Valid inputs are given in the following table:

Value	Type of Conditioning
0	"Not Included"
1	"Conditioned -or- Indirectly Conditioned"
2	"Plenum -or- Enclosed Ceiling"
3	"Semiheated"
4	"Unconditioned, Enclosed"
5	"Ventilated Parking/Crawl/Attic"

C-901-BLDG-TYPE

An integer representing the primary ASHRAE building for the analysis, with the same valid values as the FLOOR and COMPLIANCE command versions of this keyword. The SPACE command keyword defaults to the parent FLOOR command keyword. The SPACE command keyword, along with the SPACE command keyword C-901-SCH-TYPE, ultimately determines the valid symbol values for the C-901-OCC-TYPE keyword. Valid inputs are listed in the table provided for this keyword in the COMPLIANCE command section.

C-901-OCC-TYPE

An integer value representing the occupancy type of the corresponding C-SUB-AREA. The available space types correspond to those listed in Table 9.6.1 of the Standard. If any elements of C-SUB-AREA are greater than zero, then values must be input for corresponding elements in C-901-OCC-TYPE. If no elements of C-SUB-AREA are input, then only the first element of C-901-OCC-TYPE must be entered and is assumed to represent the occupancy type for the entire space. If T24 Compliance Analysis values for the C-OCC-TYPE keyword are defined in the input file, a DOE-2 default will set this keyword value based on the T24 to 90.1 occupancy type mapping table listed in [Appendix A](#). The valid inputs are dependent on the value of both C-901-SCH-TYPE and C-901-BLDG-TYPE, as defined by the matrix below. Please note that unlike the T24 methodology, ASHRAE Appendix G prescribes residential spaces to be modeled as a separate thermal spaces. Therefore, if C-901-SCH-TYPE = “Residential”, only residential defined C-901-OCC-TYPE values are valid and all other C-OCC-TYPE values will be reset to “Living Spaces”.

C-SUB-AREA

A list of up to ten values representing individual activity areas in the SPACE command. There are no defaults for this ten element keyword, however, the rules processor will produce errors if the sum of the values entered for this keyword does not equal the value input for the standard DOE-2 keyword AREA. The sum of all elements of this keyword must be equal to any user input value for AREA or C-AREA.

C-HTG-SYS-CLASS (Beta version only)

An integer representing the heating energy source of the proposed building space. This keyword is defaulted by and has the same valid values as the parent FLOOR command version of this keyword. Valid inputs for this keyword are listed in the table provided for this keyword in the COMPLIANCE command section.

C-SYS-EXCEPTION1 (Beta version only)

This keyword designates if the parent space and related thermal zone fall under any of the applicable HVAC baseline system exceptions listed in G3.1.1. This keyword is required and defaults to the value for “No Exception”. Valid inputs are given in the following table:

Value	Baseline System Exceptions
0	"No Exception"
1	"a) Non-predominant conditions"
2	"b) Significantly different occupancy/loads"
3	"c) Pressurization/cross-contamination"
4	"d) Laboratory spaces >5000cfm exhaust"

C-SYS-EXCEPTION2 (Future version only)

This keyword designates if the parent space and related thermal zone fall under any of the applicable exceptions to the baseline economizer requirement exceptions listed in G3.1.2.6. This keyword is required and defaults to the value for “No Exception”. Valid inputs are given in the following table:

Value	Baseline Economizer Exceptions
0	"No Exception"
1	"a) Gas phase air-cleaning"
2	"b) Supermarket casework"

C-SYS-EXCEPTION3 (Future version only)

This keyword designates if the parent space and related thermal zone falls under any of the applicable exceptions to the baseline heat recovery requirement exceptions listed in G3.1.2.6. This keyword is required and defaults to the value for “No Exception”. Valid inputs are given in the following table:

Value	Baseline Economizer Exceptions
0	"No Exception"
1	"a) No cooling, heating to <60F"
2	"b) Exhaust toxics/flamables/corrosives"
3	"c) Commercial kitchen grease hood"
4	"d) Heating systems in CZ 1-3"
5	"e) Cooling systems in CZ 3c, 4c, 5b, 5c, 6b, 7 & 8"
7	"f) Largest exhaust source is <75% of design OA flow"
8	"g) Dehumidification device"
9	"h) Laboratory systems >5000cfm"

Table 4. List of Space-by-Space occupancy types (C-901-OCC-TYPE) by building type (C-901-BLDG-TYPE).

C-901-SCH-TYPE	Occupancy Type	Value	C-901-BLDG-TYPE Value																																		
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
Nonresidential	Office - Enclosed	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Office - Open Plan	2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Conference/Meeting/Multipurpose	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Classroom/Lecture/Training	4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Lobby	5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Audience/Seating Area	6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Atrium-first three floors	7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Atrium-each additional floors	8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Lounge/Recreation	9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Dining Area	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Food Preparation	11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Nonresidential	Laboratory	12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Restrooms	13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Dressing/Locker/Fitting Room	14	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Corridor/Transition	15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Stairs-active	16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Active Storage	17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Inactive Storage	18	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Electrical/Mechanical	19	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Workshop	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Sales Area	21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nonresidential	Playing Area	22	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Exercise Area	23	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Audience/Seating Area (gymnasium)	24	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Audience/Seating Area (exercise center)	25	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Playing Area	26	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Exercise Area	27	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Courtroom	28	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Confinement Cells	29	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Judges Chambers	30	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Courtroom	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Confinement Cells	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Judges Chambers	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Dining Area (penitentiary)	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Classroom/Lecture/Training (penitentiary)	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Audience/Seating Area (penitentiary)	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Courtroom	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Confinement Cells	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Judges Chambers	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Engine Room	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	
Residential	Sleeping Quarters	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Sorting Area	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Exhibit Space	43	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Audience/Seating Area (convention center)	44	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Card File & Cataloging	45	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Stacks	46	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Reading Area	47	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Lounge/Recreation (hospital)	48	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Corridor/Transition (hospital)	49	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	Active Storage (hospital)	50	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Table 4 – cont'd. List of Space-by-Space occupancy types (C-901-OCC-TYPE) by building type (C-901-BLDG-TYPE).

Schedule Type	Occupancy Type	Value	C-901-BLDG-TYPE Value																																	
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Nonresidential	Emergency	51	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Recovery	52	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Nurse Station	53	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Exam/Treatment	54	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Pharmacy	55	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Patient Room	56	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Operating Room	57	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Nursery	58	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Medical Supply	59	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Physical Therapy	60	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Radiology	61	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Laundry-Washing	62	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Service/Repair	63	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Corridor/Transition (manufacturing facility)	64	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Low Bay Manufacturing (<25ft)	65	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	High Bay Manufacturing (≥ 25ft)	66	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Detailed Manufacturing	67	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Equipment Room	68	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Control Room	69	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Lobby (hotel)	70	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Nonresidential	Dining Area (hotel)	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	
Residential	Guest Rooms	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	
Nonresidential	Lobby (motel)	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Nonresidential	Dining Area (motel)	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Residential	Guest Rooms	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Residential	Living Quarters	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	
Nonresidential	Inactive Storage (museum)	77	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nonresidential	General Exhibition	78	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Restoration	79	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Banking Activity Area	80	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Audience/Seating Area (religious building)	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Worship-pulpit, choir	82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Fellowship Hall	83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Mall Concourse	84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Audience/Seating Area (sports arena)	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Ring Sports Area	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Court Sports Area	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Indoor Plying Field Area	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Fine Material Storage	89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Nonresidential	Medium/Bulky Material Storage	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Nonresidential	Garage Area	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Nonresidential	Audience/Seating Area (transportation)	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Nonresidential	Airport - Concourse	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Nonresidential	Air/Train/Bus - Baggage Area	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Nonresidential	Terminal - Ticket Counter	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Nonresidential	Lobby (performing arts theatre)	96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Audience/Seating Area (performing arts theatre)	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Nonresidential	Lobby (motion picture theatre)	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Nonresidential	Audience/Seating Area (motion picture theatre)	99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Nonresidential	Dining Area (bar lounge/leisure dining)	100	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nonresidential	Dining Area (family dining)	101	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residential	Living Spaces	102	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X

EXTERIOR-WALL

The following compliance analysis keywords are available in the EXTERIOR-WALL command:

C-SKYLIGHT-ROOF

Flag indicating whether or not the EXTERIOR-WALL is defined simply to facilitate the modeling of skylights above a space that is located below a plenum. The default value will be set to 1 if the wall has the tilt of a roof ($-60^\circ \leq \text{tilt} \leq 60^\circ$) and the assigned construction is defined with simplified properties with a U-value of < 0.0011 .

UNDERGROUND-WALL

The following compliance analysis keywords are available in the UNDERGROUND-WALL command:

C-EXPOSED-PERIM

Length in feet of exposed slab perimeter or underground wall that is within 8' of established grade.

C-FRAC-BELOW-GRD

Decimal fraction of vertical underground wall height that is within 8' of established grade.

C-FFACTOR

F-Factor (Btu/hr-ft-°F) performance of the baseline underground floor or wall.

C-CFACTOR

C-Factor (Btu/hr-ft²-°F) performance of the baseline underground wall.

GLASS-TYPE

The following compliance analysis keywords are available in the GLASS-TYPE command:

All of the following compliance analysis keywords in the GLASS-TYPE command have default values, and out of range inputs will yield errors in BDL processing. However, similar to the T24 rules processor, the LEED rules processor only references these values under certain conditions (inputs for compliance analysis keywords in the WINDOW command). Refer to the WINDOW command for further discussion of when compliance analysis keywords in the GLASS-TYPE command are utilized.

C-901-PROD-TYPE

The product type as needed to determine the baseline U-factor and SHGC. If T24 Compliance Analysis values for the C-PRODUCT-TYPE keyword are defined in the input file, a DOE-2 default will set this keyword value based on the T24 to 90.1 occupancy type mapping table listed in Appendix A. Valid inputs are listed in the following table:

Value	Product Type
1	"Vertical Glazing"
2	"Skylight w/ Curb, Glass"
3	"Skylight w/ Curb, Plastic"
4	"Skylight w/o Curb, All"

C-901-FRAME-TYPE

The type of fenestration framing for the GLASS-TYPE. This input is also needed to determine the baseline U-factor and SHGC performance. If T24 Compliance Analysis values for the C-PRODUCT-TYPE keyword are defined in the input file, a DOE-2 default will set this keyword value based on the T24 to 90.1 occupancy type mapping table listed in Appendix A. Valid inputs for this keyword are given in the following table:

Value	Type of Fenestration Frame
1	"Nonmetal framing, all"
2	"Metal framing, curtainwall/storefront"
3	"Metal framing, entrance door"
4	"Metal framing, all other"

WINDOW

The following compliance analysis keywords are available in the WINDOW command:

C-901-PROD-TYPE

The product type is one of two values used needed to determine the baseline U-factor and SHGC performance. In the absence of user input this value will default to the value of the same keyword value of the referenced GLASS-TYPE command. If C-901-PROD-TYPE is not defined and T24 Compliance Analysis values for the C-PRODUCT-TYPE keyword are defined in the input file, a DOE-2 default will set this keyword value based on the T24 to 90.1 occupancy type mapping table listed in Appendix A. Valid inputs are listed in the following table:

Value	Product Type
1	"Vertical Glazing"
2	"Skylight w/ Curb, Glass"
3	"Skylight w/ Curb, Plastic"
4	"Skylight w/o Curb, All"

C-901-FRAME-TYPE

The type of fenestration framing for the GLASS-TYPE. This input is also needed to determine the baseline U-factor and SHGC performance. In the absence of user input this value will default to the value of the same keyword value of the referenced GLASS-TYPE command. If C-901-FRAME-TYPE is not defined and T24 Compliance

Analysis values for the C-FRAME-TYPE keyword are defined in the input file, a DOE-2 default will set this keyword value based on the T24 to 90.1 occupancy type mapping table listed in Appendix A. Valid inputs for this keyword are given in the following table:

Value	Type of Fenestration Frame
1	"Nonmetal framing, all"
2	"Metal framing, curtainwall/storefront"
3	"Metal framing, entrance door"
4	"Metal framing, all other"

HVAC Commands and Keywords

This section lists the enhancements to the HVAC equipment (SYSTEMS and PLANT) portion of DOE-2.2. The following commands have compliance analysis keywords:

SYSTEM

At this time, there are no unique HVAC system and central plant properties or methods. The LEED compliance analysis rules process is capable of converting user created HVAC systems and plants to Appendix G baselines using inputs from the loads sections. Please note that the compliance analysis will not automatically size baseline systems so a large portion of the analysis still must be performed manually by the user, including:

- Calculating HVAC fan system power
- Determining requirements for baseline heat recovery on high outside air systems
- Calculating capacities of central plant equipment such as boilers and chillers



Title 24 to LEED Keyword Defaulting Reference Tables

The following tables display the BDL defaulting relationships for the similar T24 and LEED Compliance Analysis keywords. The default relationships are intended to save time for users of both the eQUEST T24 and LEED Compliance Analysis tools, by establishing definitions of similar keywords in both analysis paths. However, given some inherent differences between the Standards, these default relationships are not expected to provide exact translations, and therefore, all default input should be reviewed by the user for accuracy.

C-CONDITIONING Symbol	CEC T24-2008 Compliance Analysis Ruleset (C-CONDITIONING)	LEED-NC v3.0 Compliance Analysis Ruleset (C-901-CONDITION)	C-901-CONDITION Symbol
0	Conditioned	Conditioned -or- Indirectly Conditioned	1
2	Indirectly Conditioned-Occupied	Conditioned -or- Indirectly Conditioned	1
3	Indirectly Conditioned-Unoccupied	SPACE:Z > 0: Plenum -or- Enclosed Ceiling	2
4	Unconditioned	SPACE:Z ≤ 0: Conditioned -or- Indirectly Conditioned	1
5	Plenum	Unconditioned, Enclosed	4
		Plenum -or- Enclosed Ceiling	2

C-SCHEDULE-TYPE	CEC T24-2008 Compliance Analysis Ruleset (C-SCHEDULE-TYPE)	LEED-NC v3.0 Compliance Analysis Ruleset (C-901-SCH-TYPE)	C-901-SCH-TYPE
0	Nonresidential	Nonresidential	1
1	Hotel Function	Nonresidential	1
2	Hotel Guest Room	Residential	2
3	Residential	Residential	1
4	Retail	Nonresidential	4

C-OCC-TYPE Symbol	CEC T24-2008 Compliance Analysis Ruleset (C-OCC-TYPE)	LEED-NC v3.0 Compliance Analysis Ruleset (C-901-OCC-TYPE)	C-901-OCC-TYPE Symbol
46	Atrium	Atrium-first three floors	7
2	Auditorium	Audience/Seating Area	6
3	Auto Repair	Service/Repair	63
4	Financial Transaction	Banking Activity Area	80
5	Bar, Cocktail Lounge and Casino	Dining Area (bar lounge/leisure dining)	100
6	Beauty Salon	Sales Area	21
7	Classrooms, Lecture, Training, Vocational Room	Classroom/Lecture/Training	4
8	Commercial and Industrial Storage (conditioned or unconditioned)	Active Storage	17
47	Commercial and Industrial Storage (refrigerated)	Inactive Storage	18
9	General Commercial and Industrial Work, High Bay	High Bay Manufacturing (≥25ft)	66
10	General Commercial and Industrial Work, Low Bay	Low Bay Manufacturing (<25ft)	65
11	General Commercial and Industrial Work, Precision	Detailed Manufacturing	67
12	Convention, Conference, Multipurpose, and Meeting Centers	Conference/Meeting/Multipurpose	3
13	Corridors, Restrooms, Stairs, and Support Areas	Corridor/Transition	15
14	Civic Meeting Place	Courtroom	28
15	Dining	Dining Area	10
16	Dry Cleaning (Coin Operated)	Sales Area	21
17	Dry Cleaning (Full Service Commercial)	Sales Area	21
18	Electrical, Mechanical, Telephone Room	Electrical/Mechanical	19
19	Exercise Center, Gymnasium	Exercise Area	23
20	Exhibit, Museum	General Exhibition	78
21	Grocery Sales	Sales Area	21
22	High-Rise Residential Living Spaces	Living Spaces	102
23	Hotel Function Area	Conference/Meeting/Multipurpose	3
24	Hotel/Motel Guest Room	Guest Rooms	72
51	Hotel/Motel Hallways	Corridor/Transition	15
44	Housing, Public and Commons Areas: Multi-family	Corridor/Transition	15
45	Housing, Public and Common Areas: Dormitory, Senior Housing	Living Quarters	76
25	Kitchen, Food Preparation	Food Preparation	11
48	Laboratory, Scientific	Laboratory	12
26	Laundry	Laundry-Washing	62
27	Library, Reading Areas	Reading Area	47
28	Library, Stacks	Stacks	46
29	Lobby, Hotel	Lobby (hotel)	70
30	Lobby, Main Entry	Lobby	5
32	Locker/Dressing Room	Dressing/Locker/Fitting Room	14
33	Mall	Mall Concourse	84
34	Medical and Clinical Care	Exam/Treatment	54
35	Office (Greater than 250 square feet in floor area)	Office - Open Plan	2
49	Office (250 square feet in floor area or less)	Office - Enclosed	1
36	Police Station and Fire Station	Engine Room	40
37	Religious Worship	Audience/Seating Area (religious building)	81
38	Retail Merchandise Sales, Wholesale Showroom	Sales Area	21
39	Lounge, Recreation	Lounge/Recreation	9
50	Tenant Lease Space	- undefined -	0
40	Theater, Motion Picture	Audience/Seating Area (motion picture theatre)	99
41	Theater, Performance	Audience/Seating Area (performing arts theatre)	97
43	Transportation Function	Terminal - Ticket Counter	95
31	Waiting Area	Lobby	5
1	All Others	- undefined -	0
42	Unknown	- undefined -	0
0	- undefined -	- undefined -	0

C-PRODUCT-TYPE	CEC T24-2008 Compliance Analysis Ruleset (C-PRODUCT-TYPE)	LEED-NC v3.0 Compliance Analysis Ruleset (C-901-PROD-TYPE)	C-901-PROD-TYPE
0	Operable Window	Vertical Glazing	1
1	Fixed Window	Vertical Glazing	1
2	Greenhouse/Garden Window	Vertical Glazing	1
3	Operable Door	Vertical Glazing	1
11	Operable Glass Skylight With Curb	Skylight w/ Curb, Glass	2
12	Operable Glass Skylight Without Curb	Skylight w/o Curb, All	4
13	Operable Plastic Skylight With Curb	Skylight w/ Curb, Plastic	3
14	Operable Plastic Skylight Without Curb	Skylight w/o Curb, All	4
15	Fixed Glass Skylight With Curb	Skylight w/ Curb, Glass	2
16	Fixed Glass Skylight Without Curb	Skylight w/o Curb, All	4
17	Fixed Plastic Skylight With Curb	Skylight w/ Curb, Plastic	3
18	Fixed Plastic Skylight Without Curb	Skylight w/o Curb, All	4

C-FRAME-TYPE	CEC T24-2008 Compliance Analysis Ruleset (C-FRAME-TYPE)	LEED-NC v3.0 Compliance Analysis Ruleset (C-901-FRAME-TYPE)	C-901-FRAME-TYPE
0	Metal	Metal framing, all other	4
1	Metal w/ Thermal Break	Metal framing, curtainwall/storefront	2
2	Non-metal	Nonmetal framing, all	1