California Energy Commission

STAFF REPORT

California Building Energy Code Compliance Software

CBECC 2025 | Version 2025.2.0

User Manual for Modeling Single-Family Residential Performance Compliance

California Energy Commission

Gavin Newsom, Governor

Disclaimer:

This document is to assist with regulatory compliance only, reflects the views of the staff of the California Energy Commission, and does not alter the provisions of the Building Energy Efficiency Standards regulations in any way. The information contained in this documentation assists users in navigating the California Building Energy Code Compliance (CBECC) software and is intended to facilitate efficient compliance with the Building Energy Efficiency Standards. If there is a discrepancy between the regulations and this document, the regulations supersede this document.

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1 Overview

1.1 Approved for 2025 Compliance

California Building Energy Code Compliance (CBECC 2025.2.0) is an open-source software program developed by the California Energy Commission (CEC) for demonstrating compliance with the single-family residential, multifamily residential and nonresidential 2025 *Building Energy Efficiency Standards* (Energy Code). The Energy Code effective date for new construction is January 1, 2026.

First approved on June 8, 2025, CBECC-Res 2025 was for complying with the performance compliance approach for low-rise residential standards. With this CBECC 2.0 2025 release, CBECC-Res has been merged into CBECC. This single software application can now be used for compliance for all projects, including low-rise buildings, hotels and motels (regardless of number of stories), and multifamily buildings. The low-rise standards include single-family dwellings, duplexes townhomes, as well as ADUs, JADUs, and SB9 units (all R-3 occupancies) while hotels, motels, and multifamily buildings are subject to the nonresidential and multifamily requirements of the Energy Code.

Even though CBECC-Res is now part of CBECC, for simplicity, the software still has three components: single family, multifamily, and nonresidential spaces. This portion of the User Manual will focus only on the use of the single-family component.

The 2025 compliance manager is the simulation and compliance rule implementation software specified by the CEC. The compliance manager, models features that affect the energy performance of the building. The Energy Code prohibits trading off mandatory requirements. For example, a metal framed wall must comply with the mandatory maximum U-factor of 0.095 for 2x4 or 0.069 for 2x6 framing (Section 150.0(c)). It is the user’s responsibility to know and comply with the Energy Code. Mandatory requirements are found in Sections 110.0 through 110.12 and 150.0. Also, Section 130.0 includes outdoor lighting requirements that may also apply (Reference: Energy Code, Table 100.0-A).

1.2 Resources for the User

A basic knowledge of the Energy Code is necessary to successfully prepare a compliance report using CBECC. If this knowledge is lacking, it can result in costly construction mistakes. Users should have available the Energy Code and all Energy Code-related documents, including the 2025 Compliance Manuals, 2025 Reference Appendices, and the 2025 SACM Reference Manuals (Section 1.13 includes how to obtain these documents). The Certificate of Compliance (CF1R) produced by CBECC and registered with an ECC provider (see Sections 1.7, 1.8, and 1.9) is submitted to the enforcement agency as proof of compliance with Title 24, Part 6. Your signature as the documentation author affirms the accuracy and completeness of the CF1R.

This user manual is a guide to the program's use. It includes information about the data required for the input file, references to other documents for additional information, and how an input may interact with another input. Where possible, useful resources are included. For example, efficiency ratings of windows and skylights come from the National Fenestration Rating Council (NFRC), appliance efficiency databases are included in the appropriate sections, and Cool Roof Rating Council (CRRC) directory for cool roof ratings. A hyperlink is included allowing you to press control+click from the user manual to open the website.

Sections are bookmarked if you are using Adobe Acrobat (see left panel) for easy navigation. The most used links are prominently displayed to help you find information to register a project and find errors. If you need help, please send your *.ribd25 file to cbecc.res@energy.ca.gov and staff will be happy to assist you.

1.3 What's New and Different in CBECC2025

While some of the changes to the 2025 *Building Energy Efficiency Standards* are mentioned in this document (because of the connection to performance compliance), it is highly recommended that you download the *Single-Family Residential Compliance Manual* which has a "new for 2025" section at the beginning of almost every chapter.

On September 11, 2024, the CEC approved the *2025 Building Energy Efficiency Standards*. Below are highlights of the biggest changes affecting compliance as well as new features of CBECC-Res 2025:

1.3.1 New Features of Version 2025

(reserved)

1.3.2 General 2025 Changes

Encourages efficient heat pumps for space conditioning and water heating in newly constructed single-family.
Establishes electric-ready requirements for some multifamily buildings, so owners can more easily switch to cleaner electric appliances, when ready.

1.3.3 2025 Code Compliance Overview

- The terminology and metrics of compliance have changed for the 2025 Energy Code. Long term System Cost (LSC) for energy efficiency and total are now used.
- Peak cooling is a new compliance requirement for new buildings. Peak cooling limits the cooling energy during peak hours for the proposed design to 120% of the standard design.
- Source energy is another compliance metric.
- Additions and alterations projects only have one metric for compliance: LSC.

1.3.4 Water Heating

- Water heating equipment is required to be a heat pump water heater or a solar water heating systems with electric backup and minimum 70 percent solar savings fraction. (Section 150.1(c)8).
- The electric-ready requirements for gas water heaters have been revised (Section 150.0(n)).
- Updated heat pump water heater (HPWH)-ready requirements for gas water heater installations that include providing a designated space for future HPWH installation.

1.3.5 IAQ (Particularly Applicable to ADUs)

- Updated mechanical ventilation requirements based on the 2022 version of ASHRAE 62.2 (Section 150.0(o)).
- New requirements for central fan integrated ventilation systems requiring a motorized controlled damper (Section 150.0(o)1B).
- Updated local exhaust requirements for kitchen range hoods. Gas ranges require higher ventilation rates or capture efficiencies than electric ranges (Section 150.0(o)1G).
- An exception was added that not require junior accessory dwelling units (JADUs) that are classified as additions to an existing building to meet the whole-building mechanical ventilation requirements.
- New language added clarifying when mechanical ventilation requirements apply to alterations.

1.3.6 Mechanical

- Ducts in conditioned space can be uninsulated if specific conditions are met as explained in Section 4.4.1 of the *Single-Family Residential Compliance Manual* (Section 150.0(m)1B).
- The heating equipment is required to be a heat pump (Section 150.1(c)6).
- New language modifying when replacement electric resistance space heating equipment is allowed.
- Reduce the duct sealing target for altered duct- and space-conditioning systems from 15 percent to 10 percent of total duct leakage in all climate zones.
- Increase the prescriptive duct insulation from R-6 to R-8 in climate zones 1, 2, 4, 8-16.
- Reduce the 40-foot trigger for prescriptive duct sealing and insulation to 25 feet for altered systems. Eliminate the minimum length requirement for additions and require duct sealing whenever an existing duct system is extended to serve an addition.

- Add a prescriptive requirement for insulation and sealing in vented attics when an entirely new or complete replacement system is installed in a vented attic in all climate zones except climate zones 5 and 7. Various exceptions to this requirement are allowed.

1.3.7 Complying with New Metrics

CBECC 2025 uses a Long-term System Cost (LSC), Source Energy, and Peak Cooling metrics to demonstrate compliance with the Standards for newly constructed buildings. The software calculates the proposed design energy use, standard design energy budget, and reference design energy use. There may be additional internal calculations to establish the standard design PV requirement. Compliance requires meeting four criteria:

1. Efficiency LSC (proposed) must be equal to or less than standard efficiency LSC,
2. Total LSC (includes PV and battery storage) must be equal to or less than standard total LSC,
3. Source Energy (proposed) must be equal to or less than standard source energy, and
4. Peak Cooling (proposed) can be up to 20% greater than the standard peak cooling.

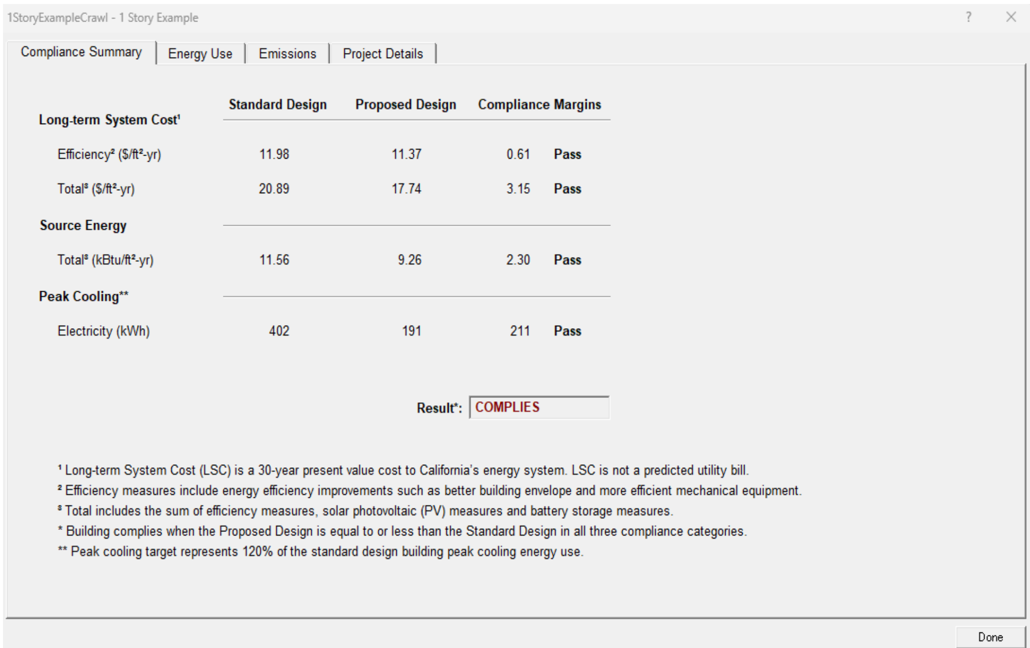
For efficiency calculations, the energy use includes space heating, space cooling, ventilation, and water heating. It can also include a portion of the battery storage (if specified) energy savings when the self-utilization credit is checked. The total energy includes PV generation and any flexibility measures or battery storage.

For projects with additions and alterations scopes, such projects only need to show compliance with LSC.

PV and battery requirements are a complex topic. To learn more about these requirements, consider reviewing the Reference Appendices, Joint Appendix JA11 (Qualification Requirements for Photovoltaic Systems) and JA12 (Qualification Requirements for Battery Storage System). Also, consider providing your client with a copy of the installation requirements found on the Certificate of Installation forms CF2R-PVB-01-E – PV Systems and CF2R-PVB-02-E–Battery Storage.

1.3.8 Compliance Summary

Figure 1-1: Compliance Summary

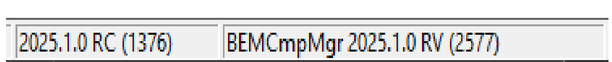


The compliance summary (Figure 1-1) is available in CBECC following an analysis. It compares the efficiency, total LSCs, source energy, and peak cooling to show whether the project complies. All four compliance margins must be greater than or equal to 0. Footnotes 1-3 describe details about the ratings, followed by PV system details.

1.4 Transitioning to CBECC 2025

As you begin using the 2025 software, you can distinguish between 2022 and 2025 files by the input file extension. Files with the extension *.ribd25 are 2025 files, and *.ribd22 are 2022 files. Because all CBECC icons look the same, during installation do not remove the date. While using the program, you can verify the correct version from the lower border of the screen, which displays the software version (Figure 1-2).

Figure 1-2: CBECC Version Number



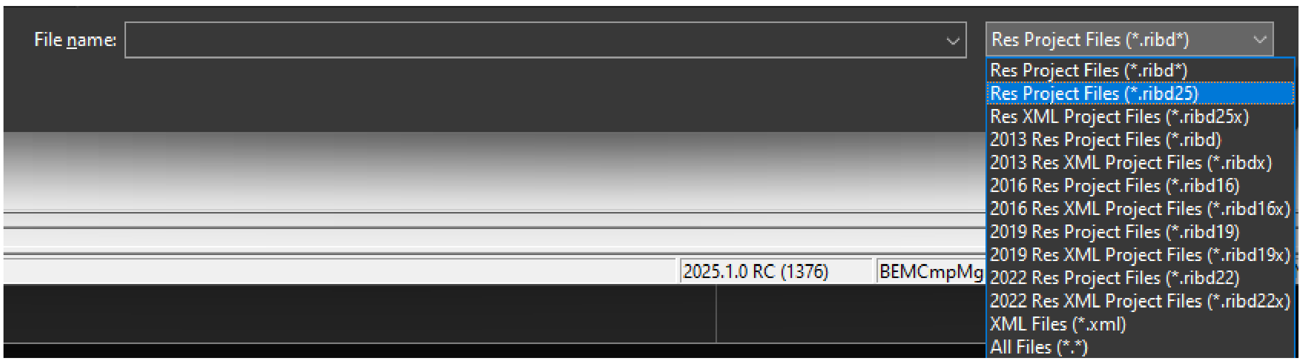
NOTE: The version number (such as 2025.2.0) is the only number relevant to the typical software user. The Compliance Manager version only appears after an input file is opened. Numbers in parenthesis are important to internal processes, or for troubleshooting by programming staff.

1.4.1 Converting Files

While it is strongly recommended to use the newest example files that come with each program (Section 2.2), existing files can be converted to 2025 files:

1. Copy the file from the 2022 (or older) project folder and paste it in the 2025 folder (this makes it easier to find).
2. Open CBECC-Res 2025 and choose ***open an existing file***. Change the file type from the default ***Res Project Files (*.ribd25)*** to the appropriate option for the file you are converting, as shown in Figure 1-3.

Figure 1-3: Opening *.ribd* files



3. Open the file.
4. Acknowledge the warning that you are opening a file that used a previous ruleset by clicking okay to change the ruleset to 2025.
5. Rename the file. Even if you keep the same name, the extension will be *.ribd25.

1.5 Background

The Standards allow compliance using either a prescriptive or performance compliance method. The prescriptive method is found in the *Single-Family Residential Compliance Manual* (see Section 1.13, Related Publications). Performance compliance is an alternative calculation method (ACM) that uses building modeling software to demonstrate compliance with the standards. CBECC-Res is the public domain software produced by the CEC.

1.6 Program Updates

For software updates and valid version numbers, check the link to the CEC's website, accessible from the [2025 software link](https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-energy-code-compliance-software) (https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-energy-code-compliance-software).

NOTE: Sign up for notifications from the CEC to keep your software up to date (https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards). Even better, and much quicker, sign up for CBECC-Res only website updates from the contractor, http://www.bwilcox.com/BEES/BEES.html.

USER TIP: Support questions can be sent to cbecc.res@energy.ca.gov. Include your *.ribd25 file or any problem file. There are also tips in Section 2.11 for finding errors yourself.

1.7 Watermarks

The only document produced by CBECC for single family residential projects is a Certificate of Compliance (CF1R). To obtain a CF1R requires an internet connection and checking the PDF option on the Analysis tab (accessible by double-clicking on project/top row).

The CF1R will have a watermark "This Certificate of Compliance is not yet registered" if ECC measures are required. The only way to remove the watermark is to register the project with an approved residential ECC provider data registry. For information about the registration process, see Section 1.7.4& 1.7.5 (the fields on the signature page are completed during the registration process). If a different watermark appears, see below.

If no ECC measures are required, such as on some addition or alteration projects, there is no watermark on the CF1R. This is confirmed by a note on page 1 of the CF1R that the building includes no ECC verified measures. To complete the documentation author and responsible person fields on the last page of the CF1R, use Adobe Acrobat® (e.g., fill and sign).

1.7.1 Not Useable Watermark

If a watermark shows "Not useable for compliance," there are potentially five reasons. The CF1R was generated:

(1) For a project that does not comply,
(2) Following a "Quick" simulation instead of "Compliance" (option on the Analysis tab),
(3) Using the tools menu option "Generate Draft T-24 Compliance Report" instead of checking the box on the analysis tab, or
(4) By software that is not valid for compliance. This is a security feature. For a full explanation of security features see the Frequently Asked Questions.
(5) Using Program and Analysis Options (found under the Tools tab) that affect analysis validity.

1.7.2 Mandatory Measures

The mandatory measures summary document (https://www.energy.ca.gov/sites/default/files/2025-04/2025_Residential_Mandatory_Measures_Summary_ADA.pdf) is a 5-page summary of all 2025 mandatory requirements.

CBECC does not include space conditioning equipment load calculations for single family residential, which are required by Section 150.0(h). Mechanical contractors are expected to prepare these and other calculations as part of their responsibilities.

1.7.3 Forms

In some cases, prescriptive compliance is a better fit, particularly for an addition or alteration. Interactive versions (meaning with fill-in fields) of the prescriptive forms for projects that do not require ECC verification are available from the Energy Code Ace website https://energycodeace.com/residentialforms. If ECC measures are required, the forms must be completed at a ECC provider data registry website (https://www.energy.ca.gov/programs-and-topics/programs/home-energy-rating-system-ECC-program/home-energy-rating-system). Documents and forms are also available from the CEC https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency.

NOTE: Every newly constructed building requires ECC verification. Indoor air quality (Section 150.0(o)) is an ECC-verified mandatory requirement. Duct leakage testing is also a mandatory requirement. ECC-verified requirements are summarized on page 3 or 4 of the CF1R (after the energy use and special features listings).

1.7.4 ECC Upload XML File

The file needed to upload a project to a ECC provider data registry is created only when you check the box labeled “Full (XML)” on the Analysis tab (see also Section 4.3.5) before performing the compliance analysis.

The file is stored in the projects folder (CBECC 2025 Projects). Select the larger xml file named:

<input file name> - **CF1RPRF01E-BEES.xml**

1.7.5 Registering the CF1R

When ECC verification is required for a project, the watermark is only removed when the CF1R has completed the registration process at a ECC provider’s data registry web site, which includes the documentation being electronically signed by the author and the person authorized by the Business and Professions Code to take responsibility for the building design.

For more information on registering a CF1R, find an approved ECC provider data registry and visit their website for assistance in that process. Find an approved ECC provider data registry at the CEC's website (https://www.energy.ca.gov/programs-and-topics/programs/home-energy-rating-system-ECC-program/home-energy-rating-system).

As construction progresses, follow-up documentation (certificates of installation (CF2R) and certificates of verification (CF3R)) is required to confirm that the required measures are installed.

1.8 Required Special Features and Modeling Assumptions

The 2025 Single-Family Residential ACM Reference Manual, Appendix A, identifies those features that are a required special feature on the CF1R.

1.9 ECC Third-Party Verification

The 2025 Single-Family Residential ACM Reference Manual, Appendix A, identifies the measures that require ECC rater verification or diagnostic testing. The CF1R identifies any measures included in the building input file that require testing or verification by a ECC rater.

1.10 Fixed and Restricted Inputs

When the specified analysis type is compliance, there are fixed and restricted inputs that cannot be changed by the user. Because example files may include assumptions that are not standard in a given climate zone, to determine the standard assumption for a given input, consult Energy Code, Section 150.1, Table 150.1-A (single family), or the Single-Family Residential ACM Reference Manual.

1.11 Preparing Basic Input

The software includes several example files, and the user manual provides a tutorial as well as a guide through program inputs. Required inputs include:

1. Building address, climate zone, front orientation, fuel type, and PV system details,
2. Conditioned floor area and average ceiling height,
3. Attic/roof details, roof pitch, roofing material, solar reflectance, and thermal emittance,
4. Ceilings below attic and vaulted ceiling R-values,
5. Wall areas, orientation, and construction details,
6. Door areas and orientation,
7. Slab or raised floor area and construction details,
8. Window and skylight areas, orientation, U-factor, Solar Heat Gain Coefficient,
9. Building overhang and side fin shading,
10. Mechanical heating and cooling equipment type and efficiency,
11. Distribution system location and construction details,

12. Method for providing mechanical ventilation,
13. Domestic water heating system details, including type of water heating equipment, fuel type, efficiency, distribution system details, and
14. PV and battery storage details.

1.12 Checklist for Compliance Submittal

The form needed for a compliance submittal includes a CF1R which is registered with a ECC provider if ECC verification is required (Section 1.7). Mandatory measures can either be included as notes on the plans or the 2025 Single-Family Residential Mandatory Measures Summary may be included with the documentation (Section 1.7.2).

Additional supporting documentation that may be required includes:

- National Fenestration Rating Council (NFRC) certified U-factor and Solar Heat Gain Coefficient (SHGC) for windows and skylights,
- Air-Conditioning, Heating, and Refrigeration Institute (AHRI) certified efficiency of cooling, heating and/or water heating equipment,
- Roofing material rating from the Cool Roof Rating Council (CRRC),
- Solar water heating documentation from the Solar Rating & Certification Corporation (SRCC) to support a modeled solar fraction, or
- Any supporting documentation requested by the building department to verify modeled features.

1.13 Resources and Publications

There are many resources available if you know how to access them:

- Sign up for the *Blueprint* newsletter, a very useful publication for compliance related topics https://www.energy.ca.gov/newsroom/blueprint-newsletter.
- Compliance forms can be found at the CEC website.
- The CEC has an Energy Code Support Center for training, videos and other helpful tools (https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/energy-code-support-center).

In addition to this manual, users of the software need to have several documents as a resource during the compliance process.

- *2025 Building Energy Efficiency Standards* (https://www.energy.ca.gov/sites/default/files/2025-07/CEC-400-2025-010-F_0.pdf) contains the official Standards adopted by the CEC.

- *2025 Single-Family Residential Compliance Manual* (https://www.energy.ca.gov/publications/2025/2025-single-family-residential-compliance-manual-2025-building-energy-efficiency) is the interpretive manual for complying with the standards (also contains sample compliance forms).
- *2025 Reference Appendices* for the *Building Energy Efficiency Standards* (https://www.energy.ca.gov/sites/default/files/2025-07/CEC-400-2025-010-AP.pdf) is the source document for climate zones, ECC protocols for measures requiring verification by a ECC rater, as well as eligibility and installation criteria for energy efficiency measures.
- *2025 Single-Family Residential Alternative Calculation Method (ACM) Reference Manual* (https://www.energy.ca.gov/publications/2025/2025-single-family-residential-alternative-calculation-method-reference-manual) contains the rules that the software follows to establish the standard and proposed designs for a proposed building.

Publications may be downloaded from the CEC website, (https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency) from:

California Energy Commission
Publications Office
715 P Street
Sacramento, CA 95814

1.14 Terminology

1.14.1 Battery storage

Excess capacity from a PV system may provide credit toward meeting the Total LSC by including battery storage. Battery capacity and controls affect the amount of credit.

1.14.2 Climate Zone

California has 16 climate zones that determine the measures included in the standard design. There are several ways for finding a climate zone for a building. The resources are listed at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/climate-zone-tool-maps-and. The representative city for each of the 16 zones is listed in the *Reference Appendices*, Joint Appendix JA2.

1.14.3 Compliance Manager

The compliance manager is the simulation and compliance rule implementation software specified by the CEC, also known as the public domain compliance software. The compliance manager is called CBECC and models the features of the building as specified in the Standards to establish the energy budget for the building. Details are included in the *2025 Single-Family Residential ACM Reference Manual*.

1.14.4 Demand Response

Demand response is a feature of the building that is automated to respond to fluctuations in utility time-of-use (TOU) rates. Controls typically must meet criteria from Section 110.12 of the Energy Code. Included are batteries, precooling, and some heat pump water heaters.

1.14.5 Long-term System Cost (LSC), Source, Peak Cooling

The Total LSC for a single-family residential project combines the LSC for all efficiency measures (Efficiency LSC) and the LSC for all photovoltaic system, battery energy storage systems, lighting, demand flexibility measures, and other plug loads.

Peak cooling is applicable in climate zones 4 and 8 through 15. Up to a 20% increase in peak cooling energy for a proposed design compared to the minimally code-compliant standard design is allowed when using the performance compliance approach.

To comply through the performance compliance approach, the Total LSC, and the Efficiency LSC of the proposed design must be equal to or less than the Total LSC, and the Efficiency LSC of the standard design. This applies to newly constructed buildings, additions to existing buildings alone, additions plus alterations of existing buildings, and alterations of existing buildings.

Compliance for additions and alterations to existing buildings requires calculating the energy use of the proposed design and the energy budget of the standard design energy budget, expressed in units of thousand TDV (kTDV) LSC per square foot of conditioned floor area (kTDVLSC/ft2). This accounts for regulated energy end uses, including space heating, space cooling, ventilation, and water heating. Unregulated energy end uses are not included, such as interior lighting, appliances, cooking, plug loads, and exterior lighting. PV generation and demand flexibility measures.

1.14.6 ECC Verification

Some mandatory or optional compliance features require an Energy Code Compliance rater to perform diagnostic testing or verify installation. ECC raters are trained and certified by an ECC provider. ECC raters perform verification and testing requirements as specified in the *Reference Appendices*, Residential Appendices RA1 – RA4. For a list of currently approved [ECC providers](https://www.energy.ca.gov/programs-and-topics/programs/home-energy-rating-system-ECC-program) see https://www.energy.ca.gov/programs-and-topics/programs/home-energy-rating-system-ECC-program .

1.14.7 Mandatory Requirements

Mandatory requirements are included in Sections 110.0 through 110.12 and 150.0 of the Standards. Any requirement that is mandatory (some are modeled, some are not) cannot be removed from the building. For example, while a whole house fan is a feature of Section 150.1, Table 150.1-A for Climate Zone 10, if a building complies without modeling a whole house fan, it would not be required. However, duct leakage testing (Section 150.0(m)) is mandatory.

1.14.8 Prescriptive Tables

The prescriptive tables can help understand compliance results of a building that is not complying. Section 150.1, Table 150.1-A includes the features used to establish the standard design for your building.

Determining how your building compares to the characteristics of these tables will help in understanding the compliance results. Is your building equal, better, or worse for glazing percent, window efficiencies, wall construction, or attic roof deck insulation construction?

1.14.9 Proposed Design

The user-defined proposed building modeled in CBECC is called the proposed design. The proposed design is part of the calculation to determine if the building complies with the standards (see *Single-Family Residential ACM Reference Manual,* Section 3).

The building is defined through entries for floors, walls, roofs and ceilings, windows, and doors. The areas and characteristics (insulation R-values, U-factors, SHGC) are defined by the program user. The entries for all building elements must be consistent with the actual building plans.

1.14.10 Reference Design

This term and how the reference design is established are described in the *Single-Family Residential ACM Reference Manual*, Section 2.1.4.

1.14.11 Registered CF1R

When ECC verification is required, the CF1R will include a watermark telling the user that registration is required. See Sections 1.7 and 1.9 for more information.

1.14.12 Report Manager

The report manager is a web-based application used to generate the Certificate of Compliance (CF1R). Although the Tools feature of CBECC contains a feature to ‘check report generator access’, most problems have their source in the user’s internet connection. Using wi-fi connections can result in timing errors because the CF1R can take several seconds to generate.

1.14.13 Self-Utilization Credit

When a PV system is coupled with battery storage system, the software allows a portion of the PV plus storage LSC to be traded against the efficiency LSC. This modest credit can be used for tradeoffs against building envelope and efficiencies of the equipment installed in the building. A checkbox is provided in the software to enable this credit.

1.14.14 Standard Design

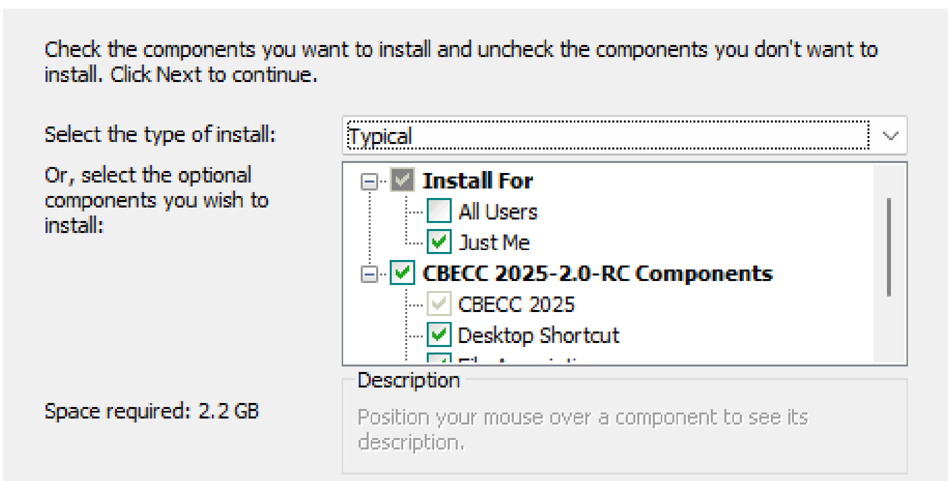
CBECC creates a version of the proposed building that has the features of Section 150.1(c), Table 150.1-A in the specified climate zone to establish the standard design (also known as the energy budget). The standard design is part of the calculation to determine if the building complies with the Energy Code (see *Single-Family Residential ACM Reference Manual,* Section 3).

2 Program Operation

2.1 Installing CBECC

To download the CBECC software, please go to either the Energy Commission's 2025 Energy Code Compliance Software webpage (https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-energy-code-compliance-software) or the NORESCO CBECC 2025 webpage (https://bees.noresco.com/software2025.html). After downloading and opening the installation file, follow the prompts and read/accept the license agreement. You can direct the software to a different drive, but do not change the names of the file folders. The software will create a desktop shortcut (if selected).

Figure 2-1: Setup Screen



2.1.1 File Locations

CBECC requires a file installation structure that has three locations – (1) executable, (2) data, and (3) projects folders. The default locations are:

Executable: C:\Program Files \CBECC 2025

Data: C:\Users\'UserName'\Documents\CBECC 2025 Data

Projects: C:\Users\'UserName'\Documents\CBECC 2025 Projects

CBECC cannot be installed on a network (for example, "\\" is part of the path name). It must be installed on a local or mapped drive. Input files are stored in the projects folder (the data folder contains program files).

NOTE: If the program will not run, consider uninstalling to reestablish the path names and reinstall following the guidelines provided here.

2.2 Example Files

The first time you use CBECC it is highly recommended that you spend a few minutes going through the tutorial in Chapter 3.

Following that introduction, the example files demonstrate how to model specific features. They are tailored to a specific climate zone so they may include measures that are not appropriate for your specific project. For example, features beneficial in the San Joaquin Valley may not be appropriate in the mild Bay Area climate. Review the CF1R thoroughly and tailor the file for the climate zone or zones in which you work.

All new construction files include PV sized to meet standard design requirements using the Standard Design PV system scaling option, 5 kWh battery storage, QII, and a high-performance attic (meaning R-19 below deck insulation) because it is included in the standard design in most climate zones for new construction.

The following example files are included in the projects directory.

1. **1StoryExample.** Based on the CEC's 2,100 ft^2 single floor prototype in climate zone 12 with slab-on-grade floors, a tile high performance attic roof, cool roof, an attached garage, window dimension inputs, and overhangs. The HVAC system is a central split heat pump with electric resistance backup.
2. **1StoryExampleBelowGrade.** Based on the CEC's 2,100 ft^2 single floor prototype with a crawl space, and a separate 750 ft^2 basement. The basement zone has its own HVAC system which is a wall furnace and no cooling system.
3. **1StoryExampleBuriedDuct.** 2,100 ft^2 single floor prototype with verified duct design with buried ducts.
4. **1StoryExampleCathedral.** Same building as above with cathedral ceiling and ducts located within the conditioned space.
5. **1StoryExampleCathedralWHF.** Same building as above with cathedral ceiling and a whole house fan (exhausting to outside).
6. **1StoryExampleCompactDist.** 2,100 ft^2 single floor prototype with compact distribution (basic credit) for the water heating system.
7. **1StoryExampleCrawl.** 2,100 ft^2 single floor prototype with a crawl space.
8. **1StoryExampleDrainWtrRecov.** 2,100 ft^2 single floor prototype with a drain water heat recovery system.

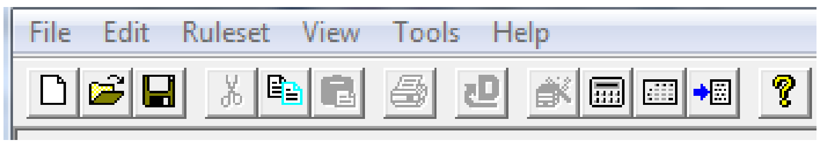
9. **1StoryExampleDuplex.** One-half of a duplex.
10. **1StoryExampleEvapCond.** 2,100 ft^2 single floor prototype with an evaporatively cooled condenser.
11. **1StoryExampleGasDHW.** 2,100 ft^2 single floor prototype with a 0.81 UEF small instantaneous gas water heater.
12. **1StoryExampleGasFurnace.** 2,100 ft^2 single floor prototype with an 80AFUE furnace and a 14.3 SEER2/11.7 EER2 Split Air Conditioner.
13. **1StoryExampleHVAC.** 2,100 ft^2 single floor prototype with a ductless mini-split heat pump, ground source, and air to water heat pumps defined in the mechanical system library from which to pick.
14. **1StoryExampleIAQ.** 2,100 ft^2 single floor prototype with a balanced Heat Recovery Ventilator (HRV) system.
15. **1StoryExampleMild.** 2,100 ft^2 single floor prototype in climate zone 3 with slab-on-grade floors, asphalt shingle attic roof, radiant barrier, no cooling, an attached garage, and windows with appropriate SHGC values for a mild climate.
16. **1StoryExampleMulti.** 2,100 ft^2 single floor prototype with multiple orientation analysis. CF1R reports compliance results for the four cardinal (north, east, south, west) orientations.
17. **1StoryExampleNEEAHPWH.** 2,100 ft^2 single floor prototype with an A. O. Smith 3.45 UEF NEEA HPWH.
18. **1StoryExampleUnvented.** 2,100 ft^2 single floor prototype with R-0 ceiling insulation, spray foam insulation at the roof level (not the ceiling), and ducts in an unvented attic.
19. **2Story2ZoneExample.** Based on the 2,700 ft^2 two-story prototype, zoned first and second story separately, each with its own HVAC system.
20. **2StoryExample.** 2,700 ft^2 two-story prototype, set in climate zone 9, with a tile high performance attic roof, and a whole house fan.
21. **2StoryExampleCombHydNoCool.** 2,700 ft^2 two-story prototype, set in climate zone 3, with PV, a combined hydronic system with a boiler as the source of heating/water heating, and no cooling.
22. **2StoryZonalExample.** 2,700 ft^2 two-story prototype with a zonally controlled credit (living vs. sleeping zones).
23. **AAExample.** An addition alone input file with existing equipment in climate zone 9.
24. **ADUExampleAdditionAlone**. Using addition alone compliance, this is a 400 ft^2 accessory dwelling unit in climate zone 12.
25. **CUACExample.** A new construction building with CUAC analysis enabled in climate zone 13.

26. **EAAExample**. An existing plus addition input file with an existing HVAC system and an altered water heating system in climate zone 9.
27. **EAAExampleADU.** An existing building with an attached ADU in climate zone 12.
28. **EAAExampleGarage.** An existing house with a garage, plus addition with an existing HVAC system and an altered water heating system in climate zone 12.
29. **EAAExampleLrgAddADU.** An existing house with an addition greater than 1,000 ft^2 with an existing HVAC system and a 440 ft^2 attached ADU in climate zone 12.

2.3 Menu Bar

The menu bar at the top of the screen allows you to access many of the program's features.

Figure 2-2: Menu and Tool Bar



USER TIP: If your icons or menu bar are very small, try adjusting the properties settings. Right-click on the icon that starts the program, select properties, select the compatibility tab, check the box to disable display scaling on high DPI settings, and click apply.

2.3.1 File

The file menu contains the standard functions for file management, opening and saving files, save as (to rename a file), and exiting the program.

2.3.2 Edit

Most users will use the right-click options to edit, rename, create, and delete components (Section 2.6).

In addition to the standard cut, copy, and paste commands, the edit menu contains several commands for editing building descriptions. They are:

- Edit component
- Create component
- Delete component

USER TIP 1: Be careful when using "delete component." You could easily delete your entire project.

USER TIP 2: To access the Analysis tab or Building tab (with address, orientation, etc.), put the cursor on the Project field (top row) and double click.

2.3.3 Ruleset

The average user of CBECC-RES will not need to know about rulesets. CBECC-Res is designed to support multiple rulesets that implement the requirements of different codes. The ruleset menu allows switching to a different compliance ruleset. Typically, changing to a different code requires changes to inputs. Users will need to pay special attention to instructions for performing accurate analysis under different rulesets.

2.3.4 View

The view menu (rarely used) enables you to toggle on and off the display of the tool bar at the top of the screen and the status bar at the bottom of the screen.

2.3.5 Tools

The tools menu contains many useful options:

- Program and Analysis Options / *Change settings such as enable research mode*
- Proxy Server Settings/ *Allows specifying proxy server settings*
- Show Model Grid / *opens the inputs in a grid format*
- View T-24 Compliance Report [same as short-cut key] / *opens the CF1R if available*
- View Project Folder / *opens the folder that contains the project files*
- View Project Log File / *contains file history, error messages*
- Delete Project Log File / *(more useful than it sounds) this file contains the entire history of an input file, by deleting it, you start fresh with only the latest error(s)*
- View CSE Simulation Errors File / *opens an error file containing more details*
- View CSE Simulation Reports File / *contains warnings and errors*
- View CUAC Submittal Report
- View CUAC Details Report
- View CUAC Details CSV
- Check Building Database / *checks for major errors*
- Check Report Generator Access / *checks for internet access to the report generator*
- Building Summary Report (input model) / *opens a .csv file in Excel*

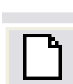
- Building Summary Report (proposed/standard) / *opens two .csv files in Excel (one standard and one proposed)*
- Perform Analysis [same as short-cut key] / *runs file to determine if it passes or fails compliance*
- Review Analysis Results [same as short-cut key] / *displays compliance results, if available*
- Generate Draft T-24 Compliance Report [same as short-cut key] / *creates a draft CF1R which will have a watermark with "not useable for compliance" (for a "not registered" watermark see Section 1.)*
- Batch Processing */ enables running multiple runs without user interaction (Section 2.12)*

2.3.6 Help

- Help Topics / [*not enabled*]
- Quick Start Guide / *opens an overview of the software and frequently asked questions*
- User Manual / *opens this user manual document*
- CSE Simulation Documentation / *links to the CSE source code*
- Mandatory Requirements for Assemblies / [inactive] *requirements from Standards Section 150.0; for example, a steel framed wall with no rigid insulation does not comply with the minimum requirements (alternative, see Section 6.4)*
- About California Code Energy Compliance . . . / *to determine the version of CBECC-Res and licenses*

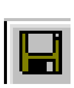
2.4 Tool Bar

This section explains the program features accessed by clicking the toolbar shortcuts (Figure 2-2).

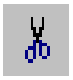


New File
This button closes the current file (if one is open) and opens a new file.

Open File
This button launches the open dialog box to enable opening an existing file. If another file is open, a prompt to save that file before proceeding will appear.



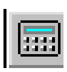
Save
This button saves the file under its current name or launches the *save as* dialog to enable a new file name.

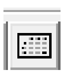

Cut
Not enabled (right-click and pick delete instead).

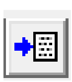

Copy
Copy the item (and any child components). If the *copy* button is not available from within program dialogs, use the keyboard shortcut Ctrl+C (to paste, use Ctrl-V).


Paste
Paste copied components. Typically, the paste location is at the bottom, but can be moved up using the right-click/move up in list function. If the paste button is not available, use the keyboard shortcut, Ctrl+V.


Print
NOT USED. The CF1R is printed in Adobe® Acrobat.


Perform Analysis
This button enables launching a compliance analysis using the currently loaded building description. You must save the current building description before performing the analysis.


View Analysis Results
Displays the previous compliance results (from the last time analysis was run).

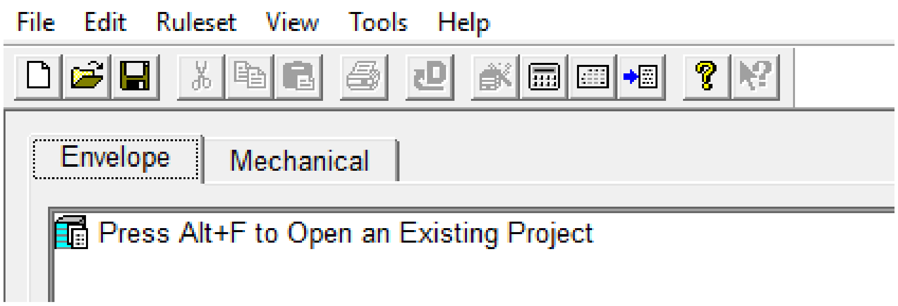

Compliance Reports
Accesses a previously generated CF1R or will generate a draft CF1R (with “not usable for compliance” watermark).


About CBECC-Res 2025
View program license and version information.

2.5 Main Screen

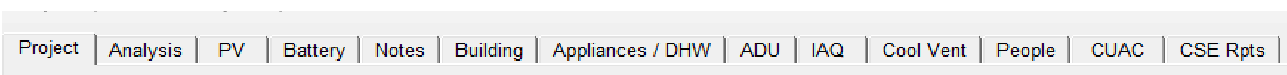
The main screen (Figure 2-3) is used for editing building descriptions. There are two tabs at the top of the main screen—Envelope and Mechanical. These tabs provide different views of the building description and provide access to two different subsets of building description data.

Figure 2-3: Main Screen (no file open)



When editing an existing file, the project tab (Figure 2-4) is activated by double-clicking on the project name.

Figure 2-4: Project Tab



2.6 Tool Tips/Automated Features

- **Right-Click.** The tools on the right-click menu are described in Section 2.7.
- **Tool Tips**. Some fields have tool tips, activated by hovering over the field.
- **File Save**. You are prompted to save a file before performing the analysis (if it was not previously saved). If you select the default save, the file is saved over the existing file. If you intended to create a new version of the file, be sure to pick <cancel> and select <file> and <save as> from the file menu.
- **Window Types**. This field is most flexible and useful if only the window U-factor and SHGC fields are completed (be sure to enter the values even if the default values are desired). The flexibility occurs in this way - if there is a change in efficiencies after a project is entered, changing the window type values updates any windows that use that type. (Detailed instructions in Section 6.13).
- **Automated Defaults Based on Climate Zone**. When a field such as duct R-value, window U-factor or SHGC is blue rather than red the value is set to the automatic default and will update based on the climate zone.
- **Restore Default.** When a field is red and you wish to enable the automated feature, swipe the cursor across the field, right-click and select “Restore Default.” The field will change from

red to blue to indicate that it will change if a climate zone with a different standard design assumption is selected. To prevent unintended changes on window efficiencies, see also Window Types in Chapter 7.

2.7 Right-Click Menu Options

CBECC-Res makes extensive use of menus accessible by right-clicking the mouse button (keyboard navigation options are shown in Section 2.8. The functions available through these menus depend on whether you are on the main screen or in an input dialog window.

Main Screen—Right-Click Menu. When clicked over a building component, the following choices are available:

- *Edit* – Opens the input dialog window for the selected component
- *Rename* – Enables renaming the selected component
- *Delete* – Deletes the selected component
- *Copy* – Copies the selected component with all its associated (“children”) components
- *Paste* – Adds copied components and children to the selected component
- *Move Up in list* – Moves a component up in the list of the same component type
- *Move Down in list* – Moves a component down in the list of the same component type
- *Expand/Contract* – Expands or contracts the list of children components (shortcut key is to use the + or – signs)
- *Create* – Enables you to create new child components for the selected component

Input Dialog—Right Mouse Menu. When clicked over an input value in the window, the following choices are available:

- *Item Help* – (not available)
- *Topic Help* – (not available)
- *Restore Default* – Returns the value of the field to its default value (if applicable)
- *Critical Default Comment* – (not available)

2.7.1 Analysis Types

Proposed Only: Simulates the proposed building’s energy use using the 2025 compliance rules without establishing the standard design.

Proposed and Standard: In addition to simulating the proposed design, simulates the standard design building (one that complies with the 2025 prescriptive standards) to establish the energy budget for compliance.

2.7.2 Building Tree Controls (Parent/Child Relationships)

To analyze a building's energy use, CBECC-Res tracks relationships among building components. CBECC-Res displays these relationships using the familiar tree control found in Windows™ Explorer and many other applications. For example, under the envelope tab, exterior walls are shown as parents to windows. Windows are connected to exterior walls and appear under walls as children to spaces. The tree controls vary in the components they display.

2.7.3 Rapid Editing

The tree control can be used to move and copy components or groups of components. To move a component, simply drag and drop. If an association is not allowed, the program will prevent the move. To copy a component, place the cursor on the component, right click/copy, move to the destination and right-click/paste. Rename to maintain consistency. When parent components are moved, copied, or deleted, child components are included.

Components shown on the tree can be moved using a drag-and-drop technique provided it results in a compatible parent-child relationship.

Right-click edit commands are described in Section 2.7. Double-clicking opens the input dialog window.

2.8 Keyboard Navigation Without the Mouse

The following alternative procedures for getting from one field to another or to access the right-click tools menu:

(1) Up/down arrow - moves up/down the tree

(2) <Alt> Enter - opens data for object highlighted / then tab to the field

(3) <Alt>F1 – opens the right mouse quick menu. Once open:

   a. Up/down arrows to highlight a selection and <enter> or type the letter, such as “E" to edit, “R” to rename

   b. When the bottommost "Create" item is selected - right/left arrow keys to open/close submenu of children to create

   c. <esc> key to close right mouse menu

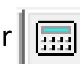
(4) Left/right arrows - when on an object with children (i.e., a wall with windows), left arrow contracts and right arrow expands (to show/hide the child objects).

2.9 Defining New Components

From the main program screen or at any point you would like to create a component under (a child to the parent component):

- Right-click on the component to which you want to add the new component.
- Select *Create*, and the type of object you want to create. Only applicable component types will appear on the list. The components available will depend on where the cursor is placed (for example, a skylight can only be created under a cathedral roof).
- Accept the defaults or edit the name, parent, and existing component from which to copy, and click OK.
- Edit the input fields with white backgrounds to describe the new component and click OK.

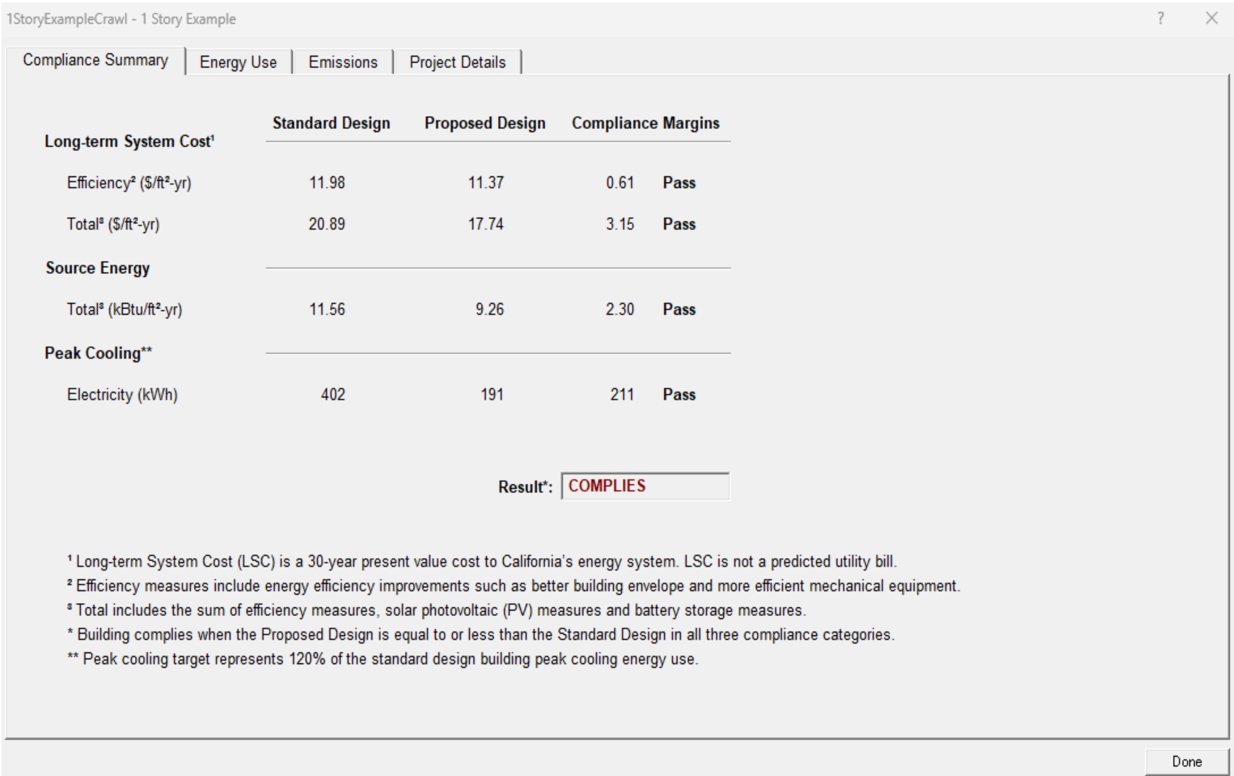
2.10 Analysis Results

Once an input file is created and the analysis performed (tools, perform analysis or ) the results can be viewed in several formats as shown below.

2.10.1 Compliance Summary

This displays the 2025 compliance results. To view the individual heating, cooling, and water heating results, pick the Energy Use Details tab.

Figure 2-5: Summary Results


1StoryExampleCrawl - 1 Story Example
Compliance Summary
Energy Use
Emissions
Project Details
Standard Design
Proposed Design
Compliance Margins
Long-term System Cost¹
Efficiency² ($/ft²-yr) 11.98 11.37 0.61 Pass
Total³ ($/ft²-yr) 20.89 17.74 3.15 Pass
Source Energy
Total³ (kBtu/ft²-yr) 11.56 9.26 2.30 Pass
Peak Cooling**
Electricity (kWh) 402 191 211 Pass
Result*: COMPLIES
¹ Long-term System Cost (LSC) is a 30-year present value cost to California's energy system. LSC is not a predicted utility bill.
² Efficiency measures include energy efficiency improvements such as better building envelope and more efficient mechanical equipment.
³ Total includes the sum of efficiency measures, solar photovoltaic (PV) measures and battery storage measures.
* Building complies when the Proposed Design is equal to or less than the Standard Design in all three compliance categories.
** Peak cooling target represents 120% of the standard design building peak cooling energy use.
Done

2.10.2 Energy Use Details

This screen provides more useful details when analyzing if a building is not complying. It provides the standard design and proposed design values in \$/ft^2 values (reported on the CF1R after the compliance summary) as well as site energy.

Figure 2-6: Energy Use Detail Results

Compliance Summary | Energy Use | Emissions | Project Details

	Standard Design				Proposed Design				Compliance Margins	
End Use	Site Elec. (kWh/yr)	Site Gas (therms/yr)	LSC¹ ($/ft²-yr)	Source (kBtu/ft²-yr)	Site Elec. (kWh/yr)	Site Gas (therms/yr)	LSC¹ ($/ft²-yr)	Source (kBtu/ft²-yr)	LSC¹ ($/ft²-yr)	Source (kBtu/ft²-yr)
Space Heating	1,256		4.91	1.98	138	106.2	6.89	4.77	-1.98	-2.79
Space Cooling	574		2.13	0.32	379		1.44	0.23	0.69	0.09
IAQ Ventilation	277		0.88	0.22	277		0.88	0.22	0.00	0.00
Water Heating	1,267		4.06	4.95	1,029		3.34	0.91	0.72	4.04
Self Util/Flexibility Credit					131		-1.18	-0.95	1.18	0.95
Compliance Total	3,374		11.98	7.47	1,954	106.2	11.37	5.18	**0.61 (5.1 %)**	
PV & Battery	-4,222		-5.39	-0.87	-4,223		-7.92	-0.87	2.53	0.00
Flexibility								0.00		0.00
Inside Lighting	506		1.75	0.50	506		1.75	0.50	0.00	0.00
Appl. & Cooking	950	43.1	5.47	2.58	948	43.1	5.46	2.57	0.01	0.01
Plug Loads	2,026		6.66	1.76	2,026		6.66	1.76	0.00	0.00
Exterior	120		0.42	0.12	120		0.42	0.12	0.00	0.00
Project Total	2,753	43.1	20.89	11.56	1,331	149.3	17.74	9.26	**3.15 (15.1 %)**	**2.30 (19.9 %)**

¹ Long-term System Cost (LSC) is a 30-year present value cost to California's energy system. LSC is not a predicted utility bill.

2.10.3 CO2 Emissions and Details

Figure 2-7: CO2 Emissions

Compliance Summary | Energy Use | Emissions | Project Details

End Use	Standard Design Emissions Electricity (kg of CO2)	Standard Design Emissions Fuel (kg of CO2)	Standard Design Emissions Total (kg of CO2)	Proposed Design Emissions Electricity (kg of CO2)	Proposed Design Emissions Fuel (kg of CO2)	Proposed Design Emissions Total (kg of CO2)	Emissions Margin Total (kg of CO2)
Space Heating	222		222	43	621	664	-442
Space Cooling	35		35	50		50	-15
IAQ Ventilation	25		25	50		50	-25
Water Heating	119		119	203		203	-84
Self Util/Flexibility Credit				-212		-212	212
Compliance Total	401		401	134	621	755	-354
PV & Battery	-96		-96	-289		-289	193
Flexibility							0
Inside Lighting	55		55	110		110	-55
Appl. & Cooking	79	252	332	158	252	411	-79
Plug Loads	196		196	391		391	-195
Exterior	14		14	28		28	-14
Project Total	649	252	902	532	873	1,406	-504

2.11 Errors & Technical Support

If the program will not run (not an error, but a functional problem), see Section 2.1.1 to determine if you need to reinstall the program.

Information helpful in determining the location of an error is found in two places – the log file, or one of the error files.

***USER TIP*:** If you cannot find an error, send your *.ribd25 file (found in the CBECC-Res 2025 Projects folder) and identify which version you are using (e.g., 2025.1.0) along with your question/request to cbecc.res@energy.ca.gov.

The border at the bottom of your screen identifies the version. For the quickest response, please send your request to the general support email (not individual staff members).

2.11.1 Log File

Select ***tools*** and pick the option "***view project log file***." (**NOTE:**

This file is cumulative. If it contains errors already corrected, you can pick "***delete project log file***," run the file again, and then it contains only the most recent error(s)). This file provides clues as to what is wrong.

Look for the word "error" and look for a word that offers a clue to where the error is located:

```
2025-06-09 14:29:16 - Project Saved
2025-06-09 14:29:17 - Performing Building Database check...
2025-06-09 14:29:17 - Building Database check completed, no problems
found.
2025-06-09 14:29:17 - Error:  unable to format the following numeric
string:  '%s' - evaluating run u, rule: Rule 1226, 19,
'Rules_Rpt_BuildingSummaryCSV.rule' Line 2723: Write DHWSys1 Water
Heater 1
2025-06-09 14:29:17 - Error:  unable to format the following numeric
string:  '%s' - evaluating run u, rule: Rule 1226, 19,
'Rules_Rpt_BuildingSummaryCSV.rule' Line 2723: Write DHWSys1 Water
Heater 1
2025-06-09 14:29:17 -    Analysis being performed by CompMgrVersion
'BEMCmpMgr 2025.1.0 RC (2588)' via SoftwareVersion 'CBECC-Res
2025.1.0 RC'
2025-06-09 14:29:17 - Error:  All compliance projects with
dwelling(s) must include DHW equipment and assignments to
zones/dwelling units. - evaluating run u, rule: Rule 851, 116,
'Rules_ModelChecks.rule' Line 878: Ensure DHW in New Cons projects
2025-06-09 14:29:17 - Error:  DHW System 'DHW System 1' is assigned
to one or more dwelling units/zones but no valid DHW heaters (w/
counts > 0) are assigned. - evaluating run u, rule: Rule 851, 120,
'Rules_ModelChecks.rule' Line 949: Ensure DHWSys objects not
assigned to serve BOTH new/altered & existing areas
2025-06-09 14:29:17 - ERROR:  Error encountered evaluating rulelist
'ProposedModelCodeCheck'
2025-06-09 14:29:17 - Analysis errant
```

This identifies a problem with the water heating system.

2.11.2 CSE Errors

In some cases, a California Simulation Engine (CSE) error results in an option to view a CSE error file. To locate this file, click ***Tools***, ***View Project Folder***. Find a subfolder with the same name as the input file appended with '- Comp25'. Inside are two files identified as file type "*.err." The files open in Notepad or Text pad and can offer clues to the error.

If you cannot solve your error, send your *.ribd25 file (located in CBECC-Res 2025 Projects folder) to cbecc.res@energy.ca.gov. Identify which version of CBECC-Res you are using along with your question/request.

2.11.3 Potential Errors

Following is a list of potential error messages, but not. They are very high-level errors and can often be confusing to make sense of. Most user errors are caused by a unique set of conditions in your file:

1 : pszCSEEXEPath doesn't exist
2 : pszCSEWeatherPath doesn't exist
3 : pszDHWDLLPath doesn't exist
4 : One or more missing files (CSE, ASHWAT or T24*(DHW/ASM32/TDV/UNZIP/WTHR) DLLs)
5 : pszBEMBasePathFile doesn't exist
6 : pszRulesetPathFile doesn't exist
7 : Error initializing BEMProc (database & rules processor module)
8 : Error initializing compliance ruleset
9 : Invalid project log file name (too long)
10 : Error writing to project log file
11 : Building model input/project file not found
12 : Error reading/initializing model input/project file
13 : Error evaluating ProposedInput rules
14 : Error retrieving CSE weather file name (from Proj:WeatherFileName)
15 : Energy (CSE) simulation weather file not found
16 : Error retrieving DHW weather file name (from Proj:DHWWthrFileName)
17 : DHW simulation weather file not found
18 : Error retrieving required data: Proj:RunID and/or Proj:RunAbbrev
19 : Analysis processing path too long
20 : Error evaluating ProposedInput rules
21 : Error evaluating PostProposedInput rules
22 : Error evaluating BudgetConversion rules
23 : Error evaluating CSE_SimulationPrep rules
24 : Unable to create or access analysis processing directory (Section 2.1)
25 : Unable to open/delete/write simulation output file (.csv or .rep)
26 : Unable to open/delete/write simulation weather file
27 : Error copying simulation weather file to processing directory
28 : Unable to open/delete/write simulation input (.cse) file
29 : Error writing simulation input (.cse) file
30 : CSE simulation not successful - error code returned
31 : DHW simulation not successful
32 : Error encountered loading CSE DLL(s)
33 : Error evaluating ProposedModelCodeCheck rules
34 : Error evaluating ProposedModelSimulationCheck rules

35 : Error evaluating ProposedModelCodeAdditions rules
36 : User aborted analysis via progress dialog 'Cancel' button
37 : Error evaluating ProposedInput rules
38 : Error performing range and/or error checks on building model
39 : Error evaluating CSE_SimulationCleanUp rules
40 : Analysis aborted by calling application (via analysis callback function)
41 : Error evaluating ProcessResults rules
42 : Error evaluating ProposedCompliance rules
43 : Error(s) encountered reading building model (project) file
44 : Error(s) encountered evaluating rules required analysis to abort
45 : Invalid results object types encountered when copying results between models
46 : Error copying results objects from a previous model
47 : Error setting up check of weather file hash
48 : Input model contains one or more objects with the same name
49: Missing Zone CSE include file
50: Error evaluating OneTimeAnalysisPrep rules
51: Invalid results object types encountered when copying final results to user model
52: Error copying results objects from the final run into the user model
53: Unable to open/delete/write CSE include file
54: Error copying CSE include file to processing directory
200: Error generating model report
201: Unable to write compliance report file (.pdf or .xml)
202: Error(s) encountered generating compliance report file (.pdf or .xml)
203: Error evaluating CheckFileHash rules
204: Weather file hash failed consistency check
205: Attempt to save project inputs (including results) following analysis failed

2.12 Batch Processing

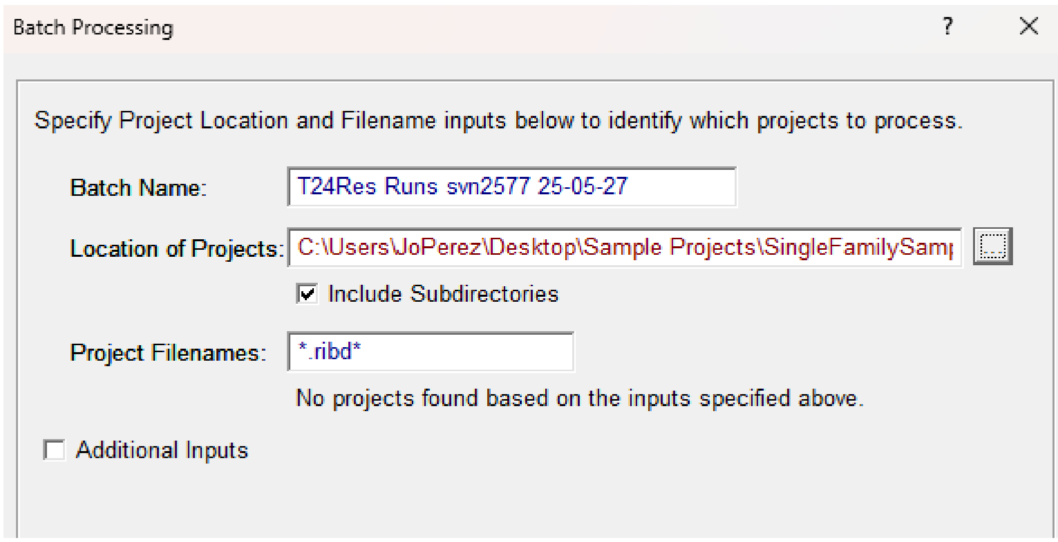
An option (tools menu) called batch processing allows you to run a group of files for comparison. Possible scenarios are adding one feature at a time to achieve compliance, comparing options for achieving compliance, or comparing different groups of features. This is a powerful and time-saving tool to run a group of files without any interaction from you.

Good planning tips are to make sure your first input file runs without any errors. Either put the files in their own folder or provide a unique input file name. Use the run title field (analysis tab) to identify the variables you're testing (the information displays at the top of the CF1R).

Naming suggestions are Job 09623 for Main Street project:

1. 09623.Main.1.ribd25 / run title “Base”
2. 09623.Main.2.ribd25 / run title “high efficiency DHW”
3. 09623.Main.3.ribd25 / run title “2 + high eff HVAC”
4. 09623.Main.4.ribd25 / run title “base + battery”

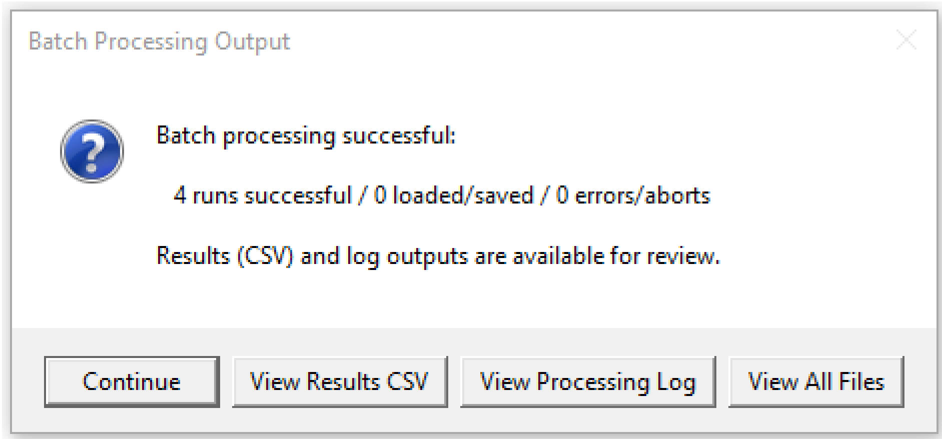
Figure 2-8. Batch Processing Inputs



Once everything is set up,

- Select File, New (so you have a blank project),
- Select Tools and Batch processing (last option on list),
- Location of Projects (default location is the folder you were last in or select browse (…)),
- Project Filenames is the unique part of the names, with an asterisk as the wild card (Figure 2-10),
- Additional Inputs includes an option to run the file in all 16 climate zones
- Select Process.

Figure 2-9: Batch Processing Complete



At this point you can select any of these options. Most likely responses are view results CSV (pens an Excel spreadsheet with compliance results) or continue (which ends the process). If you had the CF1R option turned on, the CF1Rs are in the projects folder.

IMPORTANT: As you move on, it will ask if you want to save the current file. The correct response is no. You could inadvertently save the results/project details of a different file.

2.13 File Clean Up

Because CBECC-Res stores a lot of information in different folders on your computer, it makes sense to clean up the projects folder. There are step-by-step instructions in the April 16, 2020, Frequently Asked Questions ().

Find the project files, which are typically stored at C:\Users\'UserName'\Documents\CBECC-Res 2025 Projects. As long as you keep the *.ribd25 file, other files can be recreated. Even being conservative and keeping the XML file and the CF1R, you may want to:

1. Delete folders named with the filename (lots of unnecessary files are stored in these folders).
2. Sort files by type.
3. Keep input files (*.ribd25) / CBECC-Res 2025 project files.
4. Keep XML file for uploading (*.CF1RPRF01E-BEES.xml) / XML document.
5. Keep the CF1R PDF file / Adobe Acrobat document.
6. Delete other files.

Keeping only the input file and the XML file for uploading retains your files in the most efficient manner. Other files can be re-created when an analysis is performed.

2.14 Background Colors

The following background color convention is used in displaying data on the dialogs:

- White background = available for user input
- Gray background = not user editable

2.15 Status Bar

The status bar at the bottom of the screen provides useful information about each input field. There are three panes on the status bar with context-sensitive information. The same information is displayed in the tool tips if you allow the mouse to linger over an input field.

Input Description Pane – Concise descriptions of the selected input field are displayed at the far left of the status bar.

Input Classification Pane – The next pane to the right on the status bar displays a set of labels that indicates whether an input is required, optional, or unavailable for input (Table 2-1).

Data Source Pane – The pane at the far right of the status bar displays a set of labels that identify the source of the information (if any) contained in the field. This distinguishes between information that is dictated by the compliance checking process and the information entered, for which you are responsible. The data source labels are explained in Table 2-2.

Table 2-1: Input Classification Explanations

TEXT DISPLAYED	EXPLANATION
No field selected	No building data field is currently selected.
Input is compulsory	Data is required; the program cannot perform a compliance analysis without this input.
Input is required	Data is required if the field is applicable to your project.
Input is optional	If applicable to your project, you may enter a value; a default value is always acceptable.
Input is Critical Default	You may overwrite the data with a more appropriate entry. You must be prepared to provide documentation substantiating the input value.
Field is not editable	The data in this field cannot be edited either because it is defined by the compliance ruleset, is not applicable to the selected compliance ruleset, or is an intermediate calculated parameter (meaning it is only referenced in this location and must be edited at the source of the input).
Navigation input	The purpose of the selected field is to enable you to select a component for editing without having to exit the current component and choose the next component from the tree

Table 2-2: Data Source Explanations

TEXT DISPLAYED	EXPLANATION
No field selected	No building data field is currently selected.
Value from user	The data shown is defined by the user either by direct input or through a wizard selection.
Value from simulation	The data shown is defined by an energy simulation.
Value undefined	No data is defined for the field.
Value from program	The data in this field is defined by the program either to implement requirements and procedures specified in the Energy Code or to conform to building energy modeling conventions.

3 Tutorial

NOTE: *This tutorial is specific to CBECC 2025.*

This tutorial takes about an hour, but is time well spent!

USER TIP: A basic knowledge of the Energy Code is assumed as a foundation for using CBECC. You should know how compliance is determined (Section 1.3). Operating the program is only a small part of a successful building simulation. As the documentation author, you are responsible for the content of the compliance report produced by CBECC and submitted to the enforcement agency showing compliance with Title 24, Part 6. If errors are discovered late in the construction process, the effects can be costly. The program will not prevent you from violating the Energy Code (e.g., an R-0 exterior wall may run, but is not legal in new construction).

This is a step-by-step tutorial for modeling a simple single-family residence in *CBECC2025.* The tutorial will help you become familiar with how components are created.

The tutorial begins with a blank project. It is the only way to learn how the program works, where items are located, and how connections are made (window types and the window entries). You will likely never start with a blank project again. The example files included with the program are listed in Section 2.2 and included in the CBECC "Projects" directory. They can be used to either see how to model complicated features or be used as an example of the correct way to model a project. You can also use them as your starting point.

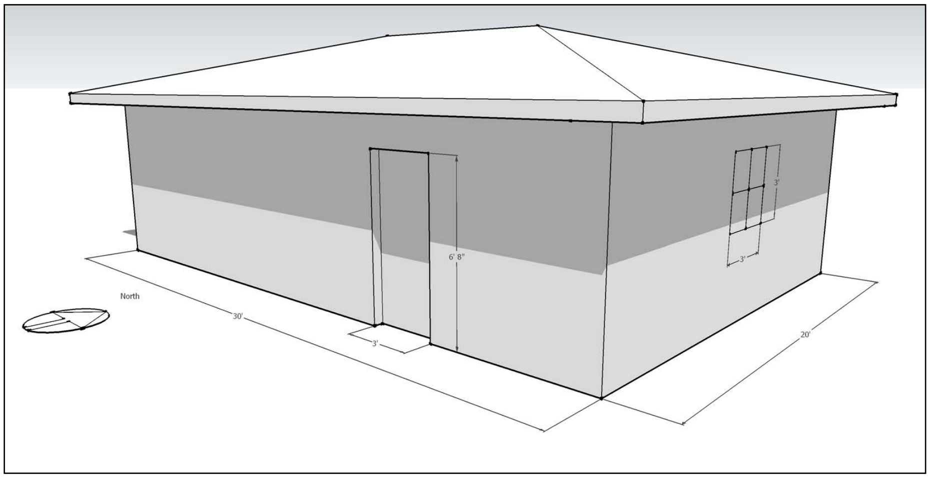
Not every input is discussed in this tutorial, but the user manual does include information about every input. To find things in this manual, you can use control-F to search, the table of contents, or the index. Additional information is also included in the 2025 *Single-Family Residential ACM Reference Manual*, which describes how the standard design is determined. These descriptions may provide insight to your compliance results.

USER TIP: As you progress through the tutorial, look around the screens and fields to get an idea of where features are located and how connections are made.

3.1 Simple House Example

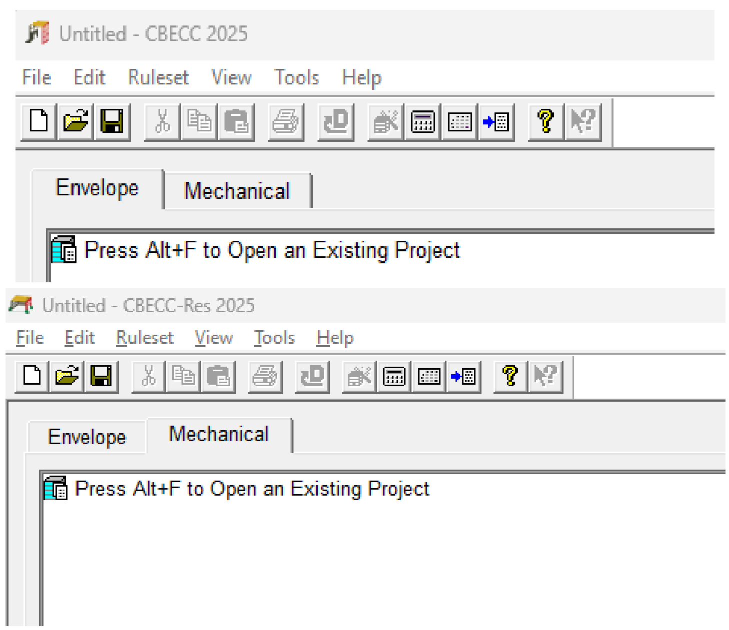
The house pictured in Figure 3-1 has a 30 ft by 20 ft living area, 8-ft ceilings with an attic above, and a slab-on-grade floor.

Figure 3-1: Simple House Example (front facing south)



On the front is a single 3'-0" x 6'-8" front opaque door. The left has two 6’0” x 4’0” windows. Back has two 3'0” x 3'0” windows and a 6’0” x 6’8” sliding glass door. Right has a 4'0” x 5'0” window.

Figure 3-2: Opening screen / start with a blank project



3.1.1 Tutorial, Project Data

1. Download and install the CBECCprogram. (The program can be downloaded from the [CEC’s approved programs website](https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-energy-code-compliance-software) -https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-energy-code-compliance-software).

2. Start the program and choose “Start with a Blank Project” and click <OK>. See Figure 3-2.

3. Right click on the line with “Press Alt+F to open…,” choose create, and pick project. Change Project 1 to “Simple House” and click <OK>. (This is your input file name, and you should give thought to how you will name your projects.)

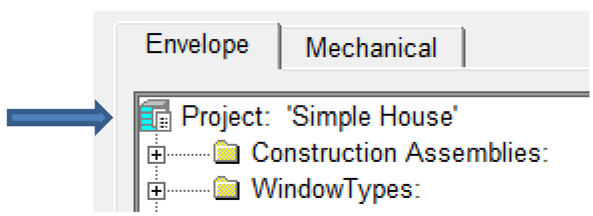
4. Select climate zone 10 (Riverside). (You can select any climate zone you like; however, program defaults and your results may be different.)

5. You are now seeing the ***Project*** tab of the building model data. The name “Simple House” is in project name and is the default name for your input file. This would normally be a client’s name/job number. Enter the address by tabbing (if you accidentally click OK, see the user tip below #6):

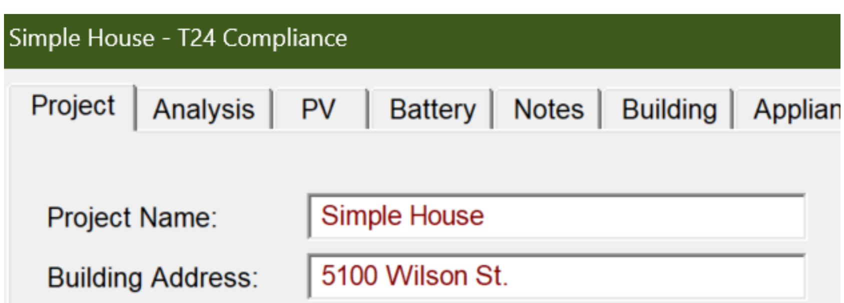
   5100 Wilson St.
   Riverside, CA
   92509
   It displays CZ10 (Riverside)   Representative city for zone 10

6. Click the ***Analysis*** tab to enter a run title. The run title appears on the CF1R in a prominent place and can be used for general information or a compliance variable (e.g., w/ high efficiency HVAC). We will enter “T24 Compliance.”

USER TIP: To get back to the screens with Project, Analysis, Cool Vent tabs, because you clicked ok and are now here:



Double click on the top row (Project: ‘Simple House’ for this file) to get back to here:



7. Check the boxes to Generate Report(s) ☑ PDF and ☑ Full (XML). This will generate both a CF1R and the file that will get uploaded to the ECC provider. The remaining inputs are kept as defaults.

8. At the bottom is the run scope, which we will keep as newly constructed.

USER TIP: If simulation speed is set to "quick" you will not get a valid CF1R or file for uploading. Results use compressed time periods which can be used in early simulations to get a high-level view of compliance results.

9. Click on the Photovoltaics (***PV***) tab. In the DC system size, enter 2 (and tab). This reveals several additional inputs. For now, we will leave them all as defaults.

10. Set PV Scaling to Standard Design PV. Once the standard design PV size is known, and as you bring the building into compliance, you can set the scaling to allow you to enter a slightly different size. Another feature on this screen is Reduced PV Requirement. This reveals the various PV exceptions. Section 4.4 has information about these inputs. The checkbox 'Default Reduced PV Requirement Data' will automatically apply the reduced PV requirement and the appropriate exception.

11. Skip the next two tabs (***Battery*** and ***Notes***). Read more in Section 4.5 about batteries. ***Notes*** appear on the CF1R before the signature page.

12. Pick ***Building*** and either leave the description blank or enter a brief description such as "Single Family Residence." Leave air leakage status and rate as defaults.

13. Quality insulation installation (QII) is defaulted to "No." Although not a mandatory requirement the standard design for all single-family new construction includes QII.

    USER TIP: Help your clients learn about QII if you set this to yes, as there are two ECC inspections: (1) at the framing stage, and (2) at the insulation stage. If the project fails one of the ECC inspections, you must remove it, and it can be extremely difficult to make up for that credit after the fact.

14. Enter a front orientation as "180" (based on the north arrow in Figure 3-1). If this house was in a subdivision, you would check perform multiple orientation analysis.

15. This is a single-family project; there is no accessory dwelling unit (keep the default no); and enter 2 bedrooms.

16. We will be using natural gas. Do not check "has attached garage." **NOTE**: For an existing input file with a garage you need to remove, uncheck this box, then you can delete the garage zone.

17. On the ***Appliances/DHW*** tab, when the building is more defined, you can specify if the washer and dryer are in the house, or you can uncheck them if outside or in a garage zone.

18. Just to point it out, if a compact water heating distribution system is being modeled, this is where that feature is set. See Chapter 9 for the inputs).

19. We will skip the ADU tab because there is no ADU.

20. On the IAQ tab, we will leave it as default. Once we enter the conditioned zone it will determine the maximum vertical distance from the height of our zone and calculate the minimum IAQ ventilation rate accordingly.

21. Cool Vent is where we model the whole house fan, but this cannot be set until the building is more fully defined. Climate zones 8-14 include a whole house fan in the standard design and not including this feature can have a big negative effect on cooling. Click <OK> to continue.

22. So that we do not lose our work, click on the save button (default name is Simple House.ribd25) and pick save. The file is automatically saved in the projects folder. If you select <File>, <Save As> you can name it something different or save it somewhere different. Now that it is named, saving is a one-step process of pressing save icon on the tool bar.

    USER TIP: A word of caution about putting in a different location – people have been known to lose files, so it is important that you remember where you saved your file.

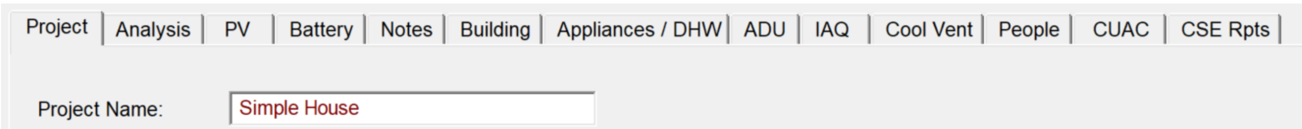
3.1.2 Tips for Getting Around

This is a good point to cover some general information.

> *NOTE:* At some point you are encouraged to read Chapter 1 if you are new to compliance, Chapter 2 for using this program effectively, and Chapter 4 for more on fundamentals such as project scope, PV, indoor air quality, and whole house fans. After that, as you use the program you will want to search for and read the user manual for guidance on specific inputs, there are helpful tips, websites, and resources for finding equipment efficiencies or cool roof products. For the complex topic of additions, Chapter 10 covers the topic thoroughly.

- The project is named Simple House (the default name for the input file). This name appears at the head of the project tree of the main CBECC-Res screen.
- To add components, on the parent component, right-click and choose <create>.
- To edit an existing component, either double click on the contents of the field to change the information, or right click and pick <edit> or <rename>.

- If you need to edit or check a project component (address, climate zone, front orientation) double click on “project” to bring up the Project tabs screen.



- Items in Construction Assemblies and Window Types are not part of your building. Do not define your windows using either one. These are libraries from which you will construct your conditioned zone. At this point the folders are empty but will be populated by the time the input file is fully created.

3.1.3 Tutorial, Zone Data

Back to the tutorial . . .

1. With the cursor on ***Project: Simple House***, right-click. From the drop-down menu hover on <create> and choose <***zone***>. Change the name Zone 1 to “House” and click <OK>.

2. At the next dialog box, the ***zone type*** is already set to “Conditioned”. Enter “600” for the floor area and “8” for the average ceiling height. Click <OK>.

3. On this screen (***Zone Data***), the number of stories in the zone is 1. “Bottom” is defining the floor level above grade. Enter 0.67 for slab (a floor over a crawl space must be at least 2).

   USER TIP: Zone data (number of stories and zone bottom) for a multistory building is explained in Sections 5.1.1.5 and 5.1.1.8.

4. Next, we will add an HVAC system which currently shows – none -.

   a. Click the drop-down menu arrow at the ***HVAC System*** box and choose to <Create new HVAC System>. Accept the default name by clicking <OK>.

   b. At the ***HVAC System Type***, pick from the drop-down menu “Other Heating and Cooling System” and click <OK>. Or you could pick heat pump. RARELY used is Variable Outdoor Air . . .” which is ONLY for a variable speed, central fan integrated (CFI) ventilation cooling system.

   c. When the ***HVAC System Data*** screen opens, define the system, starting with the ***Heating Unit***.

   d. On ***Heating Unit*** pick from the down arrow <create new heating system>. Keep the default name and click <OK>. The first one listed is a central furnace. So that you know what is here, click on the down arrow to see all types available. We will pick "CntrlFurnace" and click <OK>. We will keep 80% AFUE and click <OK>.

e. On ***Cooling Unit*** follow the same process – pick <create new cooling system>, keep the default name (normally you will want to use a descriptive name such as Split 14, or No Cooling). For the type, as with heating, there are many options (no cooling is at the very top of the list). For now, we will select SplitAirCond and <OK>. The efficiencies are minimum, and the AC charge (refrigerant charge) is set to default based on the climate zone. Because other ECC tests are already required, we will keep the AC charge, and for the SEER/SEER2 we will keep it as 14.3.

f. The EER/EER2 field has default values based on the SEER/SEER2. If the equipment has a higher EER/EER2, enter a higher number. Values higher than 15 SEER, 14.3 SEER2, 12.2 EER, and 11.7 EER2 require ECC verification.

NOTE: At another time, read about multi-speed and zonally controlled equipment in Chapter 8. There are some situations where it is advisable to model less than 350 CFM/ton (it incurs an energy penalty, but the exception is there for a reason).

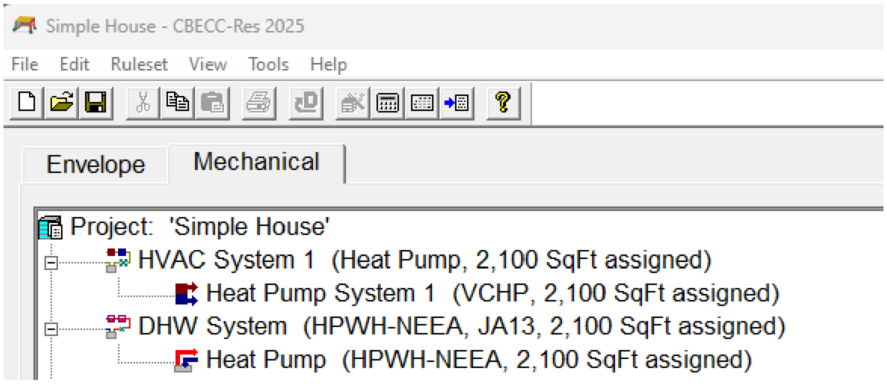
g. In the ***Distribution*** field follow the same procedure— keep the default name, select ducts located in attic and uncheck "keep the default values" (default values based on the climate zone). Change the R-value to R-6. Click <OK>.

USER TIP**:** If the "use defaults" is unchecked other fields become available. For example, specifying where the supply and return ducts are located, or low leakage air handler allows specifying a lower leakage target than the default 5% duct leakage.

h. Next create the ***Fan*** data. Pick the only option available, which is a single speed fan and click <OK>. The program defaults to the required W/CFM cooling value of "0.45." If we had specified a heat pump it would be 0.58. Click <OK>.

i. You are now back at the ***HVAC System Data*** tab. Beneath Heating unit, it shows the central furnace with 80 AFUE, the Cooling shows 14.3 SEER2, 11.7 EER2. If there were two identical systems, you could change the count to 2. Click <OK> to return to the ***Zone Data***.

USER TIP: Although we will not edit the HVAC system, to do so click on the **Mechanical** tab at the CBECC-Res main screen. The **Mechanical** tab is where the libraries of HVAC, DHW, IAQ, cool vent equipment resides.



5. Next, we will define the domestic water heating (***DHW System***) by selecting “create new DHW System.” Keep the default system name and click <OK>.

    a. We likely could meet compact distribution criteria (Section 9.4.1) if we had a floor plan. For now, we will keep the dwelling unit distribution as “standard”.

    b. For ***Water Heater(s)*** pick “create/import new Water Heater”. Keep the default name. Keep the heater type as gas, select tank type “consumer instantaneous (UEF)”. You may have seen the Uniform Energy Factor (UEF) change to the default 0.81, which we will keep for now. We will not check that there is a mini tank given the size of this house. Click <OK>. Keep the count as 1 and click <OK> again.

    c. Back on the zone data tab, everything needed is complete. Click <OK>.

NOTE: It is important to develop a good habit of creating short descriptive names.

3.1.4 Tutorial, Surfaces

1. Add components from the top of the house down beginning with a 600 square foot ceiling. With your cursor on House, right click and choose <create> and then “Ceiling (below attic)” about 1/3 of the way down (the list is not alphabetical).

2. Change the name to “Ceiling” and click <OK>.

3. Follow the prompts – the area is 600 square feet. Pick ‘create a new construction assembly’. Change the name to “Ceiling R38” and click <OK>.

4. Ceiling R38 has the construction type of wood framed ceiling. In the **Cavity Path** column of Cavity / Frame pick R38. Because this is ceiling insulation, we do not need to pick one of the compressed values. For the **Frame Path** pick 2x4 at 24 in. O.C. The checkboxes for non-standard spray foam or raised heel truss are not applicable.

5. Watch the screens as you click <OK> three times so you see the connection of the construction assembly, to the ceiling, to the zone. Now you are back to the main screen.

6. When we created the ceiling, the program created an **attic zone** with 600 square feet. Double click on the attic zone. Change the **roof rise** from 5 to 3 to match the plans. Keep the **conditioning** as ventilated.

   NOTE: The area of the zone is derived from the ceiling area.

7. The **construction** is a default tile roof. We need to change this. Climate Zone 10 includes below roof deck insulation in the standard design, if we do not change to a better construction the project will likely not comply (see ***User Tip*** in Section 5.2.1 for more about the importance of roof deck insulation). Pick create new object. We will try R13 (it is less than the standard design but still very beneficial). Name it "Roof R13 below deck." Copy data from "Tile Roof" and click <OK>.

8. Change the details to include R13 in the **Cavity/Frame** row. Do not check radiant barrier (RB). **(NOTE**: While RB affects compliance, the location of the roof deck insulation makes it much less effective. Leave the roof tile with an air gap - **Roofing Type** is "steep slope..." and **Roofing** is 10 PSF (RoofTileAirGap). Click <OK>.

9. A cool roof is "standard" for this zone. Change Solar Reflectance from 0.1 to 0.2. Keep the IR Emittance as 0.85 (these two values, 0.2/0.85, are the defaults for cool roof) and click <OK>.

10. To create exterior walls, move the cursor to House (600 ft^2).

    a. Right-click and choose <create> and then pick <exterior wall>. Change the Exterior Wall Name to "Front" and click <OK>.

    b. Enter a gross area of 240 square feet of wall area, and for the construction assembly create a new construction. Call it R19 + R5 Wall and click <OK>. For Cavity, pick R-19 in 5-1/2 in cavity, and for framing change it to 2x6 at 16 in. O.C., select sheathing insulation of R-5 and an exterior finish of synthetic stucco (this is the appropriate method for modeling 1-coat stucco). **NOTE about sheathing**: Either whole R-values are selected, or you can "specify R-value" to enter a value such as 4.8. Before proceeding, notice that the U-factor is 0.051 (standard design walls have a 0.048 U-factor) meaning there will be is a slight energy penalty for the walls. Click <OK> twice.

    c. Leave the wall ***Tilt*** as 90 (this is not orientation; walls are 90 degrees unless they are not vertical).

    d. Change the ***Orientation*** to front. This value is the plan orientation. Resist the urge to use numbers for the plan orientation for anything other than angle walls. Read Section 7.1 for more on plan azimuth versus orientation. Click <OK>.

e. Move to the ***House*** row and repeat steps a. through d. three more times for a "Left," "Back" and "Right" wall with the gross wall area of 160 square feet for left and right walls, 240 square feet for back wall) and orientation (<Left>, <Back> or <Right>).

   ***USER TIP*:** When creating anything, the program has a <Copy Data From> feature. It is a time saver. For the right wall, copy the left wall and the only thing you need to change is orientation. For the back wall copy the front wall and change the orientation.

11. Before creating any windows, first set up the ***Window Types*** library. Move to the window types row, right-click and pick create and window type. Name the window "Oper" (for your use only, it does not appear on the CF1R) and click <OK>.

    Leave everything as is or blank except for U-factor and Solar Heat Gain Coefficient (SHGC). Our client wants to see if 0.32 U-factor and 0.25 SHGC windows (2016 standards values) will work. Type in the values **(for future reference, do this even if accepting the default values)** 0.32 U-factor and 0.25 SHGC and click <OK>.

    USER TIP: The process for using window types is described in Section 6.13. It allows updating all window efficiencies in 2-3 steps rather than editing every window entry individually. Typing in the values for U-factor and SHGC changes them from blue to red, which confirms it is done correctly. The window type name is for your use only, it does not appear on the CF1R.

12. Move the cursor to ***Window Types***, right-click and create a window type naming it "Door" (for sliding glass or French doors). Click <OK> and enter 0.31 and 0.25 for U-factor and SHGC values.

13. Move up to the "House" zone and enter the building's doors, windows, and doors with glass. Move the cursor to the front wall. Right click on the ***Front***, choose <create> and then click on <InputDoor> for opaque doors (doors with ≥ 25% glass are treated as windows).

    Follow the prompts, naming it Entry, it has 20 square feet, and we will keep the new default U-factor which is 0.20. Click <OK> to return to the main screen.

14. Now move to ***Left***, right-click, <create> a window.

    a. Name it L1 and click <OK>.

    b. The next dialog box asks you to choose between ***window dimensions*** and ***overall window area***. Choose window dimension so an overhang can be modeled and click <OK>.

    c. Select the window type "Oper" we created. Move down to width and enter 6 feet. For height enter 4 feet (the area is calculated). Change the multiplier to 2. It captured the U-factor and SHGC from the window type. Click <OK>.

NOTE: The total is for one window, the CF1R will reflect 48 ft^2 total.

d. To add an overhang, click on the ***Window Overhang*** tab at the top of the screen. You will see an illustration of the inputs. Enter a ***Depth*** of 2.5 feet, a ***Dist Up*** of 1 foot, and an ***Extends Left*** and ***Extends Right*** of 3 feet each. Leave the ***Flap Height*** as 0. Complete the overhang by clicking <OK>.

USER TIP: Save space on the CF1R by unchecking the model fins and/or overhangs when there are no overhangs. Otherwise, when checked, an entire row with 0s shows on the form.

15. Right click on ***Back*** to <create> a window.

    a. Name it B1, pick copy data from L1, and click <OK>.

    b. Change the window width to 3 feet and height 3 feet and keep the multiplier of 2 because we will model identical overhangs for the two windows. Click on the overhang tab and change ***Extends Left*** and ***Extends Right*** values to 4 feet. If the overhangs were different, you would enter the windows individually. Click <OK>.

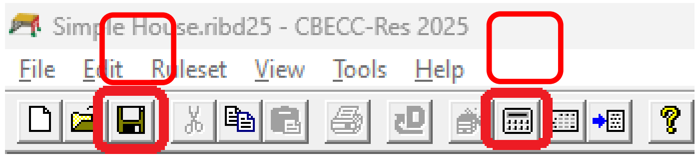
    c. Put the cursor on the back wall, right-click to create another window, naming it B2 SGD, copy window B1. Change window type to “Door” from library (notice that it picked up the 0.31 and 0.25 efficiencies). Change the width to 6 feet and a height of 6.67 feet. Change the multiplier to 1. Click on the ***Overhang*** tab and change the overhang to a left distance of 3 and a right distance of 10 and click <OK>.

16. Finally, right-click on ***Right*** wall using the same method to create a window. Name it R1. Copy data from the B1, changing the window width to 4 feet and height to 5 feet and a multiplier of 1. On the ***Overhang*** tab change ***Extends Left*** and ***Extends Right*** values to 5 feet each. All other data remain the same. Click <OK>.

17. Next move the cursor back up to “House (600 ft^2).” Right-click and choose <create> and then pick <Slab on Grade>, keeping the default name. Enter an area of 600 square feet, a floor elevation of 0.67 feet (the level of the surface of the floor above grade) and a perimeter of 100 feet (length of the four sides exposed to the exterior). (If there was a garage, the edge includes only the lengths adjacent to the exterior.) Keep the surface set to default 80% covered, 20% exposed. Click <OK>.

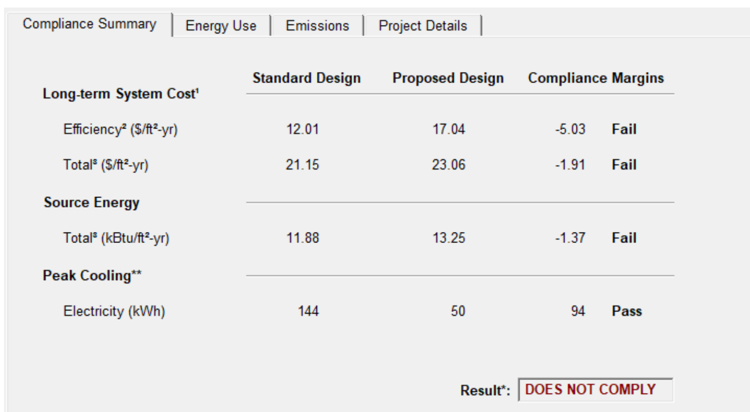
3.1.5 Tutorial, Running Analysis

1. To perform an analysis, save your input file using the ***Save*** shortcut key, and the ***Perform Analysis*** shortcut key. Confirm that our PV size is “standard design.” CBECC-RES will perform the simulation of the current model, which takes 2 minutes or less.



2. When the analysis is complete, you can either “view the compliance report” (CF1R), or press continue to see only the compliance summary. These are the results with the new LSC information.

Figure 3-3: Compliance Summary



USER TIP: Energy use details provide useful information for determining why the project does not comply.`. What it does show is standard design values. Where is it most out of compliance? Which is the biggest contributor to the energy use of the building? Use that to figure out where there are opportunities for improvement.

3. Water heating is the largest contributor to the energy use with space heating second with. What does that mean? With space heating and water heating having negative compliance margins, those are good candidates for improvements.

Figure 3-4: Energy Use Details

Compliance Summary | Energy Use | Emissions | Project Details

End Use	Standard Design Site Elec. (kWh/yr)	Standard Design Site Gas (therms/yr)	Standard Design LSC[1] ($\$/\text{ft}^2$-yr)	Standard Design Source (kBtu/ft^2-yr)	Proposed Design Site Elec. (kWh/yr)	Proposed Design Site Gas (therms/yr)	Proposed Design LSC[1] ($\$/\text{ft}^2$-yr)	Proposed Design Source (kBtu/ft^2-yr)	Compliance Margins LSC[1] ($\$/\text{ft}^2$-yr)	Compliance Margins Source (kBtu/ft^2-yr)
Space Heating	1,638		6.24	2.48	149	125.8	8.08	5.62	-1.84	-3.14
Space Cooling	223		0.83	0.15	145		0.49	0.09	0.34	0.06
IAQ Ventilation	277		0.88	0.22	277		0.88	0.22	0.00	0.00
Water Heating	1,268		4.06	4.95	1,029		3.34	0.91	0.72	4.04
Self Util/Flexibility Credit					98		-1.20	-0.74	1.20	0.74
Compliance Total	3,406		12.01	7.80	1,699	125.8	11.59	6.10	**0.42 (3.5 %)**	
PV & Battery	-4,222		-5.14	-0.87	-4,190		-8.15	-1.12	3.01	0.25

4. But to make this tutorial as useful as possible, we will try trading off some simple features.

5. Click on the **Mechanical** tab and double click on the Heating and Cooling Systems to change the efficiencies. Change the heating system AFUE to 95 (not 0.95), and the cooling efficiency to 16 SEER. Next, double click on the Distribution System and check the box for “use defaults for all inputs below”.

   USER TIP: We did not change anything but the efficiency and duct insulation R-value, so that is all there is to it. If for example the heating system was named Furnace 80, we would also need to change the name, but HVAC System 1 is already assigned to the house on the zone data tab, so we do not need to do anything else.

6. Click on the **Envelope** tab and we will change the windows to model the new minimum efficiencies. This will let you see how this feature works when set up properly.

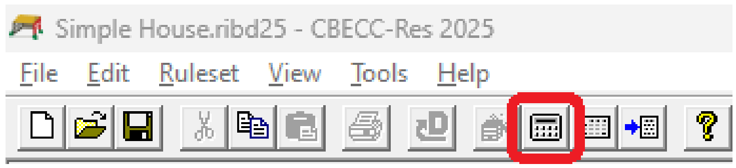
7. Click on ***window types***, double click on “Oper”, and change the U-factor to 0.30 and SHGC to 0.23. Click <OK>. Make the same change to “Door” (0.30 and 0.23).

8. To verify they were entered correctly, double-click on widow L1, and make sure the windows show 0.30 U-factor and 0.23 SHGC. That is how you can change window efficiencies in an entire house in 2-3 steps. Click <OK>.

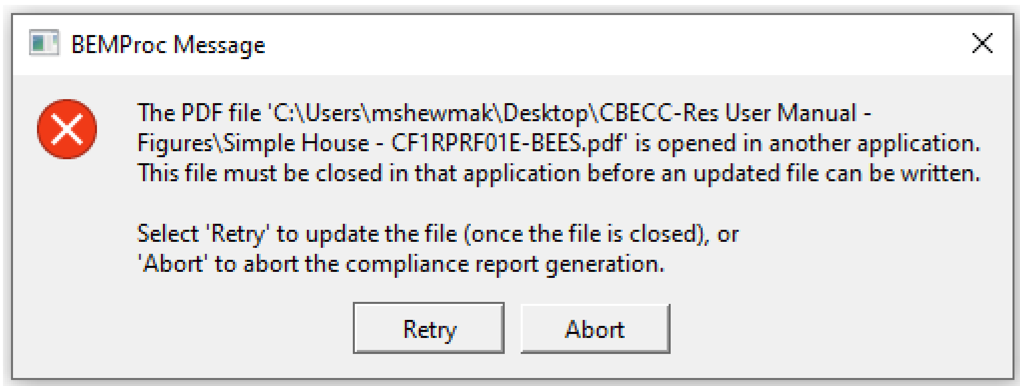
9. Double-click on the **Project**, then click the **Cool Vent** tab to add a whole house fan. From the ***Cooling Ventilation*** selection, pick “Default Prescriptive Whole House Fan.” We will check ECC Cool Vent Verification to get full credit for the fan.

10. Click on the analysis tool, first it will ask us to confirm the PV option is standard design, next it will tell us that it needs to save the file before running. Click <OK>.

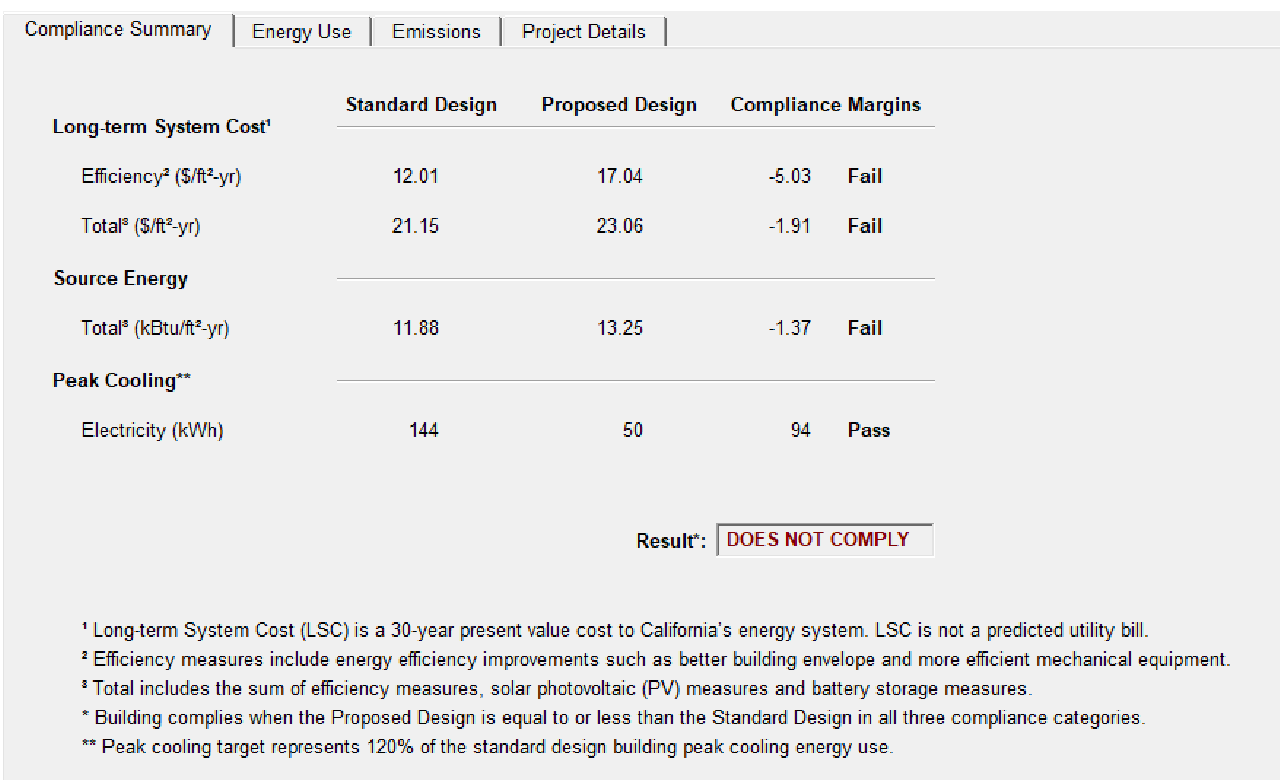
    NOTE: We could have saved the file first, so it is your choice if you view this as a time-saver or not. As long as we did not intend to change the file name, it saves a step.



11. While waiting for the file to run, a tip. Have you ever been stuck at 84% and wondered what is holding things up? When the CF1R is open, your file will not complete until you close the PDF and pick “retry”:



12. The results show that the project still does not comply and requires improvements :



Compliance Summary | Energy Use | Emissions | Project Details

	Standard Design	Proposed Design	Compliance Margins	
Long-term System Cost[1]				
Efficiency[2] ($/ft²-yr)	12.01	17.04	-5.03	**Fail**
Total[3] ($/ft²-yr)	21.15	23.06	-1.91	**Fail**
Source Energy				
Total[3] (kBtu/ft²-yr)	11.88	13.25	-1.37	**Fail**
Peak Cooling**				
Electricity (kWh)	144	50	94	**Pass**

Result*: DOES NOT COMPLY

[1] Long-term System Cost (LSC) is a 30-year present value cost to California's energy system. LSC is not a predicted utility bill.
[2] Efficiency measures include energy efficiency improvements such as better building envelope and more efficient mechanical equipment.
[3] Total includes the sum of efficiency measures, solar photovoltaic (PV) measures and battery storage measures.
* Building complies when the Proposed Design is equal to or less than the Standard Design in all three compliance categories.
** Peak cooling target represents 120% of the standard design building peak cooling energy use.

(Results may vary)

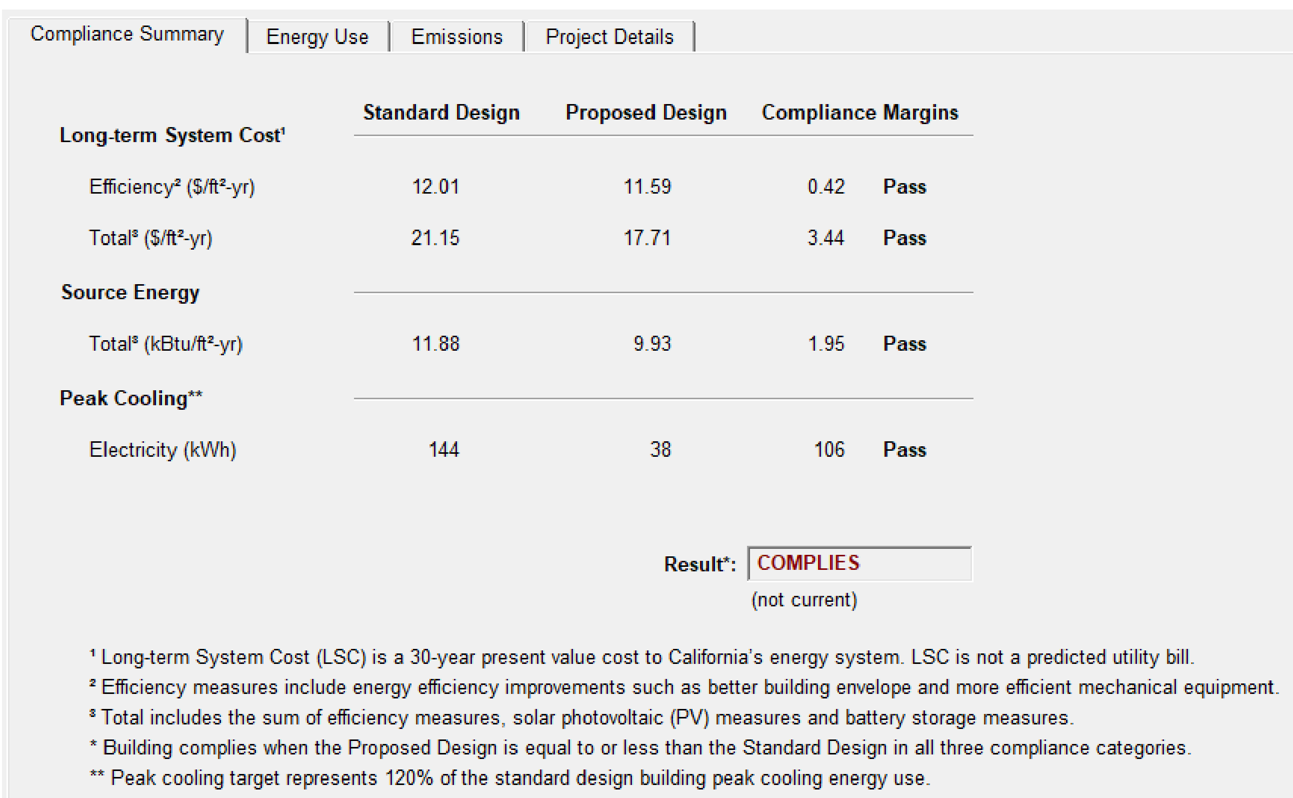
13. Go back to the **Mechanical** tab and double click on the Water Heater and change the ***Heater Type*** to Heat Pump. For the ***Category***, select Residential (NEEA rated), and for NEEA HPWH Brand select the option for "(generic)". For the Model select "UEF 2 (50 gal)" and leave the Tank Location and Outside Air Source in their default configuration.

14. Double-click on **Project**, then click the **Appliances/DHW** tab and using the dropdown menu for ***DHW Distribution Compactness***, select "Expanded Credit (ECC Req'd)". Leave the Compactness Factor at 0.6.

15. Click on the **Building** tab and using the dropdown menu for ***Quality Insulation Installation***, select "Yes". Click <OK>.

16. Click on the analysis tool, to reperform the analysis. It will again ask us to confirm the PV option is standard design, and it will tell us that it needs to save the file before running. Click <OK>.

17. The results now show that the project complies.



	Standard Design	Proposed Design	Compliance Margins	
Long-term System Cost[1]				
Efficiency[2] ($/ft²-yr)	12.01	11.59	0.42	**Pass**
Total[3] ($/ft²-yr)	21.15	17.71	3.44	**Pass**
Source Energy				
Total[3] (kBtu/ft²-yr)	11.88	9.93	1.95	**Pass**
Peak Cooling**				
Electricity (kWh)	144	38	106	**Pass**

Result*: COMPLIES
(not current)

[1] Long-term System Cost (LSC) is a 30-year present value cost to California's energy system. LSC is not a predicted utility bill.
[2] Efficiency measures include energy efficiency improvements such as better building envelope and more efficient mechanical equipment.
[3] Total includes the sum of efficiency measures, solar photovoltaic (PV) measures and battery storage measures.
* Building complies when the Proposed Design is equal to or less than the Standard Design in all three compliance categories.
** Peak cooling target represents 120% of the standard design building peak cooling energy use.

18. Your CF1R likely tells you (via watermark) that the project needs to be registered. Every new construction project requires ECC verification and thus registration with a ECC provider. Chapter 1, Sections 1.7.4 and 1.7.5, cover how to generate the XML and find the file. Beyond that you need to pick an ECC provider and learn their process.

19. If the watermark shows something else, such as not useable for compliance, see Section 1.7.

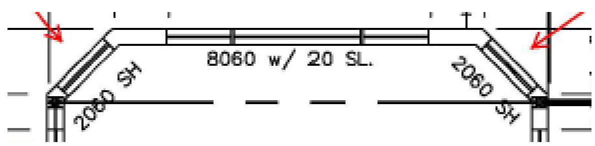
3.1.6 Tutorial, Conclusion

1 Although this tutorial started with a blank project, most people use the example files that come with the program. Section 2.2 has the list of files that are in your project folder. Many demonstrate how to model a specific feature. They also serve the function of providing a skeleton for a house or addition.

2 Help with error messages is documented in Section 2.11.

3 Registering projects is documented in Section 1.7.4 and 1.7.5.

4 Please read Section 7.1 to know how to enter angled surfaces. If 8060 is "back" what is the wall orientation for the 2060 windows? Hint you do not need a site plan to correctly enter these walls and windows.



4 Project

4.1 General Information

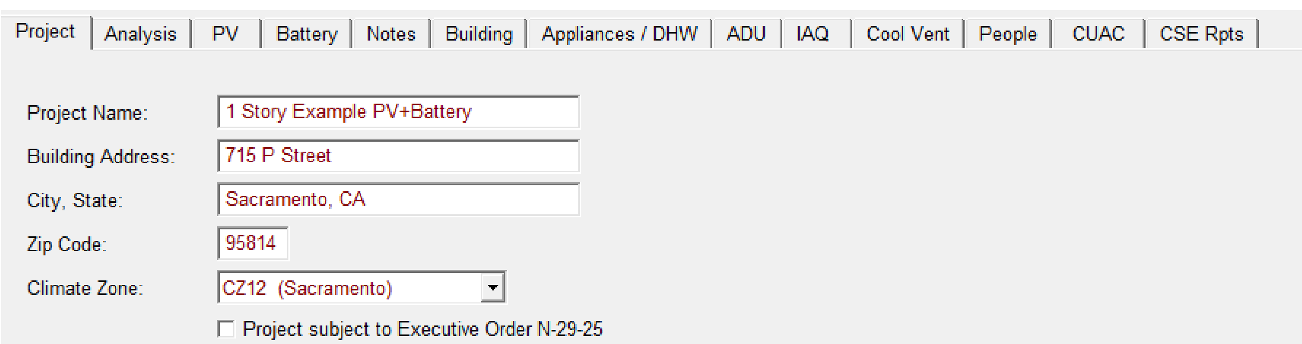
It is often best to start with an existing input file for a similar project, which will have the structure of the building set up (example files included are listed in Section 2.2). Be sure to note the climate zone because the sample file may have features that are not appropriate for a mild or cold climate. Because new sample files are made when program improvements are made or errors corrected, use the newest files available. Other alternatives available to you are to start with a blank project as demonstrated during the tutorial, or to use an existing input file.

NOTE: To access information on the Analysis or Building tabs (address, front orientation, or number of bedrooms), double-click on the top row ("Project: . . .") from either the Envelope or Mechanical tab.

4.2 Project Information

Double-click on the project row to access the tabs illustrated in Figure 4-1.

Figure 4-1: Project Information



4.2.1 Project Names and Descriptions

NOTE: To assist with wrapping when columns are narrow, use short names and include spaces (for windows, walls, HVAC systems names).

In addition to the project name, there is one additional field available for unique information about the project on the CF1R. Figure 4-2 identifies these inputs and where they appear on the CF1R:

Figure 4-2: CF1R Descriptions

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: 1 Story Example PV+Battery **Calculation Date/Time:** 2025-05-27T14:4

Calculation Description: 1 Story Example **Input File Name:** 1storyExample.ribd25

GENERAL INFORMATION				
01	Project Name	1 Story Example PV+Battery		
02	Run Title	1 Story Example		
03	Project Location	715 P Street		
04	City	Sacramento, CA	05	Standards V
06	Zip code	95814	07	Software V

4.2.1.1 Project Name

The project name is user-defined field that appears as the first piece of general information on the CF1R.

4.2.1.2 Building Address

Enter a building address, assessor's parcel number (APN), or legal description to identify the location of the proposed building project.

4.2.1.3 City, State

Enter the city or town in which the proposed building is located.

4.2.1.4 Zip Code

The zip code used to establish the correct climate zone.

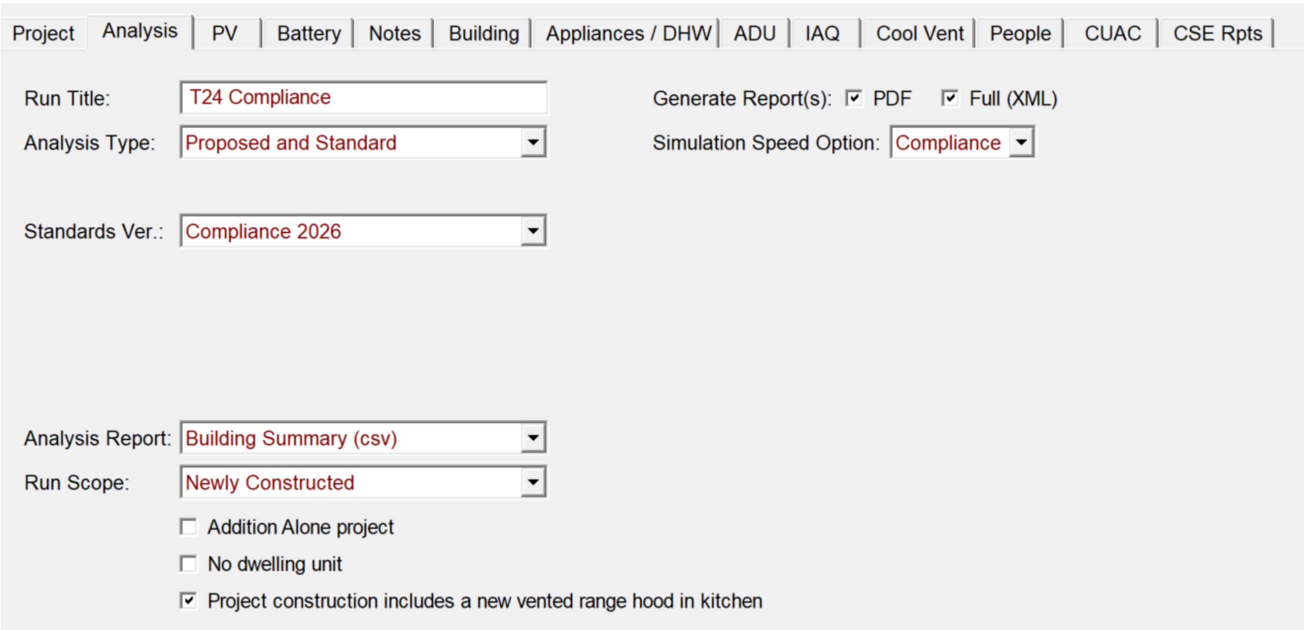
4.2.1.5 Climate Zone

Use online resources to find the climate zone for the project zip code.

4.3 Analysis

The inputs for this screen will vary slightly if the project scope is any type of addition.

Figure 4-3: Analysis Information



4.3.1 Run Title

Run title is a user-defined field for useful project information that appears in a prominent location on the CF1R.

4.3.2 Analysis Type

The two types of analysis are ***proposed and standard design*** (typical for compliance) and ***proposed only***.

4.3.3 Standards Version

Default Compliance 2026.

4.3.4 Generate Report PDF (the CF1R)

To generate a PDF of the Certificate of Compliance (CF1R) at the end of the analysis, check the PDF box. The PDF automatically generated when this box is checked will have a watermark identifying that the CF1R is not registered (if an addition does not require any ECC verified measures, there is no watermark). The watermark changes to the ECC provider's watermark once the project is registered (Section 1.7).

Once the CF1R has a registration number and a ECC provider watermark it can be printed and submitted to the building department to obtain a building permit.

NOTE: If the CF1R has a watermark stating that it is not useable for compliance, this is an indication of one of several situations:

(1) The project does not comply,
(2) The compliance was run using the quick simulation speed option,
(3) The CF1R was generated via the tools option “Generate Draft T-24 Compliance Report” rather than as part of the compliance run (as explained in the frequently asked questions, this is a security feature),
(4) Your project includes a feature that is not yet approved for compliance (this may require technical support help to identify because it means we made a mistake - send the *.ribd25 file to cbecc.res@energy.ca.gov), or
(5) The software is out of date and no longer certified for compliance.

If the CF1R does not open at the end of a compliance run, the PDF file can be found in the CBECC-Res 2025 Projects folder with the same name as the input file.

4.3.5 Full (XML) (the ECC Upload File)

Check this box to produce the XML file that gets uploaded to a ECC provider data registry. The file is generated during the simulation. The file is located in the CBECC-Res 2025 Projects folder named:

<input file name> - **CF1RPRF01E-BEES.xml**

Although XML files are easily modified, the ECC providers have in place security measures to reject files that are modified. You can read more about this in the Frequently Asked Questions.

4.3.6 Simulation Speed Option

Options include Compliance and Quick. Quick allows results approximately 40 percent faster. Results are typically within 5 percent accuracy of the more detailed and lengthy Compliance simulation. To obtain a CF1R that can be registered, results must be from a simulation run in Compliance mode.

4.3.7 Analysis Report

The default report type is Building Summary (csv).

4.3.8 Run Scope

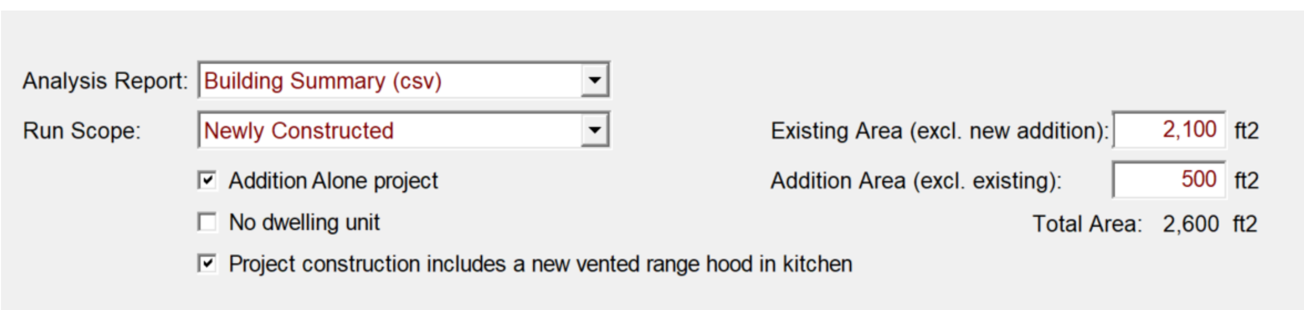
The two types of projects are ***Newly Constructed*** (which includes an addition alone) and ***Addition and/or Alteration***. Select addition and/or alteration only if modeling the existing building. Otherwise select ***Newly Constructed*** and check ***Addition Alone***.

NOTES: For a project to be considered an addition, it must be attached to an existing building. Otherwise, an existing unconditioned space must be converted to a newly conditioned space to be classified as an addition. (See Section 100.1 of the 2025 Building Efficiency Standards for definitions of an addition, newly conditioned space, and newly constructed building).

If you have determined (based on information in Chapter 10 or other documentation), that an accessory dwelling unit (ADU) must comply as newly constructed rather than as an addition, do not identify it as an ADU on the building tab. The ADU options were designed to address the unique IAQ requirements for additions that are classified as a “dwelling unit.”

You must also provide information that affects mandatory indoor air quality requirements (Figure 4-4). The requirement to specify the existing and new floor areas affects internal gains and (if an addition exceeds 1,000 ft^2) indoor air quality requirements.

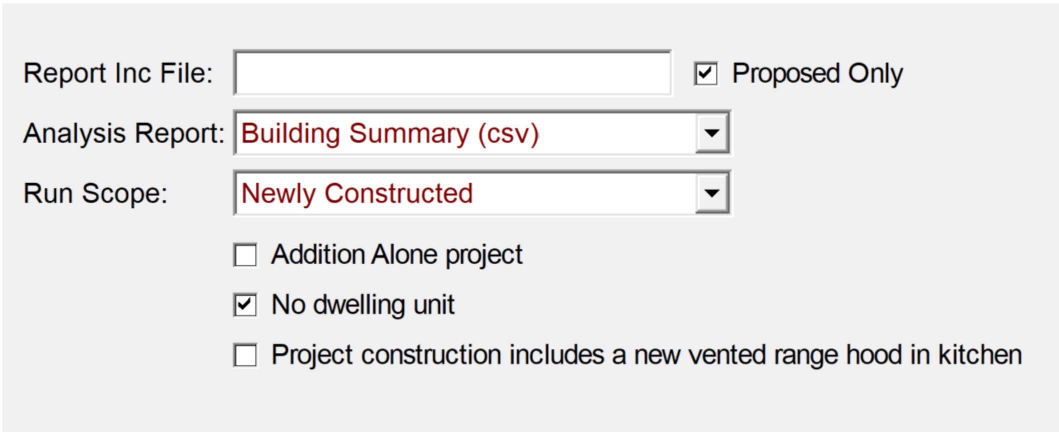
Figure 4-4: Run Scope, Addition Alone



4.3.9 No Dwelling Unit

Users have the option of modeling their project as a non-dwelling unit if applicable. This option is made available for all project run scopes.

Figure 4-5: No Dwelling Unit Option



4.3.10 Project Construction Includes a New Vented Range Hood in Kitchen

This checkbox is available for all projects. It triggers the new ECC verification requirement for kitchen range hoods to meet mandatory requirements for airflow and sound (Energy Code, §150.0(o)2B).

For addition/alteration projects, if there is no vented range hood in the kitchen in the scope of the project, leave this box unchecked.

4.3.11 Existing Area

This is the conditioned floor area of the existing building. This area is used primarily for determining the correct indoor air quality requirements if any apply.

4.3.12 Addition Area

This is the conditioned floor area of the addition used to determine if indoor air quality requirements apply.

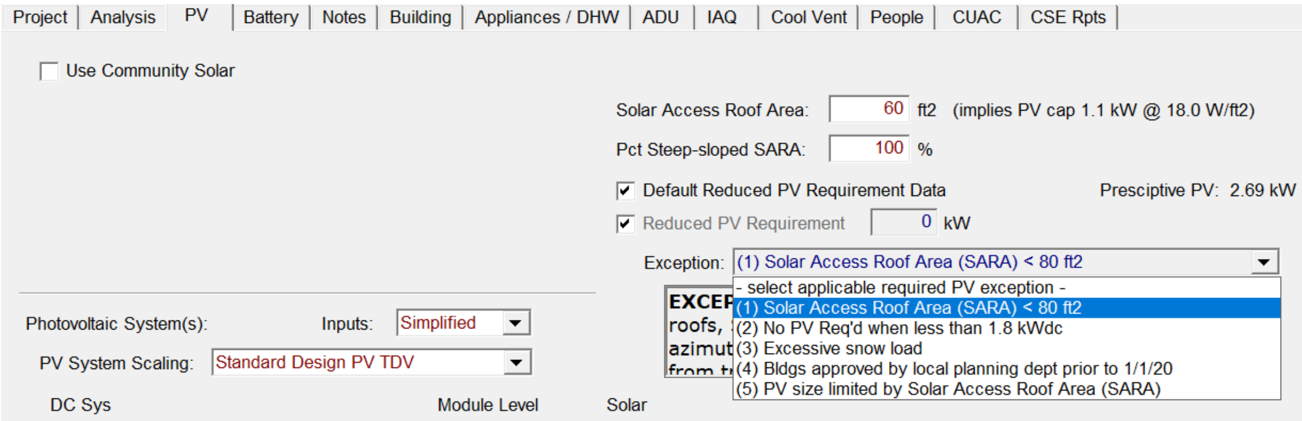
NOTE: If the zone data for the addition zone is defined, you can right-click and pick restore default.

4.4 PV System Credit

USER TIP: To move through the fields on this screen, tab rather than selecting enter.

NOTES on PV: Until a solar professional is providing input on the PV system designed for the construction project, most of the assumptions used for compliance are going to be guesses. Your best choice for the PV System Scaling dropdown is “Standard Design.” (Once you know what that value is you can tweak it up or down.) The five exceptions in Section 150.1(c)14 are implemented to allow PV size requirement be reduced, activated by checking the “Reduced PV Requirement” box (see 4.4.5 below).

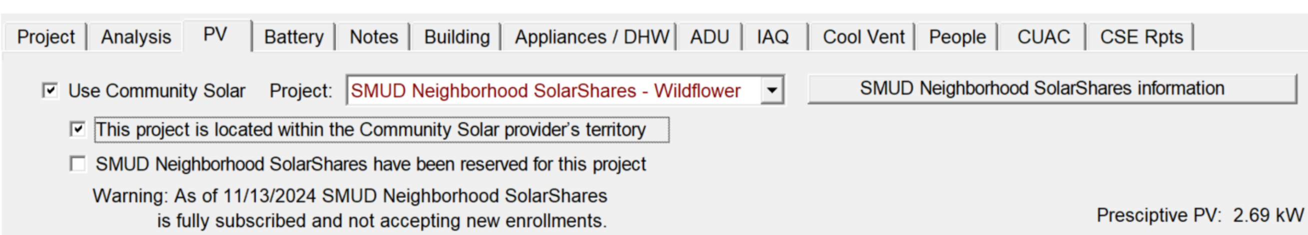
Figure 4-5: PV



4.4.1 The PV credit uses calculations based on [PVWatts](). If information beyond that found here or in the Single-Family Residential ACM Reference Manual is needed, consult [PVWatts]() technical documentation.Use Community Solar

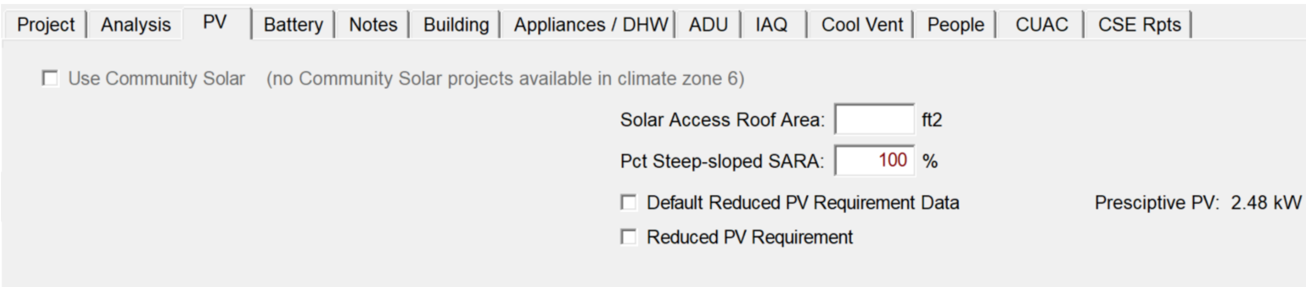
The CEC approved the community solar projected for the Sacramento Municipal Utility District (SMUD) service territory. This project is the Neighborhood SolarShares (NSS) program. However, as of 11/23/2024, the SMUD Neighborhood SolarShares has been fully subscribed and now close for new enrollments. By confirming that the project is in an appropriate Community Solar provider’s territory and verifying that the subscription to the SolarShares has been accepted, the required PV is automatically calculated using the NSS program’s site PV characteristics to size the required PV system for the building.

Figure 4-6: Community Solar in Applicable Climate Zones



Until other community solar programs are approved, the option to use community solar is not available to those outside of SMUD territory.

Figure 4-7: Community Solar Not Available



4.4.2 Solar Access Roof Area

SARA includes the area of the building's roof space capable of structurally supporting a PV system, and the area of all roof space on covered parking areas, carports and all other newly constructed structures on the site that are compatible with supporting a PV system per Title 24, Part 2, Section 1511.10. See Section 140.10(a) of the 2025 Building Energy Efficiency Standards for more details.

4.4.3 Percent Steep-sloped SARA

4.4.4 Default Reduced PV Requirement Data

4.4.5 Reduced PV Requirement

Checking this box activates the exceptions, most of which are based on prescriptive exceptions in Section 150.1(c)14. Some may result in a reduced PV requirement. Other than Assembly Bill (AB) 178, these are summaries only and you need to refer to the Energy Code for the full requirements of the exception.

1. For steep-sloped roofs, no PV system is required if the Solar Access Roof Area (SARA) is less than 80 contiguous square feet.
2. No PV system is required when the minimum PV system size specified by Section 150.1(c)14 is less than 1.8 kWdc.
3. Excessive snow load: No PV is required for building sites where the design snow load exceeds the PV system rating and are unable to comply with the California Building Code and California Residential Code snow load structural requirements (Title 24, Part 1, section 1-313).
4. Plans approved prior to 01/01/2020.

4.4.6 If the roof cannot accommodate the standard design PV size, the required PV can be reduced to the maximum PV system size that can be installed on the building's Solar Access Roof Area (SARA).

4.4.7 Photovoltaic System(s)

Inputs options include Simplified or Detailed.

4.4.8 PV System Scaling

Options available are:

- User Specified Sizes: Models the specified PV size. As explained earlier, the 2025 Single-Family Residential ACM Reference Manual limits the size of PV systems to approximately the amount of PV needed to meet the building's electric needs (excluding heating and water heating). Setting this value does not mean you will get credit for that value. See User tip below.
- Standard Design PV: The software will automatically scale the PV size to meet the standard design PV size, disregarding the input system size.
- Maximum PV for Compliance Credit: This option will automatically scale the PV size to the maximum Total LSC credit based on the proposed design, regardless of the input system size. For buildings without a battery storage system, the maximum credit is equal to the PV kWh output that matches the annual kWh load of the building. For buildings with a battery storage system, the maximum credit is 1.6 times the annual kWh load of the building. However, when PV kWh output exceeds the annual electricity use, it may violate Net Energy Metering (NEM) rules and the homeowner/builder should contact the local utility before checking this option.
- Specify PV System Scaling: This option will model the input PV system size with any value for scaling from 1 (no battery) to 1.6 (if a battery is modeled).

USER TIP: Check the CF1R carefully. You may believe you are modeling a certain size system, but CBECC-RES applies limits set out in the Single-Family Residential ACM Reference Manual. For example, you could put in 20, but because you cannot build an inefficient building and make up for it with PV, you are only receiving the benefit of 2.8 kWdc. To determine the PV size being simulated, check two areas on the CF1R:

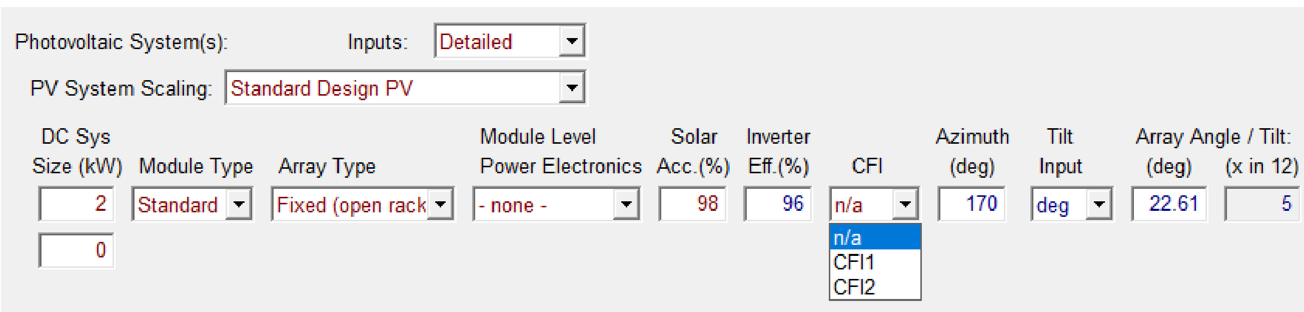
1. Required Special Features; and

REQUIRED SPECIAL FEATURES
The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.
• PV System: 2 kWdc • Battery System: 5 kWh (Self Utilization Credit taken) • Whole house fan • Cool roof • Insulation below roof deck • Window overhangs and/or fins

2. Required PV System.

REQUIRED PV SYSTEMS						
01	02	03	04	05	06	07
DC System Size (kWdc)	Exception	Module Type	Array Type	Power Electronics	CFI	Azimuth (deg)
2.8	NA	Premium (~18-20%)	Fixed	none	true	150-270

Figure 4-8: PV Array Inputs



4.4.9 DC System Size (kW)

Enter the PV system size in kWdc.

4.4.10 Module Type

Select the most appropriate option based on information on the module data sheet:

- Standard is a typical poly- or mono-crystalline silicon module, with efficiencies of 14-17 percent.
- Premium is appropriate for modeling high efficiency (approximately 18-20 percent) monocrystalline silicon modules that have anti-reflective coatings and lower temperature coefficients.

4.4.11 Array Type

Options are Fixed (open rack), Tracking (one axis), and Tracking (two axis).

4.4.12 Solar Access (%)

This input is to account for the effect of shading on the building's PV system effectiveness. For example, shading from adjacent buildings, chimneys, or other permanent obstructions may mean the output is only 97 percent effective. Horizon shading is already accounted for in the standard design. This value is confirmed during installation by an approved third-party PV sizing/shading tool (see JA11.4.1).

4.4.13 California Flexible Installation (CFI)

When California Flexible Installation (CFI1 or CFI2) is selected (more fully described in Section 4.4.2), inputs are simplified, with no requirement to include the specific orientation, tilt and shading conditions (typically an option for subdivision builders). When CFI is selected, the performance of the PV system is based on an average orientation and tilt.

- CFI1 allows the PV installation anywhere from 150 to 270 degrees.
- CFI2 allows the PV installation anywhere from 105 to 300 degrees.

When performance of the PV system is based on CFI, the ECC rater will verify that the modules are installed with an azimuth and tilt within the acceptable ranges. Additionally, each system on each site must meet the "minimal shading" criterion.

4.4.13.1 CFI1

With CFI1 selected, the performance is based on a PV system installed with an azimuth of 170° on a 5:12 roof pitch. Installation ranges allowed are from 150° to 270° on a roof with a pitch from 0:12 to 7:12)

4.4.13.2 CFI2

With CFI2 selected, the performance of the proposed system is derated by approximately 10 percent, with Installation ranges allowed are from 105° to 300° on a roof with a pitch from 0:12 to 7:12)

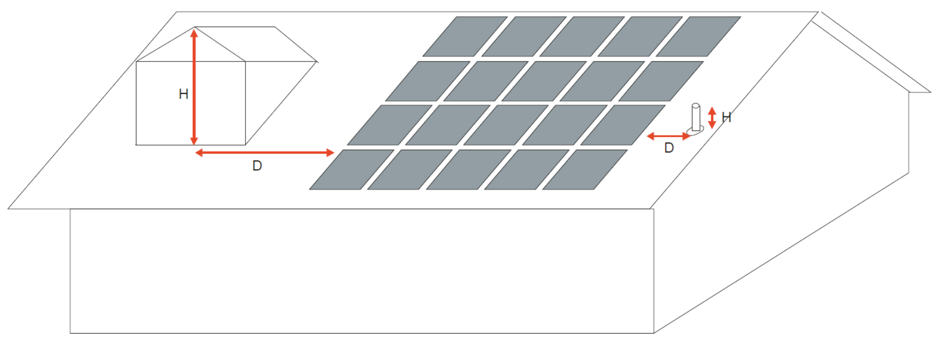
4.4.13.3 Minimal Shading

The "minimal shading" criterion is that no obstruction is closer than a distance ("D") of twice the height ("H") it extends above the PV modules (see Figure 4-9 for a depiction of "H" and "D"). As the figure illustrates, the distance "D" must be at least two times greater than the distance "H." Any obstruction that projects above any portion of the PV array must meet this criterion for the PV array to be considered minimally shaded.

Obstructions that are subject to this criterion include any:

1. Vent, chimney, architectural feature, mechanical equipment, or other obstruction that projects above the roof of the residential building with the installed solar system,
2. Part of the neighboring terrain that projects above the roof of the residential building,
3. Tree that is mature at the time of installation of the solar system or any tree that is planted or planned to be planted as part of the landscaping for the residential building (the expected performance must be based on the expected mature height of any tree planted or planned to be planted as part of the landscaping for the residential building),
4. Existing or planned residential building or other structure neighboring the residential building with the solar system, and
5. Telephone or other utility pole that is closer than thirty feet from the nearest point of the array.

Figure 4-9: Minimal Shading Criterion



4.4.14 Azimuth (deg)

For a fixed array, the azimuth angle is the angle clockwise from true north describing the direction that the array faces. An azimuth angle of 180 degrees is for a south-facing array, and an azimuth angle of zero degrees is for a north-facing array.

For an array with one-axis tracking, the azimuth angle is the angle clockwise from true north of the axis of rotation. The azimuth angle does not apply to arrays with two-axis tracking.

4.4.15 Tilt Input

Select the input type as either degrees or pitch (x in 12). When pitch is selected as the input, CBECC-Res determines the degrees (for example, a 4:12 pitch roof has an 18.43-degree angle).

4.4.16 Array Angle/Tilt

The tilt angle is the angle from horizontal of the photovoltaic modules in the array. For a fixed array, the tilt angle is the angle from horizontal of the array where 0 degrees = horizontal and 90 degrees =

vertical. For arrays with one-axis tracking, the tilt is the angle from horizontal of the tracking axis. The tilt angle is ignored for arrays with two-axis tracking.

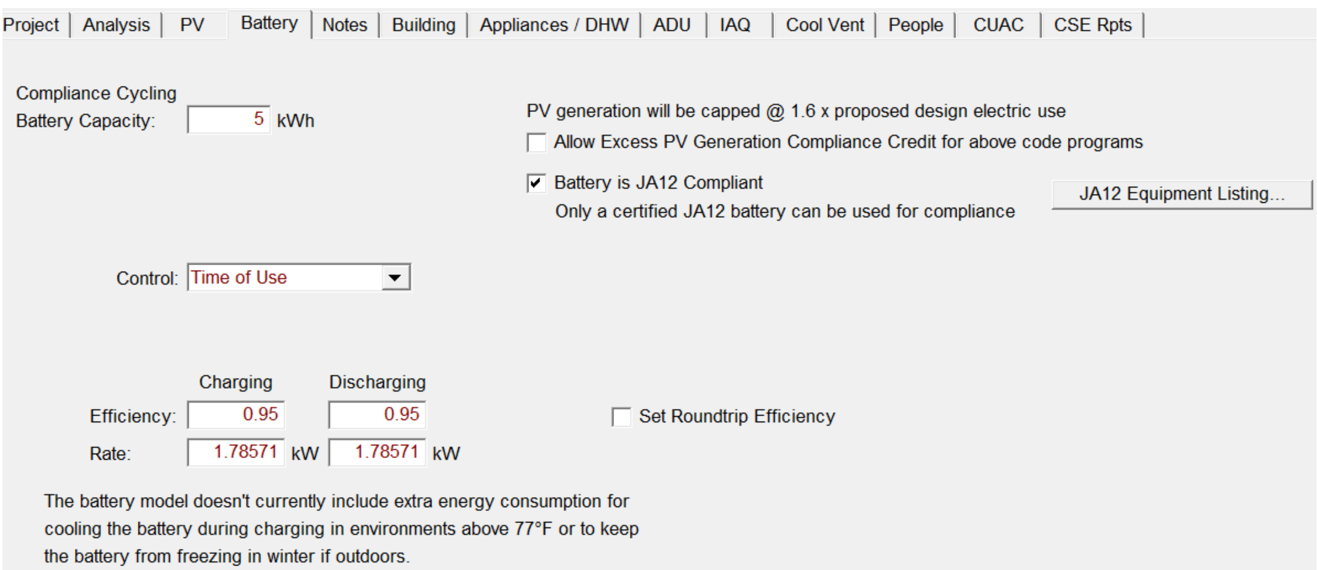
4.5 Battery Storage and NEM

Battery requirements are a powerful compliance option but get to know the requirements you are specifying. Reference Appendices, Joint Appendix 12 (Qualification Requirements for Battery Storage System) is a good place to start. Also, consider providing your client with a copy of the CF2R-PVB-02 – Battery storage form.

Once a battery capacity is entered, press “tab” on keyboard to reveal additional inputs.

Net Energy Metering (NEM) sets rules for compensating PV generated electricity. NEM sizing rules limit the PV to a size equal to the site annual kWh. Compensation varies by (1) behind the meter self-utilized kWh, (2) hourly exports, and (3) net annual surplus. In most cases, PV generation is capped at 1.6 times the proposed design electric use (meaning the home cannot become a mini solar power plant). For more details, see the Single-Family Residential ACM Reference Manual.

Figure 4-10: Battery Inputs



4.5.1 Total Rated Battery Capacity

Batteries must comply with *Reference Appendices*, Joint Appendix JA12, Qualification Requirements for Battery Storage System in the Single-Family Residential ACM Reference Manual Appendices. Approved battery storage systems are listed on the CEC’s website on the Solar Equipment List webpage at https://solarequipment.energy.ca.gov/Home/BatteryList.

The software compliance credit for a battery storage system coupled with a PV array requires a 5 kWh storage capacity or larger. For Energy Code compliance this credit has no impact on energy efficiency components (this means the effects of a larger PV size will likely not change the energy use summary). The reason this cannot be stated more definitively is because including a battery storage system allows downsizing of the PV system, in which case there could be a slight effect.

PV generation is capped at 1.6 times the proposed design electric use to meet Net Energy Metering (NEM) rules. The user can check box to allow credit for above code programs.

4.5.2 Allow Excess PV Generation Compliance Credit for Above-Code Programs

PV generation is capped due to something known as NEM limits (see above). NEM sets the rules for compensating excess PV generated by residential customers. By including battery storage, it is possible to increase the EDR credit for PV generation.

4.5.3 Battery is JA12 Compliant

Check this box once the installed battery is verified to be JA12 compliant. The "JA equipment listing" contains a link to the CEC Solar Equipment Lists.

4.5.4 Control

- **Basic**. The default basic control is a simple control strategy. This option assumes batteries are charged anytime PV generation is greater than the house load, and batteries are discharged when load exceeds generation. This control strategy does not allow the batteries to discharge into the grid. If the battery is a standalone (no PV system), then basic control is not an available control option.
- **Time of Use** [TOU]. The battery storage system begins discharging during the highest priced TOU hours of the day.

4.5.5 Efficiency

Charging and discharging efficiency and rate values from manufacturer's data (or default values).

4.5.6 Roundtrip Efficiency

As an optional input to entering separate charge and discharge efficiencies, roundtrip efficiency values from manufacturer's data (or default values) can be used.

4.5.7 Rate

Charging and discharging rate (in kW) from manufacturer's data (or default values).

4.6 Notes

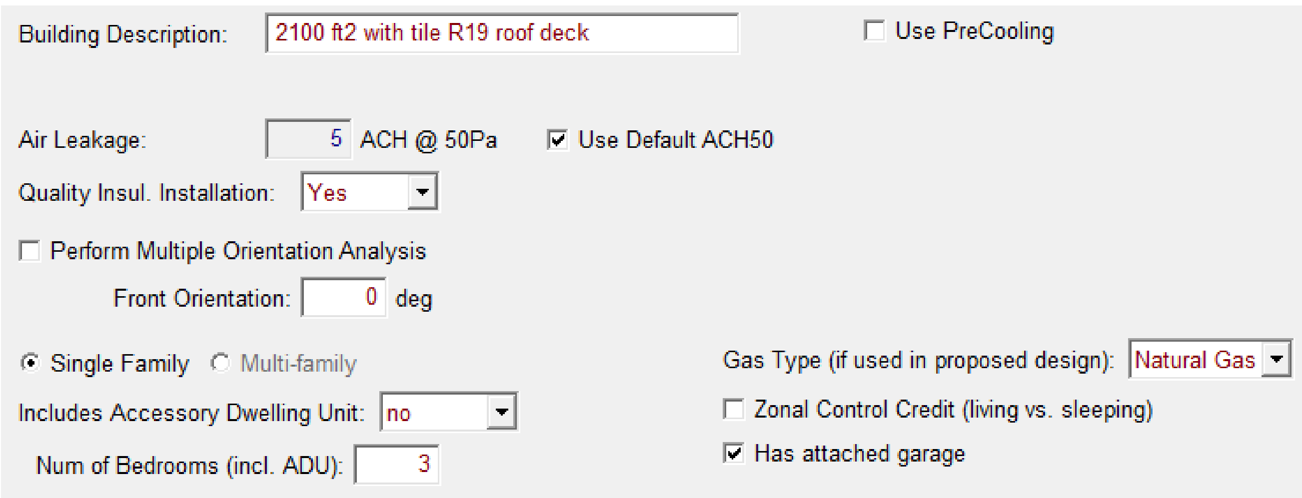
Include any project notes to appear on the Certificate of Compliance (CF1R). Information will appear prior to the signature page. The maximum space available is 10 lines. The font size allows for about 155-160 characters per row. To paste text from another document, use Control-V.

The project remarks field is for the program user. Text in this field is not printed on the CF1R.

4.7 Building

Inputs for the ***Building*** tab vary based on the run scope selected on the ***Analysis*** tab.

Figure 4-11: Building Information



4.7.1 Building Description

The building description is a field for the software user's own notes or project information. The information will not appear on the CF1R. It can be used to identify information such as a compliance variable being considered (e.g., "w/ high efficiency HVAC").

4.7.2 Use Precooling

Precooling will cool a building well below the typical comfort range when energy rates are low. The building temperature then floats up during peak energy cost periods. This allows building occupants to be comfortable while using no electricity during peak TOU rates.

This demand response measure requires controls meeting Section 110.12(a) of the Energy Code.

4.7.3 Air Leakage

Input as Air Changes per Hour at 50 Pascal (ACH50).

Default value (no blower door test) for buildings with space conditioning ducts in unconditioned space, and the default condition for no cooling, is 5 ACH50. When there are no heating and/or cooling system ducts in unconditioned space, the default is 4.4 for single family buildings and townhomes. If a single family or town home will have ECC verified infiltration testing (blower door test), model an achievable target leakage area value.

This input represents the air flow through a blower door at 50 Pascal (Pa) of pressure measured in cubic feet per minute, called CFM50 or ACH50. CFM50 x 60 minutes divided by the volume of conditioned space is the air changes per hour (ACH) at 50 Pa, called ACH50. When a value lower than default is modeled, diagnostic testing for reduced infiltration, with the details and target values modeled, is reported as a ECC Required Verification on the CF1R.

4.7.4 Quality Insulation Installation

Quality Insulation Installation (QII) is indicated as either yes or no. The default value is no, however, in most cases the standard design is yes, so there is a penalty for not including QII.

Yes, means an ECC rater will verify insulation installation complies with *Reference Appendices*, Residential Appendix RA3.5. Including QII should be communicated to the client because it involves multiple inspections and the consequences of failing one of these inspections could become an insurmountable problem. If one of the inspections fails and QII must be removed, it could be difficult to comply. Verification is applicable to all insulated assemblies in a newly constructed building or all new surfaces in an addition—ceilings/attics, knee walls, exterior walls, and exterior floors. See *Reference Appendices*, Residential Appendix RA3.5.

The standard design includes QII for all newly constructed buildings and additions greater than 700 square feet (ft^2).

4.7.5 Perform Multiple Orientation Analysis

Multiple orientation (or cardinal compliance) is a valid selection for subdivisions where homes will be built in any orientation. The building must comply with the same energy features in all orientations. A single CF1R will display the compliance results for the four cardinal orientations—north, east, south, and west.

4.7.6 Front Orientation

If the project is not a subdivision, indicate the front orientation in degrees, accurate within 5 degrees. This value is from the site plan. North is 0, east is 90, south is 180, and west is 270 degrees. While this input is typically the side of the building where the front door is located, if the front door, front façade, or the side of the building facing the street are different, any choice is acceptable as long as the end result is a CF1R with windows facing the correct actual azimuth.

NOTE: The front orientation or actual azimuth establishes the orientation of walls and windows, which are modeled using either labels such as “front” or “left,” or the orientation with respect to the front and not the actual orientation. See Orientation in Section 7.1 and carefully review the CF1R to ensure the correct information appears for azimuth of opaque surfaces and windows.

4.7.7 Single Family

This checkbox will automatically default to single family (R-3 occupancy group). For 2025, compliance for multifamily buildings must be demonstrated using the CBECC compliance software (formerly CBECC-Com).

4.7.8 Includes Accessory Dwelling Unit

This selection is only picked if the accessory dwelling unit (ADU) is part of an addition (addition alone, or existing plus addition (Section 10.2), or if the main dwelling and ADU are complying as one Title 24 report). A yes response enables the additional inputs on the ADU tab to establish indoor air quality requirements. Input choices are:

- Attached (if the ADU shares a common wall with the main dwelling unit),
- Detached (if there are no common walls with the dwelling unit), or
- No (if it is newly constructed or is not an ADU).

ADUs must meet indoor air quality requirements, regardless of their size.

NOTE: If a project is a duplex or townhome (an R-3 occupancy), this requires checking an input on the IAQ tab (Section 4.11.1) for each of the individual dwelling unit input files.

Because an ADU has the input “attached” above, it is not necessary to also check the attached to another dwelling unit option on the IAQ tab.

4.7.9 Number of Bedrooms

Indicate the number of bedrooms to establish mechanical ventilation requirements.

4.7.10 Fuel Type

Select whether the fuel type being used in the building for heating, cooking, or water heating is natural gas or propane. Natural gas is selected in newly constructed buildings if a gas service line can be connected to the site without a gas main extension. Natural gas is selected in additions/alterations if gas is connected to the existing building.

NOTE: For an all-electric building, change the clothes dryer and cooking appliances fuel types on the ***Appliances/DHW*** tab to electric.

4.7.11 Zonal Control Credit

Checking this box enables modeling of a building that meets the criteria for zonal control requirements of the heating system, including separately modeled living and sleeping zones. This compliance option is not available with heat pump or combined hydronic space conditioning. Zonal control credit requires compliance with several eligibility criteria (see *Single-Family Residential Compliance Manual*, Chapter 4, Section 4.5.2 for the complete list). This credit requires that the living and sleeping areas are modeled and conditioned separately. The conditioning is either with zonally controlled equipment or separate space conditioning equipment with separate thermostat settings for living and sleeping zones. See Section 8.1. for more information on modeling zonal control.

CBECC-Res also has modeling capabilities for zonal cooling (Section 8.5.3).

4.7.12 Has Attached Garage

This check box is used to indicate if there is an attached garage, which must be modeled. While there are no minimum requirements for the garage construction, it is modeled to accurately represent the building to be constructed and typically improves compliance due to the buffering effect of an enclosed attached space. To remove the garage zone, uncheck this box, and delete the garage zone.

4.8 Lighting

For energy compliance, lighting is a nonregulated load (meaning the same assumptions are used for the proposed building are used in the standard design building, so there is no credit and no penalty) and are not user editable.

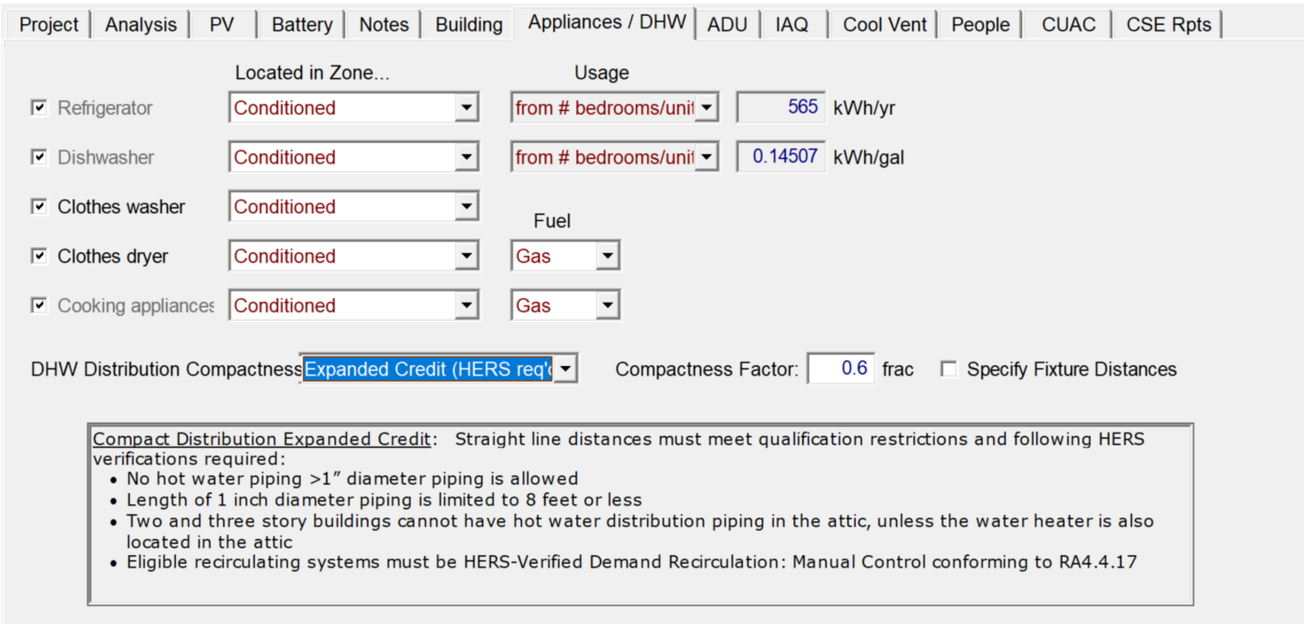
4.9 Appliances/DHW

Check the box to indicate if an appliance is located within a conditioned zone of the dwelling unit. The fuel type choices for the clothes dryer and cooking appliances are gas (based on the selection made on the building tab, this is either natural gas or propane) or electricity.

4.9.1 Compact Distribution

There are two options for compact distribution—basic credit, or an expanded credit which requires ECC verification. Once expanded or basic is selected, either the fixture distances will need to be input for the DHW system (Section 9.4.1) or, if distances are unknown, ‘Specify Fixture Distances’ can be un-checked and the software will allow a user specified compactness factor to be used.

Figure 4-12: Appliances/DHW



If fixture distances are not specified, compliance with the user input compactness factor will be verified on the CF2R where the actual fixture distances for the design will need to be specified. If the compactness factor, calculated on the CF2R based on the actual design fixture distances, is not less than or equal to the factor used in the performance model, the performance model will need to be updated and a re-run will be needed.

For additional information on the compactness factor calculation see *Reference Appendices,* Residential Appendix RA4.4.6.

4.10 ADU

An accessory dwelling unit (ADU), sometimes called a granny flat, in-law unit, or secondary unit, are a popular trend. In determining the approach to compliance, if the ADU is detached and newly constructed, it is treated the same as any newly constructed residential building and does not use this ADU tab.

NOTE: References in CBECC-Res to an ADU are for ADUs complying as either addition alone or existing plus addition (to facilitate indoor air quality (IAQ) requirements that are unique to ADU additions). Section 10.2 describes in greater detail how to determine which approach to compliance is allowed.

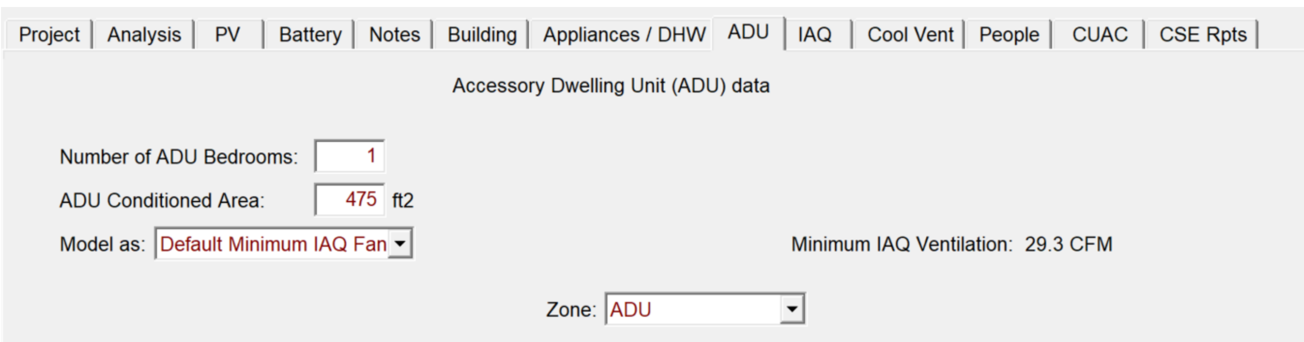
Often built after the main residence, if attached to the main residence or if converting an existing unconditioned space into a dwelling unit, there are IAQ requirements applicable without regard to the addition being 1,000 ft^2 or less (when IAQ requirements become triggered for a typical addition).

For other requirements or information, the California Department of Housing and Community Development has more information at their website, https://www.hcd.ca.gov/policy-and-research/accessory-dwelling-units.

4.10.1 Setting up the ADU Addition

If the ADU is being constructed as an addition or converting existing unconditioned space, be sure to check Chapter 10, Sections 10.2 and 10.7, for guidance on approaches to compliance and exceptions to continuous wall insulation.

Figure 4-13: ADU Data



When the building tab input value “includes accessory dwelling unit” is set to attached or detached, the values on this screen will determine the IAQ requirements. If the input file includes other zones (such as for an existing plus addition), this tab is strictly for the ADU.

4.10.1.1 Number of ADU Bedrooms

This is the number of bedrooms in the ADU itself, regardless of any other additions or existing bedrooms. It is used for the IAQ requirements for the ADU only.

4.10.1.2 ADU Conditioned Area

The conditioned floor area of the ADU is entered here.

4.10.1.3 Model as

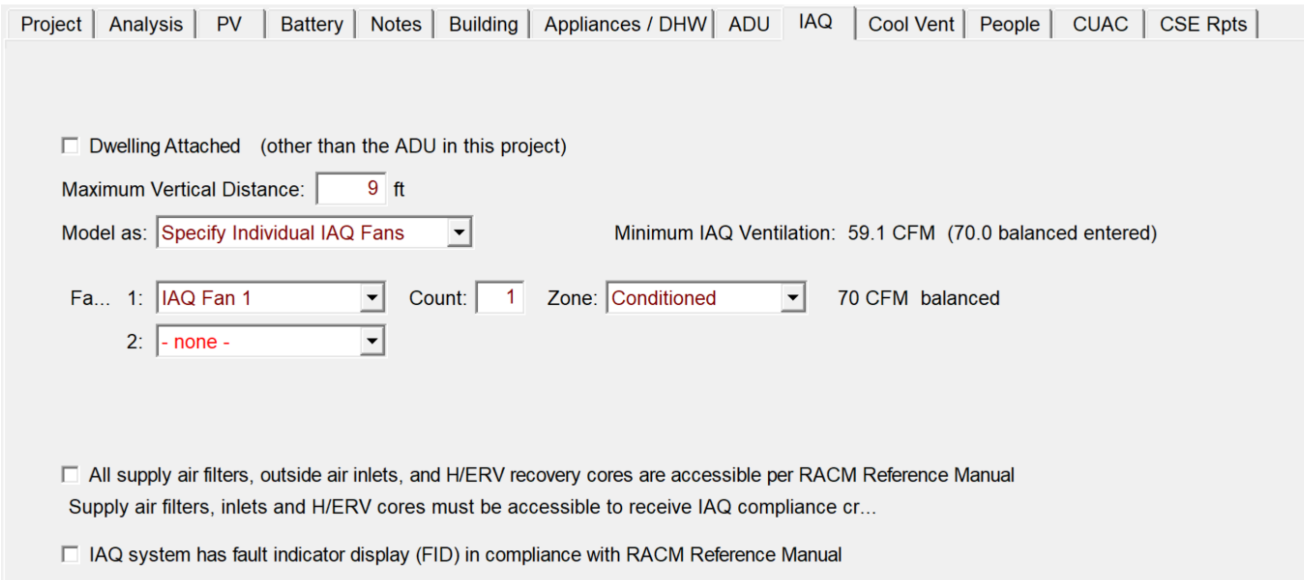
Select method of ventilation as either default minimum IAQ fan or specify individual fans (as described in Section 8.8).

4.10.1.4 Zone

Assign to the zone that contains the ADU.

4.11 IAQ

Figure 4-14: Indoor Air Quality (IAQ)



For single family dwelling units the mandatory indoor air quality (IAQ) ventilation rate and the means for supplying that ventilation are specified here. The minimum rate is determined by conditioned floor area, number of bedrooms, and other factors (see also Section 8.8). For more information on this mandatory requirement, see *Single-Family Residential Compliance Manual*, Section 4.6 or Energy Code, Section 150.0(o).

4.11.1 Dwelling Attached

If the input file is for a duplex or townhome, check this box.

NOTE: If the input file is for an accessory dwelling unit (ADU), on the ***Building*** tab select "attached" for the input "Includes Accessory Dwelling Unit." This is used as a variable in determining IAQ required airflow (CFM).

4.11.2 Maximum Vertical Distance

Enter the largest floor to ceiling height of the zone. This value is used to determine infiltration rates that affect the IAQ requirements. The default value is the zone height. Because zone height is the average height, this input may need to be increased for zones with cathedral ceilings.

4.11.3 Model as

Select method of ventilation as either default minimum IAQ fan or specify individual fans (as described in Section 8.8). Central Fan Integrated (CFI) systems are shown in the dropdown as a placeholder but are not yet implemented.

4.11.4 Zone

Assign to one of the conditioned zones.

4.12 Cooling Ventilation (Whole House Fan)

Figure 4-15: Cooling Ventilation

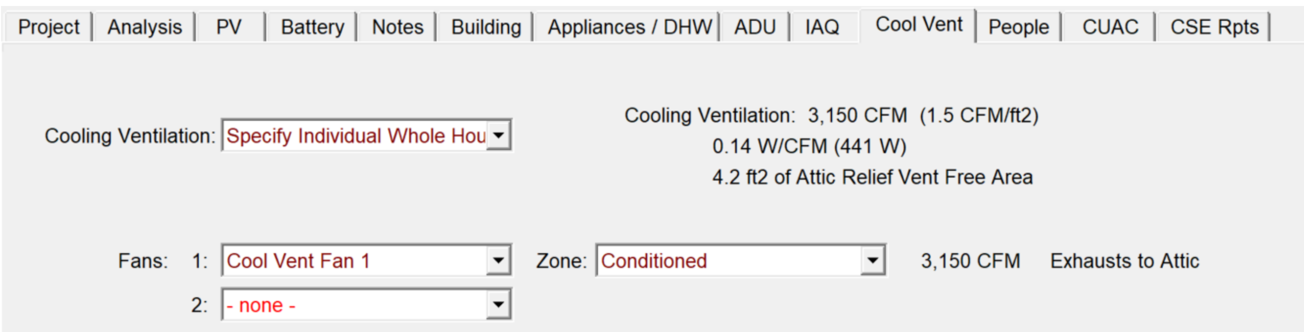
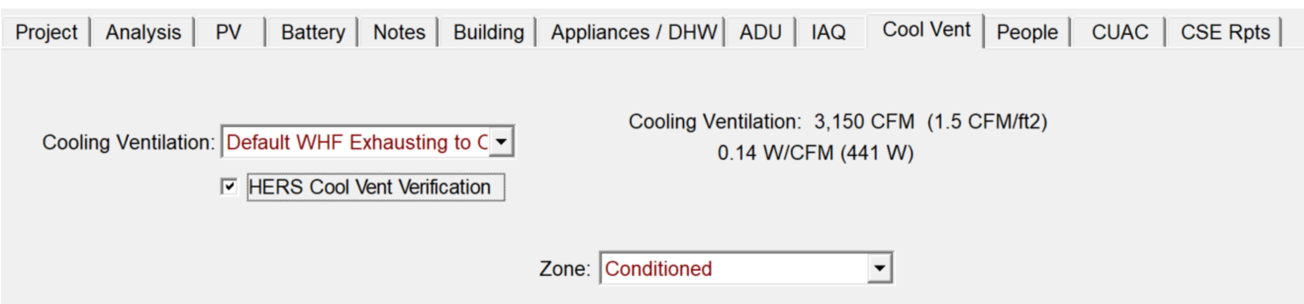


Figure 4-16: Whole House Fan with Cathedral Roof



Cooling ventilation systems use fans to bring in outside air to cool the house when this could reduce cooling loads and save energy. The most commonly used method is a whole house fan. The standard design in climate zones 8-14, where the evenings may cool down enough to provide a cost-effective means of cooling the house, includes a whole house fan. Table 4-1 includes all types of cooling ventilation. Additional inputs are discussed in Section 8.9.

NOTE: Find whole house fans by conducting an advanced search of the CEC's appliance directory, https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx. Select a directory of fans and dehumidifiers. Check the fields of data desired and export the results to an Excel spreadsheet. This will enable you to find an appropriate size fan and exclude exhaust fans from your search.

4.12.1 Cooling Ventilation

Default value is none. Other options are a default prescriptive whole house fan (set to exactly 1.5 CFM/ft^2), specify individual fans, default whole house fan exhausting to outside, or a central fan integrated system which uses the space conditioning distribution system to provide outside air for cooling. Additional inputs are discussed in Chapter 8, Section 8.9.

Table 4-1: Cooling Ventilation Fans

Measure	**Description**
Whole House Fan	Traditional whole house fan is mounted in the ceiling to exhaust air from the house to the attic or through ducting, bringing outside air in through open windows. Fans must be listed in the Home Ventilating Institute (HVI) Certified Products Directory. If multiple fans are used, enter the total CFM.
CFI (Central Fan Integrated) cool vent (fixed or variable speed)	These systems use the furnace or air handler fan to deliver outdoor air to conditioned space. With an automated damper, outside air duct, temperature sensors and controls, these systems can automatically deliver filtered outdoor air to occupant set comfort levels when outdoor conditions warrant the use of ventilation.

4.12.2 ECC Cool Vent Verification

To receive full credit for cooling ventilation, select ECC verification. Without ECC verification, the fan capacity is derated by one-third.

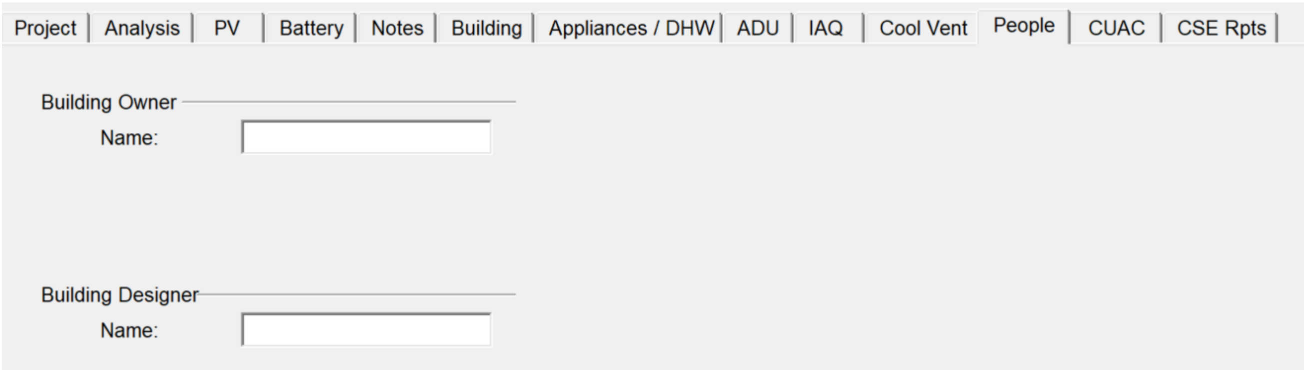
4.12.3 Zone

Assign to any conditioned zone.

4.13 People

Building owner and designer names can be inputted in this tab if desired.

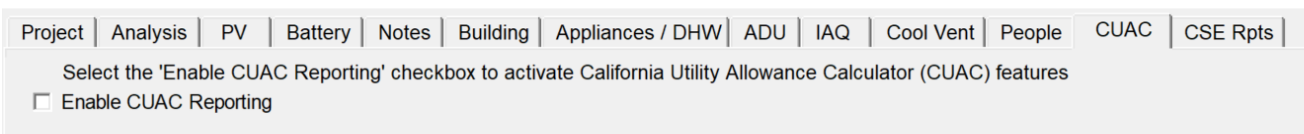
Figure 4-16: Building Owner/Designer Information



4.14 CUAC Tool

Click “Enable CUAC Reporting” will activate the California Utility Allowance Calculator features. See Appendix in Section 11.

Figure 4-17: CUAC Tool

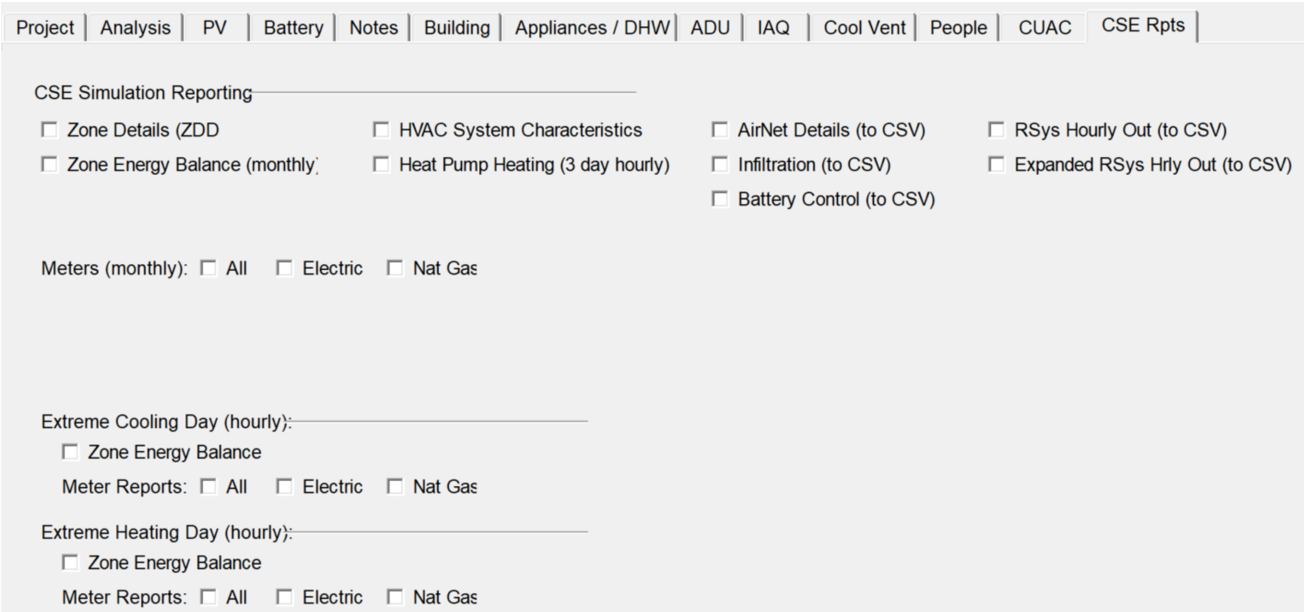


4.15 CSE Simulation Reports

The CSE reports are very detailed tables included in the project folder. These tables are not compliance reports and can be opened in Excel.

NOTE: Some of these reports significantly increase the size of files stored on your computer, so use discretion.

Figure 4-18: CSE Reports



5 Zones

Zones are the main component in which the conditioned floor area, space conditioning, and water heating systems are defined. Under the zone are listed ceilings, walls, windows, doors, and floors.

An **attic zone** is only created when a ceiling below attic is defined. The area cannot be edited; it is determined by any of the ceilings associated with the attic zone.

A **crawl space zone** is created when a floor over crawl space surface is defined. The area is determined by the area of crawl space above the zone and cannot be edited, however, the perimeter length is editable.

***USER TIP*:** If the area of a floor over crawl space area is modified, it can result in an invalid perimeter length. A quick and easy fix is to delete the “crawl space zone” which forces CBECC-RES to recreate the crawl space zone and recalculate the perimeter length.

The **garage zone** is created when the check box “has attached garage” (on the building tab) is checked. The zone type “unconditioned” is not yet implemented. Therefore, any attached unconditioned space can be modeled as, or combined with, the garage zone (the name garage can be modified).

***USER TIP 1*:** To delete an existing garage, the checkbox on the building tab must be unchecked first, then the garage zone can be deleted.

USER TIP 2: A garage typically needs five surfaces (ceiling/roof, slab floor, three walls), however, the surface that connects the conditioned space to the garage must be modeled as part of the conditioned space.

5.1 Conditioned Zones

USER TIP: The names of zones, surfaces, and systems are within your control. Because of all the necessary information on the CF1R, the longer the names, the longer your CF1R.

To create the house or dwelling unit, right-click on project, and pick create zone (or edit an existing file that has a conditioned zone) (see Figure 5-1). Decide early how many zones are needed to adequately define a building because it is difficult (not technically, but practically) to increase the number of zones.

Multiple zones are required for:

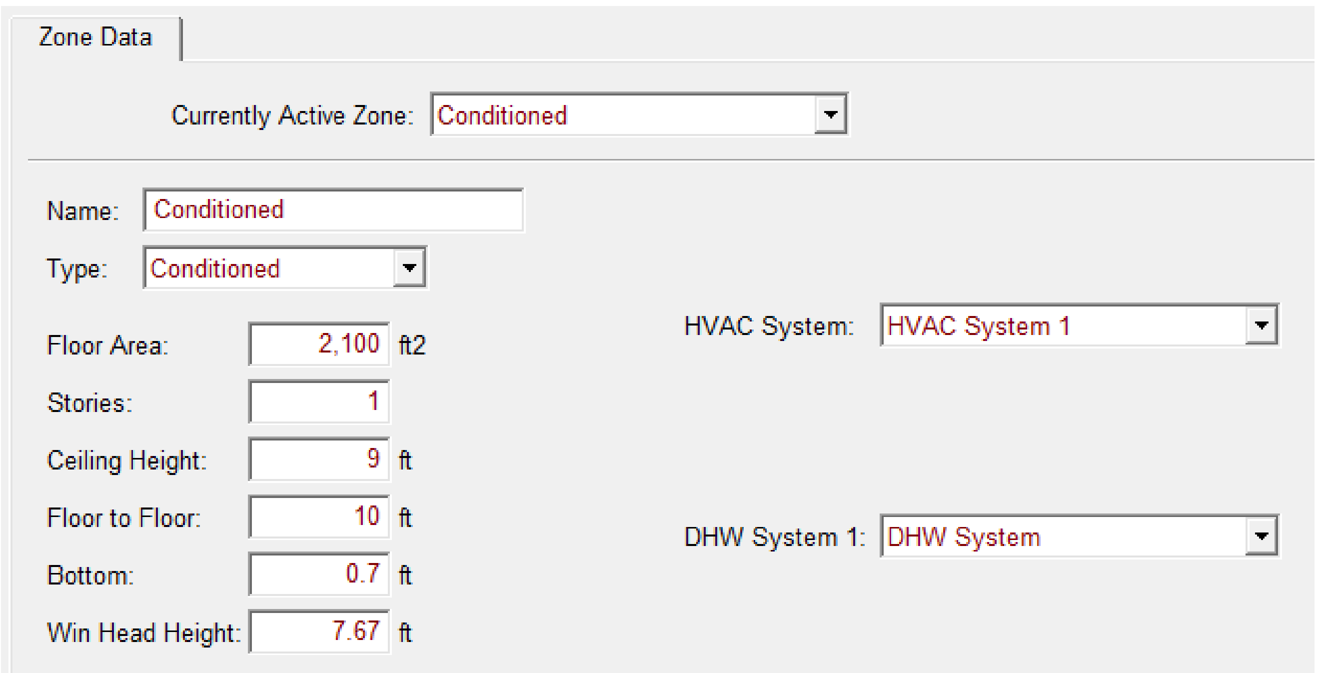
- Existing vs. new zones in an addition.

- Zonal control (living and sleeping zones separately controlled) [this is not the same as zonally controlled HVAC equipment and has specific criteria that may be difficult to meet, see Section 8.1.];
- Spaces served by different types of heating/cooling equipment (such as a heat pump and a gas furnace); or
- Different duct conditions or locations.

  NOTE: A more complex building model does not necessarily yield better compliance results.

5.1.1 Conditioned Zone Data

Figure 5-1: Conditioned Zone Data



5.1.1.1 Name

User-defined name. This name appears frequently on the CF1R.

5.1.1.2 Zone Status

When shown as an input, the default status is new for new construction or for the new zone of an addition. New also applies to spaces and surfaces in a previously unconditioned space that is converted to a conditioned space. Other options include new and existing.

5.1.1.3 Type

The default zone type is conditioned. If the building specifies zonal control (on building tab), the type is defined as either living or sleeping. For more information on zonal control see Section 8.1.2. Unconditioned spaces are modeled as garage or included with the garage (see Section 5.4). Unconditioned is not a valid choice at this time.

5.1.1.4 Floor Area

Specify the floor area of the zone.

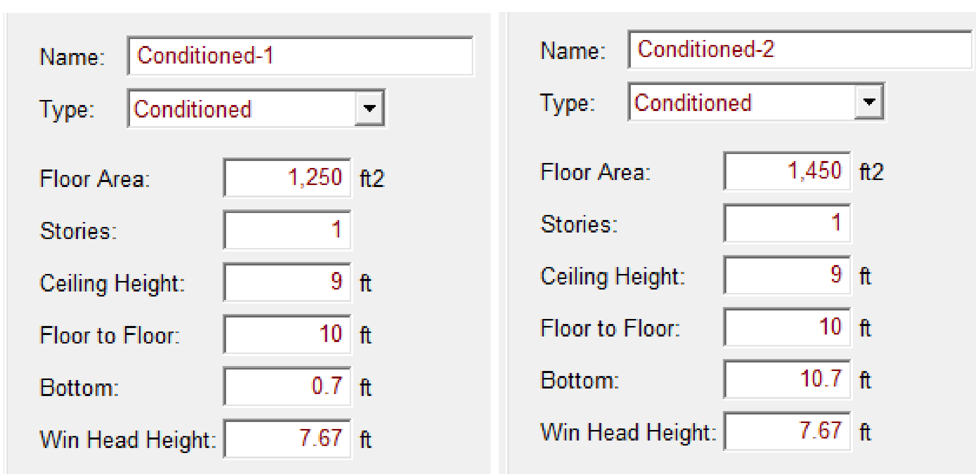
5.1.1.5 Number of Stories

Enter the number of stories ***in the zone, not the building***.

A 2-story single zone file will enter 2. A 2-zone model with each floor as a separate zone will enter 1 story for each of the zones (see Figure 5-2: Stories and Zone Bottom (for a 2-zone, 2-story building). CBECC-RES will reflect 2 stories on the CF1R if the zone bottom for the second zone is correctly input (see 5.1.1.8).

USER TIP:) Plan checkers can be informed that as long as the building's floor areas, surfaces and window areas are input correctly, the number of stories reflecting 3 rather than 4 (or more) is not significant.

Figure 5-2: Stories and Zone Bottom (for a 2-zone, 2-story building)



5.1.1.6 Ceiling Height

Average ceiling height, in feet.

5.1.1.7 Floor to Floor

Distance between the floor being modeled and any floor above. Default value is average ceiling height plus one foot.

5.1.1.8 Bottom

Typical values are 0.7 feet for a slab on grade floor or 2 feet for a crawl space floor. The default 0 is almost never the correct input.

The value depends on how the building is zoned and whether there are below grade surfaces. It is the distance above grade for the surface of the floor (if below grade it is a negative value). For multi-story buildings, if the upper floor is a separate zone, the bottom for that zone is the total distance from grade to the inside surface of the upper floor (see Figure 5-2: Stories and Zone Bottom (for a 2-zone, 2-story building). In other words, add the values for “Floor to Floor” plus “Bottom” from the first-floor zone and enter that as the zone bottom for the second floor.

5.1.1.9 Window Head Height

Default value is based on the average ceiling height (program will establish this value based on ceiling height.

5.1.1.10 HVAC System

Identify the name of the heating, ventilating, and air conditioning (HVAC) system by picking a defined system or creating a new system. These systems consist of the heating, cooling, distribution system, and a furnace fan. See more in Chapter 8, Mechanical Systems.

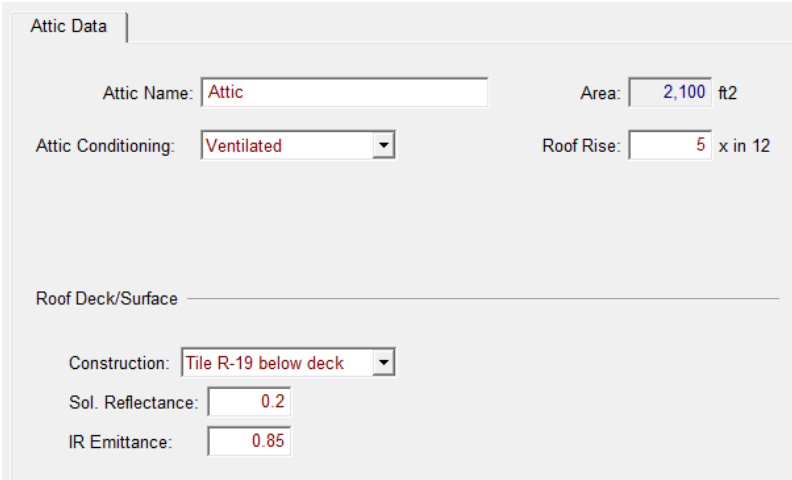
5.1.1.11 DHW System

Identify the name of the domestic water heating (DHW) system by picking a defined system or creating a new system. Multiple water heaters can be modeled as one system. See more in Chapter 9, Domestic Hot Water.

5.2 Attic

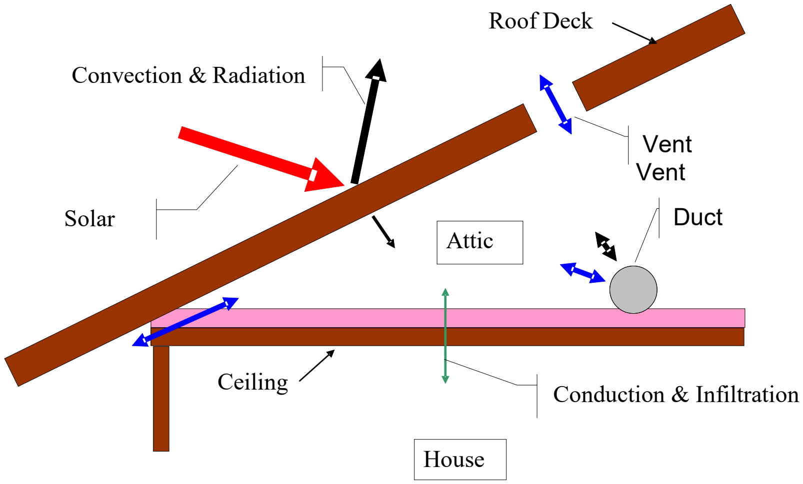
The attic zone is created when a ceiling below attic is modeled in the conditioned zone (Figure 5-6). This is where everything above the ceiling insulation is defined. This includes roofing material (tile, asphalt shingles), radiant barrier, above and below deck insulation (as defined in the specified construction), as well as roofing characteristics (i.e., default or cool roof) are assigned.

Figure 5-3: Attic Zone Data



The compliance software models attics (up to two) as a separate thermal zone and includes the interaction with the air distribution ducts, infiltration exchange between the attic and the house, the solar gains on the roof deck and other factors. These interactions are illustrated in Figure 5-4.

Figure 5-4: Attic Model Components



5.2.1 Roof Deck Insulation

The standard design is based on Option B from §150.1, Table 150.1-A. In Climate Zones 4 and 8-16 below deck insulation is included (typically R-19 installed between the roof rafters). This insulation is modeled in the attic zone, while the ceiling insulation is modeled in the conditioned zone (as ceiling below attic) (see Figure 5-5). This distinction is important to receive the full benefit of this insulation. This construction (with R-19 below deck) is sometimes called a high-performance attic and the sample files assume this construction. If you build in zones other than 4 and 8-16, be sure to modify the sample file to use a different construction. The CF1R required special features section includes a note about above or below deck insulation.

USER TIP: In Climate Zones 4 and 8-16, the standard design roof includes below roof deck insulation. Without this insulation, ducts in the attic are assumed to be exposed to temperatures ranging from 130-150 degrees F. It is extremely difficult to achieve compliance without this insulation when ducts are in the attic. Many default assumptions go into modeling attic ducts even though it may not be obvious. Depending on other variables, this may include no cooling equipment and ductless mini-split equipment.

Figure 5-5: Attic with below deck insulation
(more common and standard design in many climate zones)

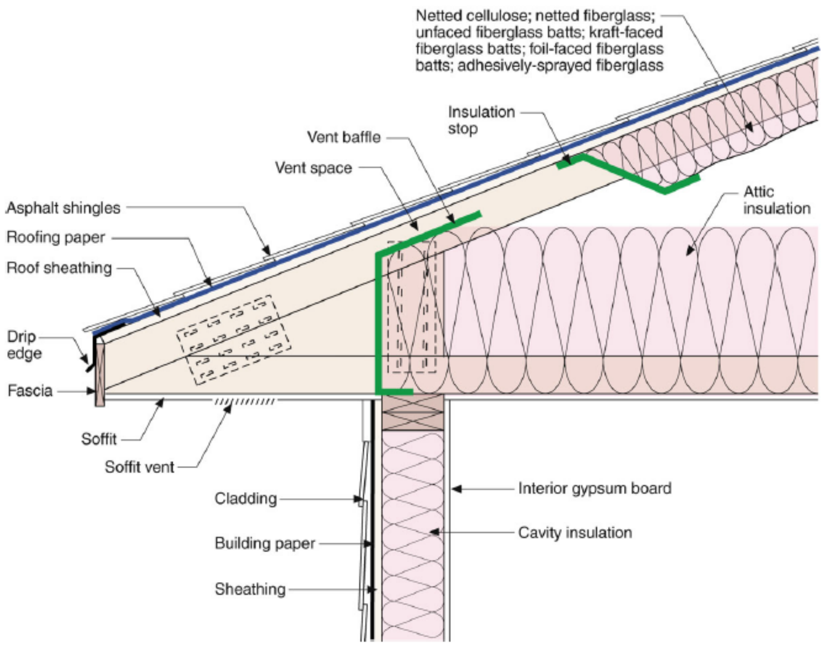


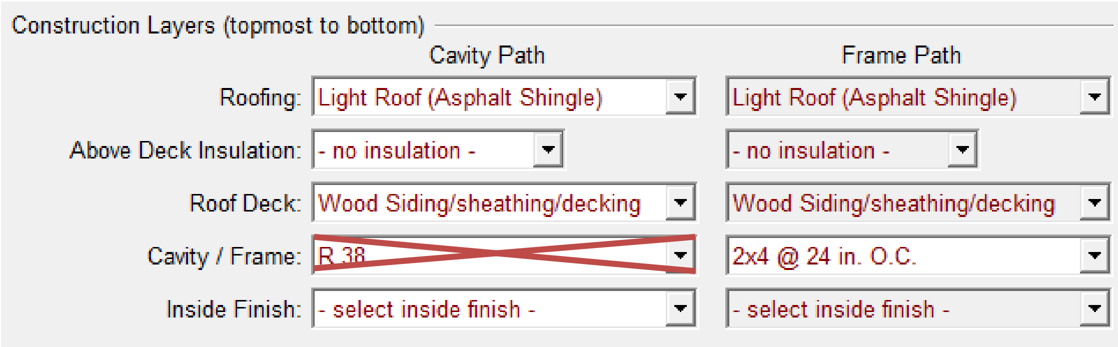
Figure 1: Venting Details for Modified Conventional Vented Attic

Source: Building Science Corporation

USER TIP: Ceiling insulation and roof deck insulation are not modeled as part of one construction assembly. Figure 5-6 is an example of an incorrectly modeled attic. It includes R-30 ceiling insulation with R-8 roof deck insulation. The R-30 should be part of a ceiling below attic construction assembly.

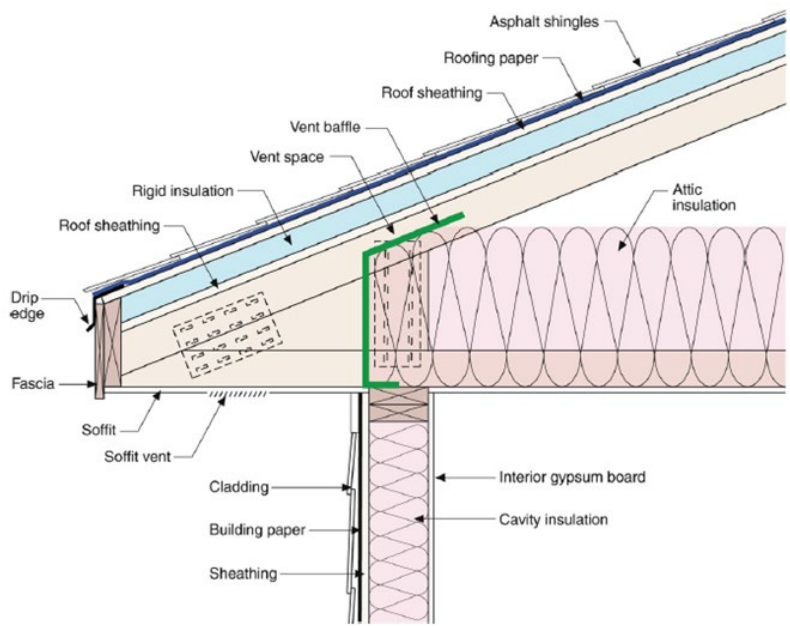
NOTE: If you see the roofing material and have the option to check radiant barrier, this is the attic. Do not model ceiling insulation in the attic.

Figure 5-6: Incorrectly Modeled Attic



Above deck insulation (Figure 5-7) is continuous and modeled in the attic construction not as part of the ceiling.

Figure 5-7: Attic with Above Deck Insulation



Source: Building Science Corporation

5.2.2 Unventilated Attic/Sealed Attic

An unvented, unventilated, or sealed attic is modeled by creating an attic roof construction (not a cathedral roof). If using spray foam insulation with a non-standard R-value (see Section 6.5), check the non-standard spray foam in cavity check box. This will result in an ECC requirement to verify the R-value. If the thickness of the insulation will cover the attic framing, check the thick cavity insulation covers framing box. Include the inside finish as gypsum board (see Figure 5-9).

The ***attic conditioning*** field should be set to “unventilated” (see Figure 5-8).

There is no ceiling insulation, and the duct location is ". . . attic (ventilated and unventilated)." This combination of features captures all the benefits of this construction technique.

Figure 5-8: Attic Data and Conditioning

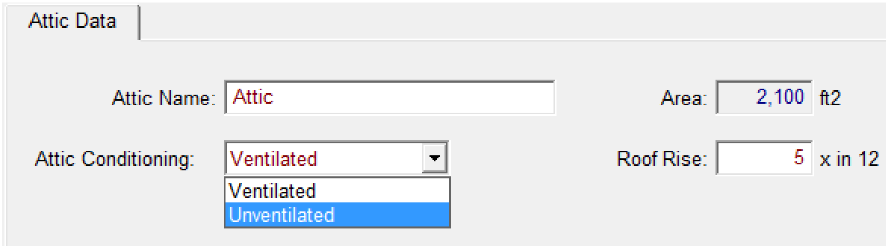
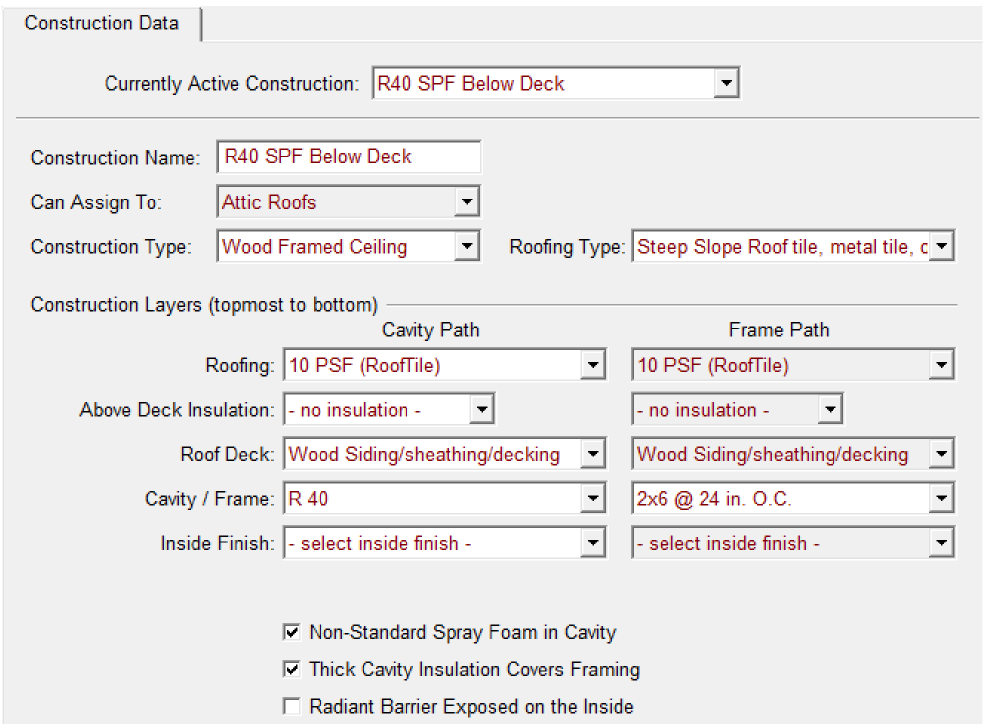


Figure 5-9: Unventilated Attic Construction



USER TIP: This user guide is merely how to model sealed attics. This is a complex topic. Outside resources should be consulted if you have concerns about moisture issues. Alternatively, roof deck insulation is modeled in a ventilated attic and likely achieves similar results.

NOTE: Ducts located in an unventilated attic do not qualify as ducts in conditioned space and should be modeled as "ducts located in attic (ventilated or unventilated)".

5.2.2.1 Attic Zone Data

The software automatically creates an attic zone once you define a ceiling below an attic as part of the conditioned space or garage.

To create a second attic zone, when defining the ceiling below attic, choose "create new attic zone."

5.2.2.2 Name

User-defined name. If the building plans have a unique identifier, that should be used here to assist in the plan checking and inspection processes.

5.2.2.3 Attic Conditioning

The conditioning type is set to either ventilated (typical attic) or unventilated. Ventilated or vented attic is the most typical construction.

5.2.2.4 Roof Rise

Specify the roof rise or roof pitch, which is the number of feet the roof rises in a span of 12 feet (shown on plans as 4:12 or 4 in 12). If there are multiple roof pitches enter the roof rise of the largest area of roof.

5.2.2.5 Area

The area is not a user input. The area is derived from the area of any ceilings assigned to the attic.

5.2.2.6 Attic Status

Default is new. Other options (for addition and/or alteration scope) are existing or altered.

5.2.2.7 Construction

The roof construction is the connection to an assembly that contains the roofing material (such as tile or asphalt shingles), radiant barrier, and other construction details, including above and below deck insulation, but not ceiling insulation (see more in Chapter 6, Construction Assemblies).

5.2.2.8 Solar Reflectance

The default aged solar reflectance for a non-cool roof is 0.10 for all roof types. When a value of 0.20 or higher is modeled, the CF1R reflects that a cool roof is modeled. When the reflectance is greater than 0.10 but less than 0.20, the CF1R reflects a non-standard roof reflectance required special features message.

The aged solar reflectance for a roof product is either published in the Cool Roof Rating Council (CRRC) product directory (www.coolroofs.org) or calculated from the initial solar reflectance value using Equation 3-1 in Section 3.4.3 of the 2025 Single-Family Residential Compliance Manual. The aged solar reflectance measures the roofing product’s ability to reflect solar heat. A higher value is better for warmer climates, so if a specific product color is unknown use a lower value to avoid having to recalculate compliance during construction.

If the roof membrane has a mass of at least 25 lb/ft^2 or any roof area that incorporates integrated solar collectors, the roof may assume the prescriptive solar reflectance value (see Section 5.2.3).

If the roof is a cathedral ceiling or rafter roof, the solar reflectance is defined as part of the roof (Chapter 7, Building Envelope).

The roofing material and roof structure is specified via the ***Roof Deck/Surface: Construction***, which is accessed under construction assemblies or by creating a new roof construction assembly as discussed in Chapter 6, Construction Assemblies.

5.2.2.9 Thermal Emittance

The default thermal emittance (or emissivity) for all roofing materials is 0.85. Otherwise, enter the emittance value published in the Cool Roof Rating Council (CRRC) product directory (www.coolroofs.org).

If the roof membrane has a mass of at least 25 lb/ft^2 or for any roof area that incorporates integrated solar collectors, the roof may assume the prescriptive emittance value (see Section 5.2.3).

If the roof is a cathedral ceiling or rafter roof, the emittance is defined as part of the roof (Chapter 7, Building Envelope).

The roofing material and roof structure is specified via the ***Roof Deck/Surface: Construction*** which is accessed under construction assemblies or by creating a new roof construction assembly which is discussed in Chapter 6, Construction Assemblies.

5.2.3 Cool Roof

The CF1R reflects that a cool roof is modeled when a solar reflectance of 0.20 or greater is modeled, and a thermal emittance of higher than 0.85. If a solar reflectance value greater than 0.10 (the default value) but less than 0.20 is modeled, the CF1R reflects a required special features message that the building contains a non-standard roof reflectance.

Cool roof is a term that refers to the ability of roofing materials to both reflect and absorb solar heat. It typically means a high solar reflectance and a high emittance, or it is a low emittance and a very high solar reflectance. Product ratings are from the Cool Roof Rating Council (CRRC) product directory (www.coolroofs.org).

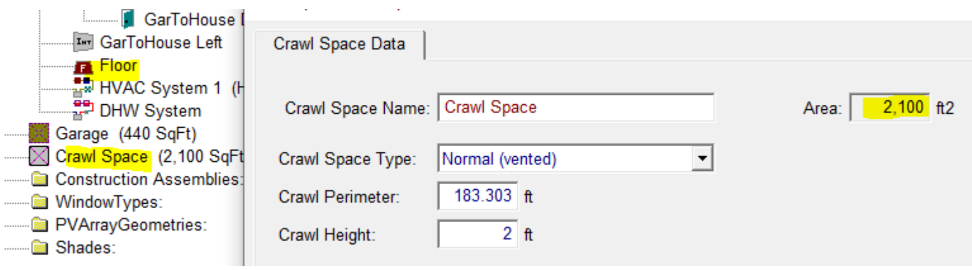
Prescriptive requirements (the basis of the standard design) contain a minimum requirement for aged solar reflectance and thermal emittance that varies by climate zone and roof slope. A low-sloped roof has a ratio of rise to run (or pitch) of less than 2 in 12 (≤9.5 degrees from the horizontal). In Climate Zones 13 and 15 a low-sloped roof is compared to a roof with 0.63 aged solar reflectance and 0.75 emittance. A steep-sloped roof has a ratio of rise to run of greater than or equal to 2:12 (≥9.5 degrees from the horizontal). In Climate Zones 10 through 15 a steep-sloped roof is compared to a roof with 0.20 aged solar reflectance and 0.75 thermal emittance.

5.3 Crawl Space

The software creates a crawl space zone when a floor over crawl space is defined. For floor construction details see Chapter 6, Construction Assemblies. The crawl space zone (Figure 5-10) is created using the user-specified area of raised floor (not an editable field) and floor elevation to set the area, perimeter, and height.

USER TIP: If the floor area is modified on an existing file, deleting the crawl space zone forces CBECC-Res to recreate this zone assigning an appropriate perimeter value.

Figure 5-10: Crawl Space Zone



5.3.1 Crawl Space Zone Data

5.3.1.1 Crawl Space Name

User-defined name. If the building plans have a unique identifier, that should be used here to assist in the plan checking and inspection processes.

5.3.1.2 Crawl Space Type

The default type (and only option currently implemented) is a normal vented crawl space.

5.3.1.3 Area

The area is not a user input. The value is based on all floors over crawl space in the building.

5.3.1.4 Crawl Perimeter

The length (in feet) of the perimeter. When initially creating the floor over crawl space, CBECC-Res determines this value.

5.3.1.5 Crawl Height

The depth/height of the crawl space, in feet (minimum of 2 feet). The same value is used for the floor elevation and the zone bottom. If the height varies enter the average height.

5.4 Garage

An attached unconditioned space or garage is modeled as a separate zone (zone type "unconditioned" is not yet enabled). When the project was defined as having an attached garage, the software created this zone (see Figure 5-11). The buffering effect of this zone is modeled to accurately represent the building.

Important to note that the surfaces connecting the conditioned space and garage are modeled as part of the conditioned space as an interior wall (or floor). These demising surfaces (different from party surfaces) must be insulated. For details on modeling the surfaces, see Chapter 6 and Chapter 7.

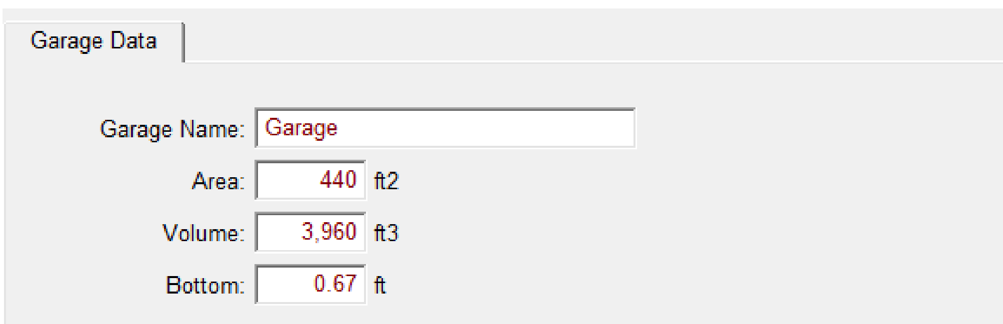
Detached garages and unconditioned spaces are not modeled.

5.4.1 Deleting a Garage

To delete a garage zone, first uncheck (on the building tab) that the building has an attached garage, then the garage zone can be deleted.

5.4.2 Garage Zone Data

Figure 5-11: Garage Zone Data



5.4.2.1 Garage Name

User-defined name.

5.4.2.2 Area

The area of the garage or unconditioned space, in square feet (ft^2).

5.4.2.3 Volume

Volume of the space, in cubic feet (ft^3). The default volume (right-click/restore default) is based on a 10-foot ceiling.

5.4.2.4 Bottom

Floor elevation or distance above grade of the surface of the floor (in feet). This can be a negative value for surfaces below grade.

6 Construction Assemblies

CBECC-Res does not use *Reference Appendices*, Joint Appendix JA4. Instead, the assembly is created inside the program. As you build an assembly, the screen displays a U-factor merely as an informational guide for the user to see how the assembly compares to the standard design assembly (Standards, §150.1(c)). For cavity insulation, model the closest insulation R-value without exceeding the product's R-value. For continuous insulation, you may pick whole R-values or specify a value.

NOTE: CBECC-Res does not enforce mandatory minimum insulation requirements. It is the user's responsibility to ensure compliance with §150.0 of the Energy Code.

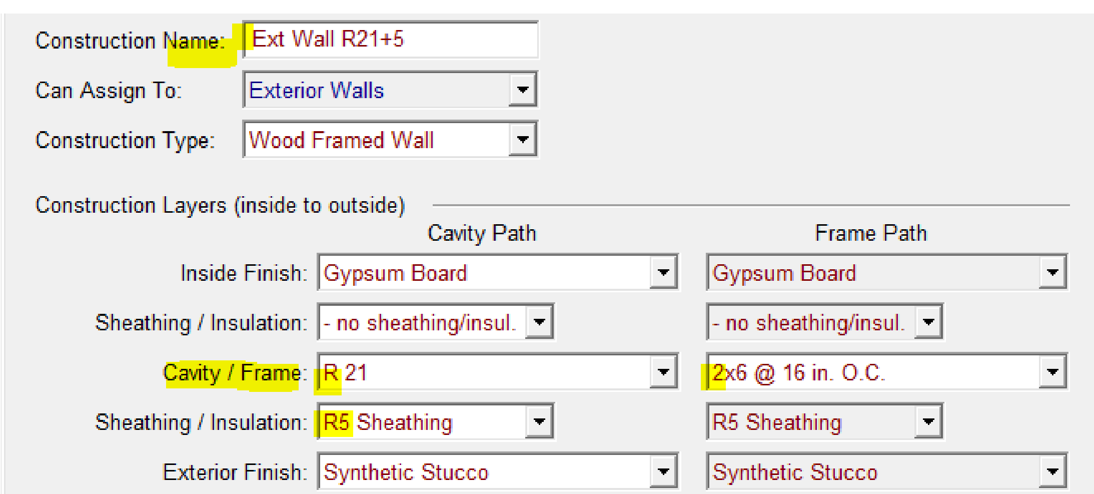
In addition to typical wood-frame construction, CBECC-Res can model advanced wall framing (AWF), steel-frame wall construction, concrete, masonry, insulated concrete form (ICF), brick, below grade walls, adobe, log, strawbale, and structurally insulated panels (SIPs).

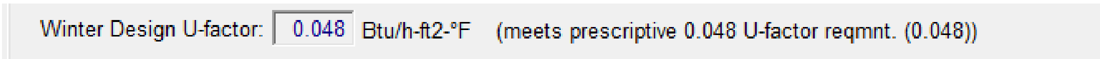
***USER TIP* – How to change construction names or details:**

Change details or rename a construction from the Construction Assemblies folder. For example, to update the wall construction from R-13+R-4 to R-21+R-5:

- Identify which construction name is assigned to the walls (such as Ext Wall R-13+4),
- Access the Construction Assemblies folder, find the one to change, double-click to expose the details,
- Change its characteristics as needed (cavity R-value, framing size, sheathing R-value, exterior finish), and
- Change the Construction Name (a brief but descriptive name) [depending on where you are in the program, you can also right-click and choose "rename"].

Figure 6-1: Renaming/Changing a Construction Assembly





Do not forget about interior walls (between house and garage). This concept applies to any constructions and enables a quick change without having to access every surface.

To rename a construction (such as from Construction Assembly 8 to something meaningful) right-click on the construction assembly name and pick rename. The change occurs to any surface that referenced that construction name. ***END USER TIP***

6.1 Metal Frame Construction Workaround

Currently, only metal framed wall assemblies can be modeled in CBECC-Res. If the roof/ceiling or floor of a building is constructed with metal or steel, you will need to use the following workaround to account for the less efficient performance of the framing material. Make sure you have downloaded a copy of the *Reference Appendices*. Also note the required maximum mandatory U-factor from Section 150.0 is 0.043 for a roof, 0.095 (2x4) or 0.069 (2x6) for walls, and 0.037 for a raised floor.

NOTE: Any references to a minimum R-value are for wood framing only.

1. In the *Reference Appendices* find the U-factor of the proposed construction. For example, Table 4.2.5 is for a metal framed rafter roof. The only assemblies that achieve 0.043 require continuous insulation.
2. You have a 2x12 roof and you find an R-30 2x12 plus R-7 continuous insulation has the required 0.043 U-factor (Figure 6-2).
3. Find a comparable (e.g., wood framed rafter roof) construction assembly that can be modeled in CBECC-Res that has that U-factor (or higher).
4. To find a construction to use as your starting point in CBECC-Res, notice that Table 4.2.2 has a 2x10 with R-22 (Figure 6-3). This construction will be substituted for the metal framed roof.
5. Create a cathedral ceiling, naming it what it needs to be constructed as, which is metal 2x12, R-30 + R-7.
6. Set the framing to 2x10 24" o.c., with R-22 cavity. Notice the U-factor is too high, so try R-23 cavity. That has the correct U-factor (see Figure 6-4).
7. Make very explicit notes for your CF1R.

NOTE: Metal performs very differently than wood and a greater amount of insulation is required to meet the same U-factor.

Figure 6-2: Joint Appendix Table for Metal Rafter Roof

Table 4.2.5 – Continued U-factors of Metal Framed Rafter Roofs – 24 in. OC Spacing

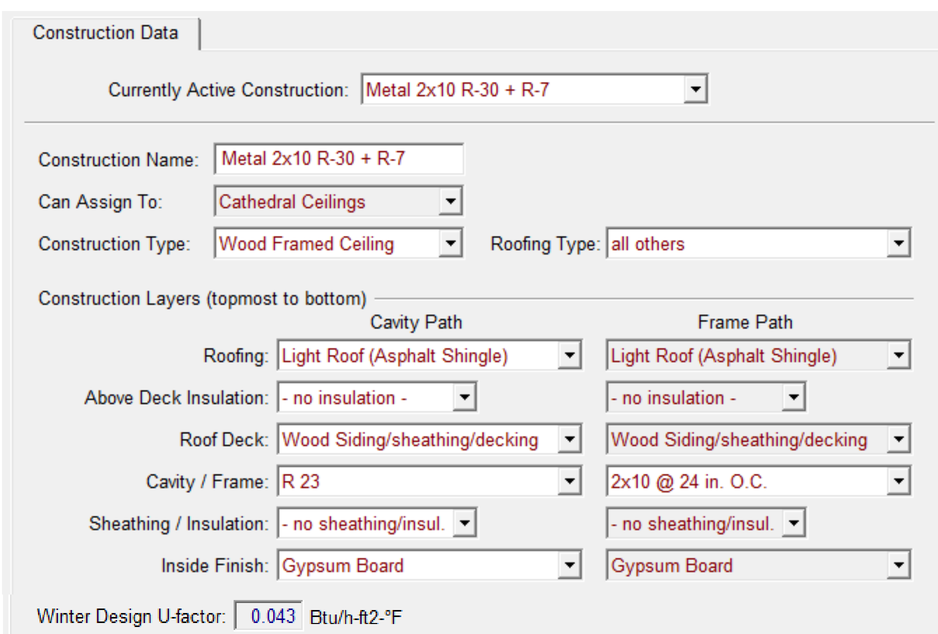
		Rated R-value of Continuous Insulation							
R-Value of Insulation Between Framing	**Nominal Framing Size**	**R-0**	**R-2**	**R-4**	**R-6**	**R-7**	**R-8**	**R-10**	**R-14**
None	Any	0.322	0~~.196~~.170	0.141	0.110	0.099	0.090	0.076	0.058
R-11[2]	2x4	0.111	0.091	0.077	0.067	0.062	0.059	0.053	0.043
R-13[2]	2x4	0.102	0.085	0.072	0.063	0.060	0.056	0.050	0.042
R-15[2]	2x4	0.096	0.081	0.069	0.061	0.057	0.054	0.049	0.041
R-19[2,3]	2x4	0.102	0.085	0.072	0.063	0.060	0.056	0.050	0.042
R-11	2x6	0.107	0.088	0.075	0.065	0.061	0.058	0.052	0.043
R-13	2x6	0.099	0.083	0.071	0.062	0.058	0.055	0.050	0.041
R-15[2]	2x6	0.086	0.073	0.064	0.057	0.054	0.051	0.046	0.039
R-19[2]	2x6	0.083	0.071	0.062	0.055	0.052	0.050	0.045	0.038
R-19[2]	2x8	0.080	0.0690	0.061	0.054	0.051	0.049	0.044	0.038
R-21	2x8	0.076	0.066	0.058	0.052	0.050	0.047	0.043	0.037
R-25	2x10	0.068	0.060	0.053	0.048	0.046	0.044	0.040	0.035
R-30[4]	2x10	0.063	0.056	0.050	0.046	0.044	0.042	0.039	0.033
R-30	2x12	0.061	0.054	0.049	0.045	0.043	0.041	0.038	0.033
R-38[4]	2x12	0.055	0.050	0.045	0.041	0.040	0.038	0.035	0.031
R-38[4]	2x14	0.053	0.048	0.044	0.040	0.039	0.037	0.035	0.030

Figure 6-3: Joint Appendix Table for Wood Rafter Roof

Table 4.2.2 – Continued U-factors of Wood Framed Rafter Roofs – 24 in. OC Rafter Spacing

		Rated R-value of Continuous Insulation[5]										
R-value of Cavity Insulation	**Nominal Framing Size**	**None**	**R-2**	**R-4**	**R-6**	**R-7**	**R-8**	**R-10**	**R-14**	**R-17**	**R-20**	**R-23**
None	Any	0.237	0.161	0.122	0.098	0.089	0.082	0.070	0.055	0.047	0.041	0.037
R-11[2]	2x4	0.081	0.070	0.061	0.055	0.052	0.049	0.045	0.038	0.034	0.031	0.028
R-13[2]	2x4	0.072	0.063	0.056	0.050	0.048	0.046	0.042	0.036	0.032	0.030	0.027
R-15[2]	2x4	0.065	0.058	0.052	0.047	0.045	0.043	0.039	0.034	0.031	0.028	0.026
R-19[2]	2x4	0.072	0.063	0.056	0.050	0.048	0.046	0.042	0.036	0.032	0.030	0.027
R-19[2,3]	2x4	0.059	0.053	0.048	0.044	0.042	0.040	0.037	0.032	0.029	0.027	0.025
R-11	2x6	0.075	0.065	0.058	0.052	0.049	0.047	0.043	0.037	0.033	0.030	0.028
R-13	2x6	0.067	0.059	0.053	0.048	0.046	0.044	0.040	0.035	0.031	0.029	0.026
R-15[2]	2x6	0.060	0.054	0.048	0.044	0.042	0.041	0.038	0.033	0.030	0.027	0.025
R-19[2]	2x6	0.054	0.049	0.044	0.041	0.039	0.038	0.035	0.031	0.028	0.026	0.024
R-21[2]	2x6	0.049	0.045	0.041	0.038	0.036	0.035	0.033	0.029	0.027	0.025	0.023
R-19[2]	2x8	0.049	0.045	0.041	0.038	0.036	0.035	0.033	0.029	0.027	0.025	0.023
R-21	2x8	0.046	0.042	0.039	0.036	0.035	0.034	0.032	0.028	0.026	0.024	0.022
R-22	2x10	0.043	0.040	0.037	0.034	0.033	0.032	0.030	0.027	0.025	0.023	0.022
R-25	2x10	0.039	0.036	0.034	0.032	0.031	0.030	0.028	0.025	0.023	0.022	0.021
R-30[4]	2x10	0.034	0.032	0.030	0.028	0.027	0.027	0.025	0.023	0.022	0.020	0.019
R-30	2x12	0.033	0.031	0.029	0.028	0.027	0.026	0.025	0.023	0.021	0.020	0.019
R-38 [4]	2x12	0.028	0.027	0.025	0.024	0.023	0.023	0.022	0.020	0.019	0.018	0.017

Figure 6-4: Construction Assembly



6.2 Cavity R-Value

When defining construction assemblies, pick either compressed (effective R-value) or non-compressed (such as high density insulation) values (Table 6-1). To accommodate for the effects of compression, there are multiple entries for some R-values:

- R-19 in 5-1/2-inch cavity (R-18)
- R-30 in 7-1/4-inch cavity (R-25)
- R-38C in 9-1/4-inch cavity (R-35)
- R-38 in 11-1/4-inch cavity (R-37)

Table 6-1: Compressed Insulation R-values

Lumber Size	Cavity Depth	Insulation R-value										
		38	**38C**	**30**	**30C**	**25**	**22**	**21C**	**19**	**15C**	**13**	**11**
2x12	11-1/4”	37	38	30								
2x10	9-1/4”	32	35	30	30	25						
2x8	7-1/4”	27	30	25	27	24	22	21	19			
2x6	5-1/2”			21	22	20	19	21	18			
2x4	3-1/2”						14	15	13	15	13	11
2x3	2-1/2”									11	10	8.9
2x2	1-1/2”										6.6	6.2
Standard Product Thickness		12”	10-1/4”	9-1/2”	8-1/4”	8”	6-3/4”	5-1/2”	6-1/4”	3-1/2”	3-1/2”	3-1/2”

6.3 Assembly Types

The types of assemblies that can be created in the program are:

- Exterior wall
- Interior wall (used for both demising surfaces between conditioned and unconditioned space, and party surfaces between two conditioned spaces)
- Underground wall
- Attic roof
- Cathedral roof
- Ceiling below attic
- Interior ceiling (used for both demising surfaces between conditioned and unconditioned space, and party surfaces between two conditioned spaces)

- Exterior floor
- Floor over crawl space
- Interior floor (used for both demising surfaces between conditioned and unconditioned space, and party surfaces between two conditioned spaces)

6.4 Mandatory Envelope Requirements

The mandatory insulation requirements (Standards Section 150.0(a)-(d)) for new construction are based on wood framing:

- Ceilings and rafter roofs with R-22, or a weighted average U-factor of 0.043.
- Framed wall insulation is either (1) R-15 in a wood-framed 2x4 wall or an overall U-factor not to exceed 0.095, or (2) R-21 in a wood-framed 2x6 wall or a U-factor not to exceed 0.069.
- Opaque non-framed assemblies with R-13 or a U-factor not to exceed 0.102
- Bay or bow window roofs and floors must meet Table 150.1-A or B.
- Mass walls must meet Table 150.1-A or B.
- Raised floor insulation with R-19 or a weighted average U-factor of 0.037.

NOTE: The software does not enforce minimum mandatory requirements. Pay close attention when modeling metal framing, which will require continuous insulation to meet the mandatory requirement.

6.5 Spray Foam Insulation (SPF)

The R-values for spray applied polyurethane foam insulation differ depending on whether the product is closed cell (default R-5.8/inch) or open cell (default R-3.6/inch). When completing a construction assembly for the roof/ceiling, walls, or floor, use the values shown in Table 6-2 to determine the default R-value for the cavity size. With ECC verification and additional documentation requirements, a higher than default value may be used, as indicated by checking the box for non-standard spray foam in cavity as part of the construction assembly (see *Reference Appendices*, Residential Appendix RA3.5.6).

Table 6-2: Required Thickness Spray Foam Insulation (in inches)

Required R-values for SPF insulation	**R-11**	**R-13**	**R-15**	**R-19**	**R-21**	**R-22**	**R-25**	**R-30**	**R-38**
Required thickness closed cell at R5.8/inch	2.00	2.25	2.75	3.50	3.75	4.00	4.50	5.25	6.75
Required thickness open cell at R3.6/inch	3.00	3.50	4.20	5.30	5.80	6.10	6.90	8.30	10.60

To receive the most credit, spray foam insulation may be combined with QII, which is modeled at the project level (see Section 4.7.4) and requires ECC verification.

6.5.1 Medium Density Closed-Cell SPF Insulation

The default R-value for spray foam insulation with a closed cellular structure is R-5.8 per inch, based on the installed nominal thickness of insulation. If the proposed insulation has an R-value greater than 5.8, include the documentation noted in Section 6.5 with your plan check submittal to verify the value modeled. Closed cell insulation has an installed nominal density of 1.5 to less than 2.5 pounds per cubic foot (pcf).

6.5.2 Low Density Open-Cell SPF Insulation

The default R-value for spray foam insulation with an open cellular structure is R-3.6 per inch, calculated based on the nominal required thickness of insulation. If the proposed insulation has an R-value greater than 3.6, include documentation noted in Section 6.5 with your plan check submittal to verify the value modeled. Open cell insulation has an installed nominal density of 0.4 to 1.5 pounds pcf.

6.6 Advanced Wall Framing

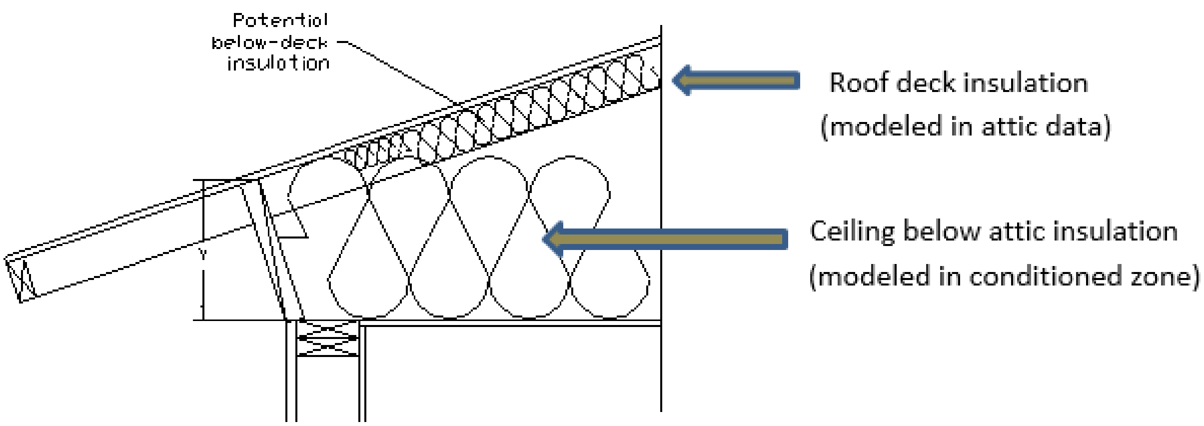
Advanced wall framing (AWF) is applicable to wood framed walls that meet the installation criteria from *Reference Appendices*, Joint Appendix JA4.1.6 to reduce the amount of wood used for framing. The construction technique, referred to as an advanced wall system, incorporates the following construction techniques:

- 24-inch on center framing,
- Eliminates intermediate framing for cripple and king studs,

- Uses single top plates, double stud corners, and in-line (i.e., stack) framing to maintain continuity of transferring live loads of roof framing to wall framing (which allows roof sheathing and exterior siding to be installed at full widths),
- Reduces framing for connections at interior partition walls (i.e., T-walls), and
- Reduces window and door header sizes.

6.7 Attic Roof Terminology

Figure 6-5: Attic insulation locations



6.7.1 Attic

Attic is an enclosed space directly below the roof deck and above the ceiling beams. The attic component of the building contains the roof and attic, and any insulation that occurs at the roof deck. In CBECC-Res, the attic is a separate zone. A typical ventilated attic does not include the ceiling or ceiling insulation, which is modeled as part of the ceiling below attic. Up to two attics can be defined in a building.

6.7.2 Cathedral Ceiling

A cathedral ceiling or rafter roof is modeled when there is no attic with a ceiling below (or to model a skylight (Section 7.7)). A cathedral ceiling typically has insulation between the rafters and may be flat or sloped. The insulation is in contact with the ceiling and there may be a one-inch air gap above the insulation to vent moisture or accommodate a radiant barrier. Whether an air space is required above the insulation, or the entire cavity is filled with insulation with no venting, is up to the local building official.

6.7.3 Ceiling Below Attic

The ceiling is defined as the interior upper surface of a space separating it from an attic, plenum, indirectly or directly conditioned space or the roof assembly, which has a slope less than 60 degrees from horizontal (definition from *Reference Appendices,* Joint Appendix JA1).

6.7.4 Cool Roof

The CF1R reflects that a cool roof is modeled when a solar reflectance of 0.20 or greater is modeled, and a thermal emittance of higher than 0.85. If a reflectance value greater than 0.10 (the default value) but less than 0.20 is modeled, the CF1R reflects a required special features message that the building contains a non-standard roof reflectance.

Cool roof is a term that refers to the ability of roofing materials to both reflect and absorb solar heat. Product ratings are from the Cool Roof Rating Council (CRRC) product directory (www.coolroofs.org).

6.7.5 Unventilated Attic

An unventilated attic (also called a sealed or unvented attic) is not typical. The insulation is typically installed at the roof, there is a ceiling but that may or may not be insulated, and the ducts are likely located in the attic. An example file is included (1StoryExampleUnvented). For more see Section 5.2.2.

6.7.6 Knee Wall

A knee wall or crawl space wall separates conditioned space from an unconditioned attic or crawl space. These walls are modeled in CBECC-Res as an interior wall (a demising surface) and are insulated as an exterior wall with no continuous insulation or exterior finish.

6.7.7 Low-Sloped Roof

A low-sloped roof has a ratio of rise to run (or pitch) of less than 2 in 12 ($\leq$9.5 degrees from the horizontal). Although a cool roof is not mandatory, the standard design for a low-sloped roof in climate zones 13 and 15 is an aged solar reflectance of 0.63 or higher.

If the roof membrane has a mass of at least 25 lb/ft^2 or includes building integrated solar collectors, the roof may assume the standard design value for solar reflectance (exceptions to Section 150.1(c)11).

6.7.8 Radiant Barrier

Modeled by checking the box on the attic or cathedral roof construction data, a radiant barrier installed below the roof decking reduces radiant heat to any ducts and insulation below it. While not a mandatory requirement, the standard design used to establish a building's energy budget may have a radiant barrier if there is no roof deck insulation.

An air space is required for a radiant barrier (installation requirements for a radiant barrier are listed in the *Reference Appendices,* Residential Appendix RA4). The radiant barrier is modeled as part of either the attic zone or cathedral construction (see Section 6.8.2 or 6.10.2).

NOTE: Installing both a radiant barrier and roof deck insulation is not typical. Be sure to check the CF1R's attic table for the presence of a radiant barrier.

6.7.9 Roof

A roof is defined as the outside cover of a building or structure, including the structural supports, decking, and top layer that is exposed to the outside with a slope less than 60 degrees from the horizontal.

When the prescriptive table (150.1-A), which is the basis of the standard design, contains a minimum requirement for solar reflectance and thermal emittance, the values vary by roof slope. A low-sloped roof has a ratio of rise to run (or pitch) of less than 2 in 12 (≤9.5 degrees from the horizontal). A steep-sloped roof has a ratio of rise to run of greater than or equal to 2:12 (≥9.5 degrees from the horizontal). There will be an energy penalty if default roof values are used in a climate zone with cool roof requirements in the standard design.

6.7.10 Steep-Sloped Roof

A steep-sloped roof has a ratio of rise to run of greater than or equal to 2:12 (≥9.5 degrees from the horizontal). Although a specific value is not mandatory, the standard design for climate zones 10 through 15 is an aged solar reflectance of 0.20.

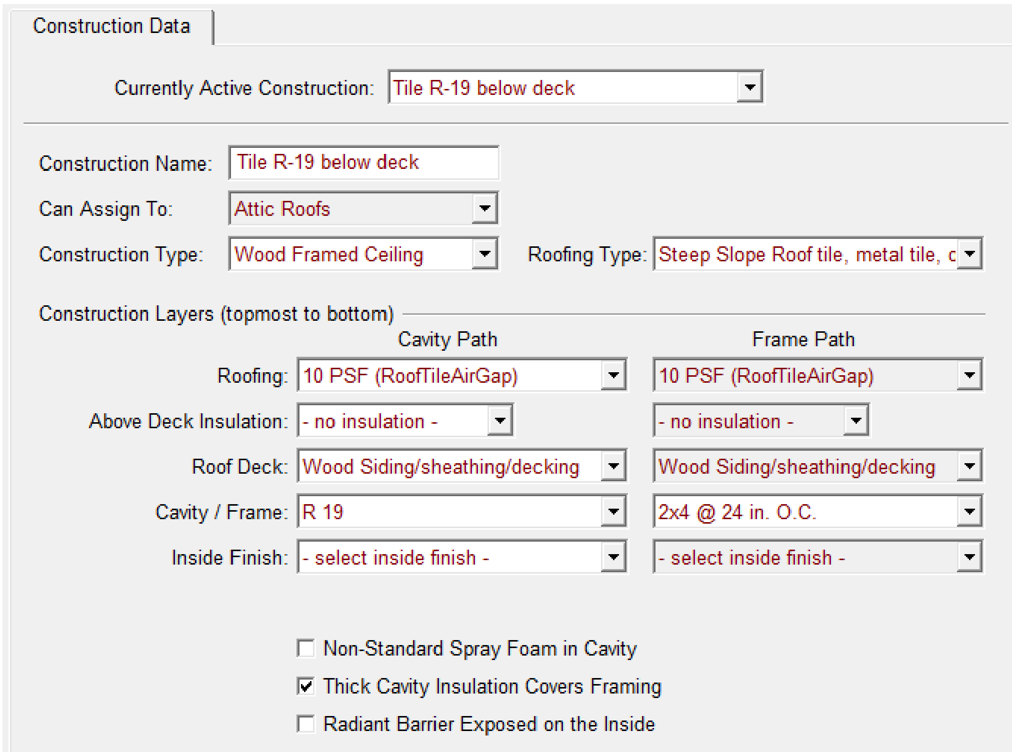
If the roof membrane has a mass of at least 25 lb/ft^2 or the roof area incorporates building integrated solar collectors, the roof may assume the standard design value for solar reflectance (exceptions to Section 150.1(c)11).

6.8 Attic Construction

An attic zone is created directly or will be created when a ceiling below attic is created. The attic construction is what contains the roofing material (e.g., tile, asphalt, etc.), above or below deck insulation, and the radiant barrier. A typical attic does not include the ceiling or ceiling insulation, instead the ceiling and ceiling insulation are modeled as part of the ceiling below attic. There is no orientation associated with an attic roof.

6.8.1 Attic Construction Data

Figure 6-6: Attic Construction Data/Roof Deck Insulation



6.8.1.1 Construction Name

User-defined name.

6.8.1.2 Can Assign To

This is a fixed field. To create a new assembly type, at the zone level, select <create> and pick the appropriate construction assembly type.

6.8.1.3 Construction Type

Options are wood framed, built-up roof, and SIP Ceiling. Steel framed is not yet implemented.

6.8.1.4 Roofing Type

Pick the appropriate roof type: (1) steep-sloped roof tile, metal tile, or wood shakes; or (2) all other. Options available for the construction layer “Roofing” vary based on this selection. Both options include a tile roof. The selection under steep-sloped is for a tile roof with an air gap. The selection under all other is for tile without an air gap.

6.8.2 Attic Construction Layers

Working from the top to the bottom of the construction layers:

6.8.2.1 Roofing

The available types will depend on the roofing type specified above. Types include light roof, roof tile, asphalt, gravel, tile with an air gap, tile with no air gap, heavy ballast or pavers, very heavy ballast or pavers, metal tile, and green hybrid roofing tile. The “10 PSF” tile roof selection under steep-sloped is for a tile roof with an air gap. The selection under all other is for tile without an air gap.

6.8.2.2 Above Deck Insulation

If above deck insulation is shown as part of the attic details, model either whole numbers of R-1 to R-60 sheathing insulation, or pick “specify R-value” and enter a value.

6.8.2.3 Roof Deck

The default is wood siding/sheathing/decking.

6.8.2.4 Cavity/Frame (below deck insulation)

List the R-value of below deck insulation (see Section 6.2) in the cavity column. This is the insulation installed at the roof, not on the ceiling. The framing column indicates the size and spacing of the framing. Options are 2x4 to 2x12 with 16- or 24-inch on center framing.

6.8.2.5 Inside Finish

This is the inside finish (if any), of the attic space, and does not include the ceiling below the attic. A layer of gypsum is not typically included here.

6.8.2.6 Non-Standard Spray Foam in Cavity

This check box identifies additional documentation and ECC verification requirements due a claimed R-value that exceeds the default assumption of R-5.8 per inch for closed cell SPF and R-3.6 per inch for open cell SPF (see also Section 6.5).

6.8.2.7 Thick Cavity Insulation Covers Framing

When below roof deck cavity insulation is greater than the size of the cavity, check this box and the program will assume any insulation greater than the selected frame size will cover the frame.

6.8.2.8 Radiant Barrier Exposed on the Inside

This check box identifies whether a radiant barrier will be installed in the attic. It is not typical construction to include both roof deck insulation and a radiant barrier.

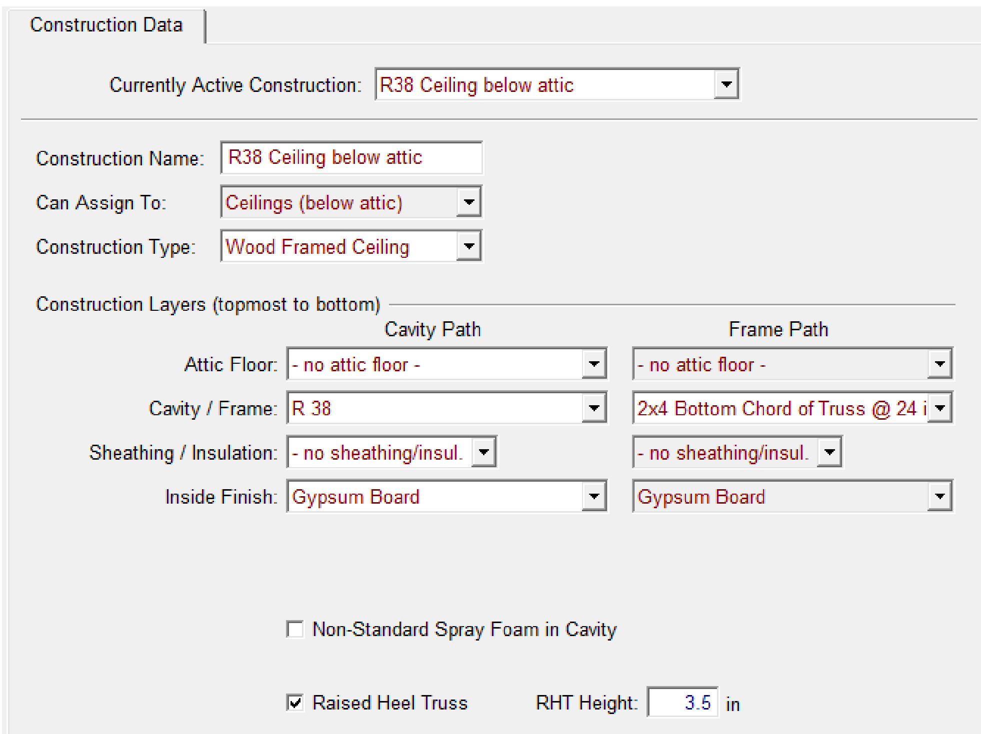
6.9 Ceiling Below Attic and Interior Ceilings

The ceiling below attic is typically where insulation is installed when it separates conditioned space from a ventilated attic zone (Figure 6-7).

Interior ceilings are used to define surfaces separating conditioned space from another conditioned space or an enclosed unconditioned space.

6.9.1 Ceiling Construction Data

Figure 6-7: Ceiling Below Attic Assembly



6.9.1.1 Construction Name

User-defined name.

6.9.1.2 Can Assign To

This is a fixed field. To create a different assembly type, at the zone level, pick <create> and select the appropriate construction assembly type.

6.9.1.3 Construction Type

Wood framed is the only option available.

6.9.2 Ceiling Construction Layers

6.9.2.1 Attic Floor

The available types include no attic floor and wood siding/sheathing/decking.

6.9.2.2 Cavity/Frame

List the R-value of cavity insulation (see Section 6.2) in the cavity column. In the framing column select the size of the framing and the spacing, such as 2x12 with 24-inch on center framing, or 2x4 roof truss at 24-inches on center.

6.9.2.3 Sheathing/Insulation

List the sheathing or insulation layer. Options are none, gypsum board, wood sheathing, and R1 to R60 insulation, or specify R-value.

6.9.2.4 Inside Finish

This is the inside finish (if any), of the attic space. A layer of gypsum is typical.

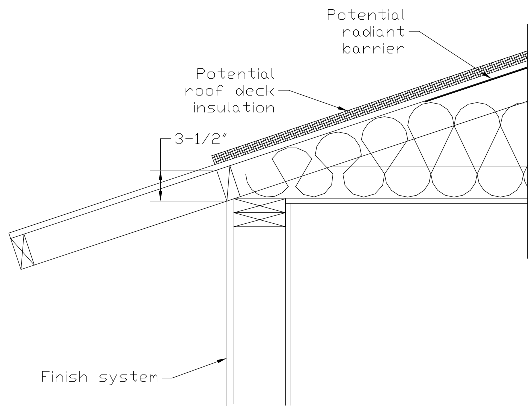
6.9.2.5 Non-Standard Spray Foam in Cavity

This check box identifies additional documentation and ECC verification requirements due a claimed R-value that exceeds the default assumption of R-5.8 per inch for closed cell SPF and R-3.6 per inch for open cell SPF (see Section 6.5).

6.9.2.6 Raised Heel Truss

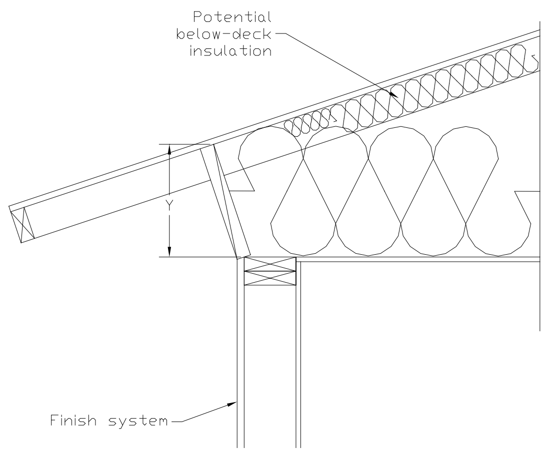
Check box to indicate if there is a raised heel truss and its height (in inches). With a standard roof truss, the depth of the ceiling insulation is restricted to the space left between the roof deck and the wall top plate for the insulation path and the space between the bottom and top chord of the truss in the framing path. If the modeled insulation completely fills this space, there is no attic air space at the edge of the roof. Heat flow through the ceiling in this attic edge area is directly to the outside both horizontally and vertically, instead of to the attic space.

Figure 6-8: Section at Attic Edge with Standard Truss



A raised heel truss provides additional height at the attic edge that, depending on the height and the ceiling insulation, can either reduce or eliminate the attic edge area and its thermal impact.

Figure 6-9: Section at Attic Edge with a Raised Heel Truss



6.10 Cathedral Ceiling

6.10.1 Cathedral Ceiling Construction Data

Each surface facing a different orientation is modeled as a separate surface (see Figure 7-3 and Section 7.2.4).

6.10.1.1 Construction Name

User-defined name.

6.10.1.2 Can Assign To

This is a fixed field. To create a new assembly type, at the zone level, pick <create> and select the appropriate construction assembly type.

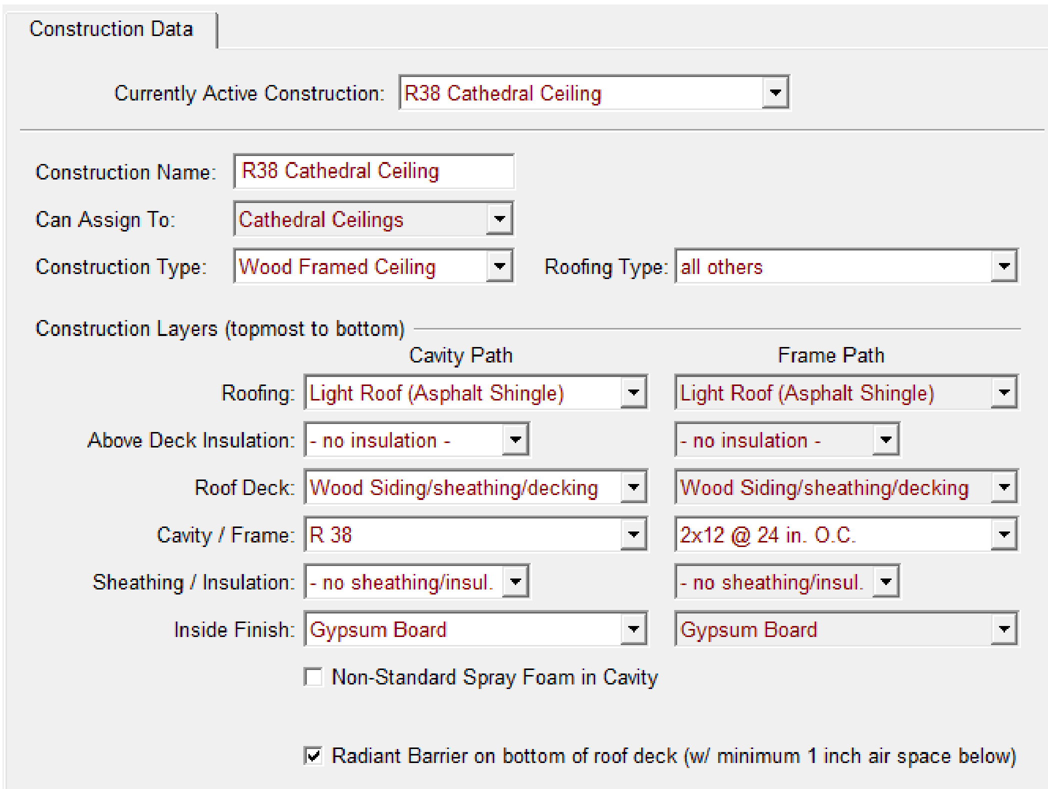
6.10.1.3 Construction Type

Options are wood framed, built-up roof, and SIPS ceiling.

6.10.1.4 Roofing Type

Pick the appropriate roof type: (1) steep slope roof tile, metal tile, or wood shakes; or (2) all other. Options available for this construction layer vary based on this selection.

Figure 6-10: Cathedral Ceiling with Radiant Barrier



6.10.2 Cathedral Ceiling Construction Layers

6.10.2.1 Roofing

The available types will depend on the roofing type specified above. Types include light roof, roof tile, asphalt, gravel, tile, heavy ballast or pavers, very heavy ballast or pavers, metal tile, and green hybrid roofing tile.

6.10.2.2 Above Deck Insulation

Options range from no insulation to R-60.

6.10.2.3 Roof Deck

The default is wood siding/sheathing/decking.

6.10.2.4 Cavity/Frame

List the compressed R-value of cavity insulation (see Section 6.2) in the cavity column. The framing column is to indicate the size of the framing and the spacing (e.g., 2x12 with 24-inch on center framing). Also included is an option for a 2x4 bottom chord of truss at 24-inches on center.

6.10.2.5 Sheathing/Insulation

List the sheathing or insulation layer. Options are no sheathing/insulation, gypsum board, wood sheathing, and R-1 to R-60 insulation, or specify R-value.

6.10.2.6 Inside Finish

This is the inside finish (if any), of the roof. A layer of gypsum is typically included.

6.10.2.7 Non-Standard Spray Foam in Cavity

This check box identifies additional documentation and ECC verification requirements due a claimed R-value that exceeds the default assumption of R-5.8 per inch for closed cell SPF and R-3.6 per inch for open cell SPF (see Section 6.5).

6.10.2.8 Radiant Barrier

Model a radiant barrier by checking the box "Radiant barrier on bottom of roof deck (with minimum 1-inch air space below)." The air space is a required component of radiant barrier installation criteria found in the *Single-Family Residential Compliance Manual*, Appendix D. While not a mandatory requirement, the standard design for a building has a radiant barrier if there is no roof deck insulation.

6.11 Walls

Wall construction details are accessible by either creating a new wall assembly or creating/ modifying an assembly in the list of Construction Assemblies. Wall details (Figure 6-11) are defined from the inside surface to the outside (as shown on the screen for construction layers). For a description of when a wall is modeled as interior (for example, demising or walls separating the house from the garage), see Section 6.11.6.

CBECC-Res can currently model wood or steel-framed, advanced wall framing, SIP, mass, straw bale, adobe, log, dual panel hollow, and underground walls.

6.11.1 Interior and Exterior Wall Construction Data

6.11.1.1 Construction Name

User-defined name.

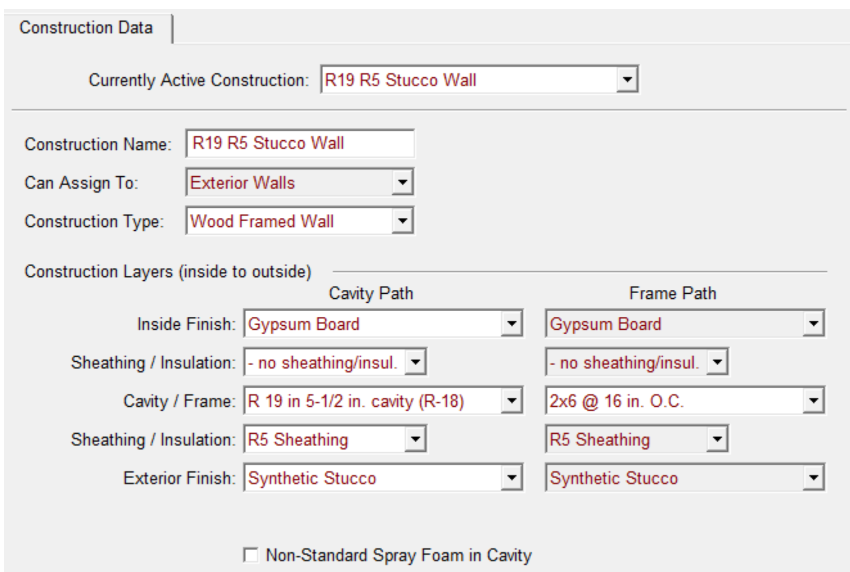
6.11.1.2 Can Assign To

This is a fixed field. To create a new assembly type, at the zone level pick <create> and select the appropriate construction assembly type.

6.11.1.3 Construction Type

Options available include wood framed and steel framed (Section 6.11.2). Unframed wall types are concrete, Insulated Concrete Form (ICF), brick, hollow unit masonry, adobe, strawbale, log (Section 6.11.3) and structurally insulated panels (SIPs) (Section 6.11.5).

Figure 6-11: Wood-Framed Wall Construction Data



6.11.2 Framed Wall Construction Layers (inside to outside)

6.11.2.1 Inside Finish

Default value gypsum board.

6.11.2.2 Sheathing/Insulation

List the sheathing or insulation layer in a wall on the inside surface (conditioned space side) of the framed wall, or the size and material of furring on the inside surface. Options are none, gypsum board, wood sheathing, and R-1to R-60 insulation, or specify R-value.

6.11.2.3 Cavity/Frame

List the compressed R-value of cavity insulation (see Section 6.2) in the cavity column. The framing column is to indicate the size of the framing and the spacing (e.g., 2x6 with 16-inch on center framing), or advanced wall framing (AWF), see Section 6.6.

6.11.2.4 Sheathing/Insulation

List the sheathing or insulation layer that will be added to the outside of the framing. Options are none, gypsum board, wood, R-1 to R-60 insulation, or specify R-value.

6.11.2.5 Exterior Finish

Exterior finish options are 3 coat stucco, or synthetic stucco (also known as 1 coat stucco, and is often modeled with sheathing insulation), wood siding, and all other siding.

6.11.2.6 Non-Standard Spray Foam in Cavity

This check box identifies that additional documentation and ECC verification requirements apply because the claimed R-value exceeds the default assumption of R-5.8 per inch for closed cell SPF and R-3.6 per inch for open cell SPF (see Section 6.5).

6.11.3 Mass or Other Unframed Walls

6.11.3.1 Inside Finish

Default value gypsum board.

6.11.3.2 Insulation/Furring

List the insulation installed if the walls are furred on the inside. Select the thickness and type of furring which is 0.5-inch to 5.5-inch thick wood or metal.

6.11.3.3 Mass Layer

List the material which varies based on the construction type and includes concrete, brick, light weight (LW), medium weight (MW) or normal weight (NW) concrete masonry units (CMU) with solid grout, insulated cores, or empty cores, strawbale, adobe, and log. Select the thickness.

6.11.3.4 Insulation/Furring

List the insulation installed if the walls are furred on the outside. Select the thickness and type of furring which is 0.5-inch to 5.5-inch thick wood or metal.

6.11.3.5 Exterior Finish

Exterior finish options are wood siding, 3 coat stucco, or synthetic stucco (also known as 1 coat stucco), wood siding/sheathing/decking, and all other siding.

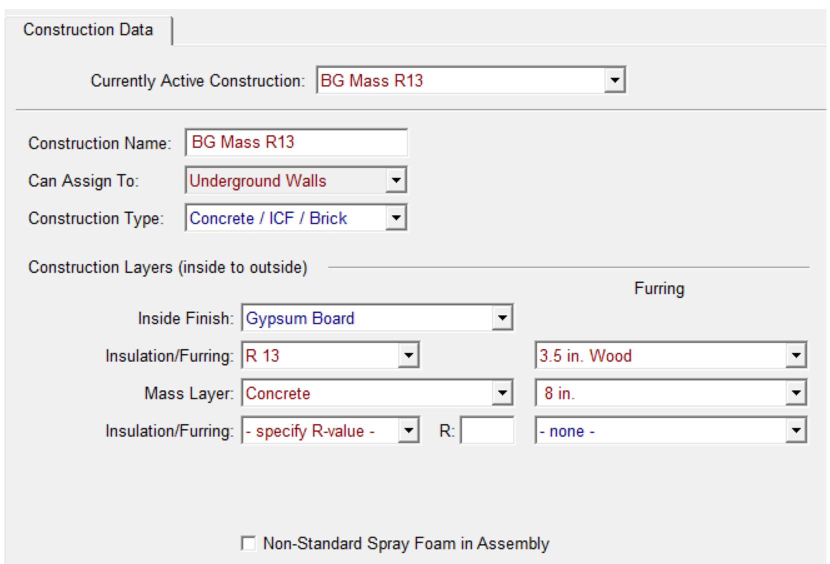
6.11.3.6 Non-Standard Spray Foam in Cavity

This check box identifies that additional documentation and ECC verification requirements apply because the claimed R-value exceeds the default assumption of R-5.8 per inch for closed cell SPF and R-3.6 per inch for open cell SPF (see Section 6.5).

6.11.4 Below Grade Walls

Underground or below grade walls that are concrete/ICF/Brick can be created using the right-click/create underground walls option on the construction assemblies list. With the exception of the exterior surface (which is assumed to be soil), the inputs are the same above grade walls (Section 6.11.3).

Figure 6-12: Below Grade Walls



6.11.5 Structurally Insulated Panels (SIPs)

6.11.5.1 Inside Finish

Default value gypsum board.

6.11.5.2 Sheathing/Insulation

List the continuous insulation layer on the inside surface (conditioned space side) of the SIP wall. Options are R-1 to R-60 insulation.

6.11.5.3 Panel Rated R (at 75 F)

Specify the panel's rated R-value at 75 degrees in the cavity path (R-14 to R-55). In the frame path list the thickness of the panel and whether it is, or is not, OSB.

6.11.5.4 Sheathing/Insulation

List the continuous insulation layer on the outside surface of the SIP wall. Options are R-1 to R-60 insulation or specify R-value.

6.11.5.5 Exterior Finish

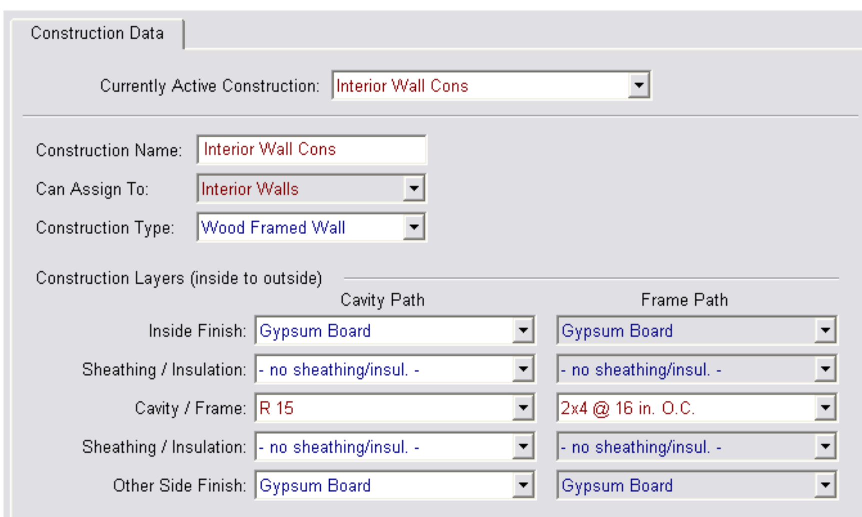
Exterior finish options are wood siding, 3 coat stucco, or synthetic stucco (also known as 1 coat stucco), wood siding/sheathing/decking, and all other siding.

6.11.6 Demising and Interior Walls

Walls separating conditioned space from unconditioned space (e.g., from house to garage, knee walls) are modeled in the conditioned space as interior walls, although actually demising walls. In creating the building envelope, the wall will have conditioned space on one side and unconditioned space or zone on the other side.

When the wall is an interior or demising wall, both the inside and outside surfaces are gypsum board, and there will be no solar gains on the unconditioned side. Knee walls are insulated as a wall.

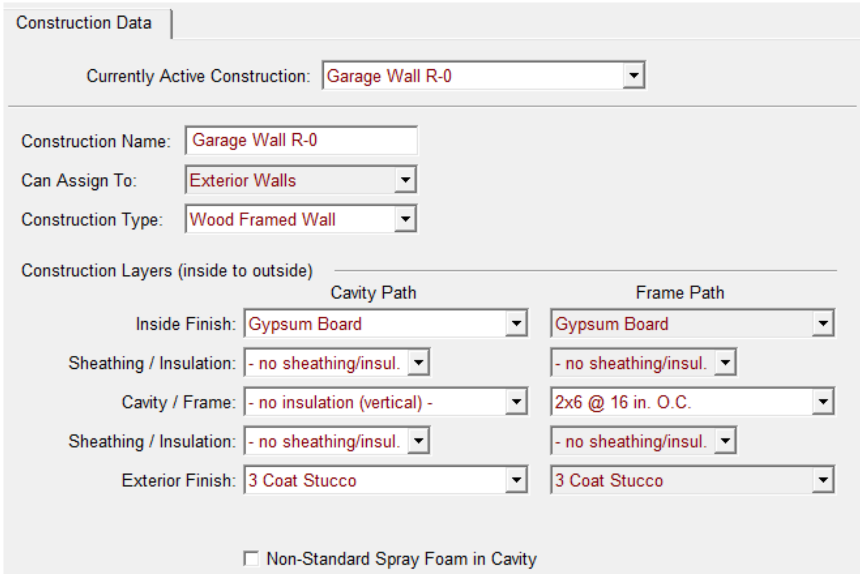
Figure 6-13: Interior Walls



6.11.7 Garage Exterior Walls

The outermost walls of the garage wall or unconditioned storage space, which are modeled as part of an unconditioned zone, typically do not have insulation (see Figure 6-14).

Figure 6-14: Uninsulated Exterior Wall



6.12 Floors

Raised floor types that can be created include wood framed, SIPs or concrete/ICF/brick constructions.

Floors may be located over a crawl space or exterior (ambient air). Interior raised floors may be over an unconditioned attached space (such as a garage) or over another conditioned space (party surface). Steel framed floor construction is not yet implemented. See Figure 6-15, Figure 6-16, and Figure 6-17.

Slab on grade and below grade slab floors are not created using a construction assembly (see Section 6.12.4).

Figure 6-15: Floor over crawl space

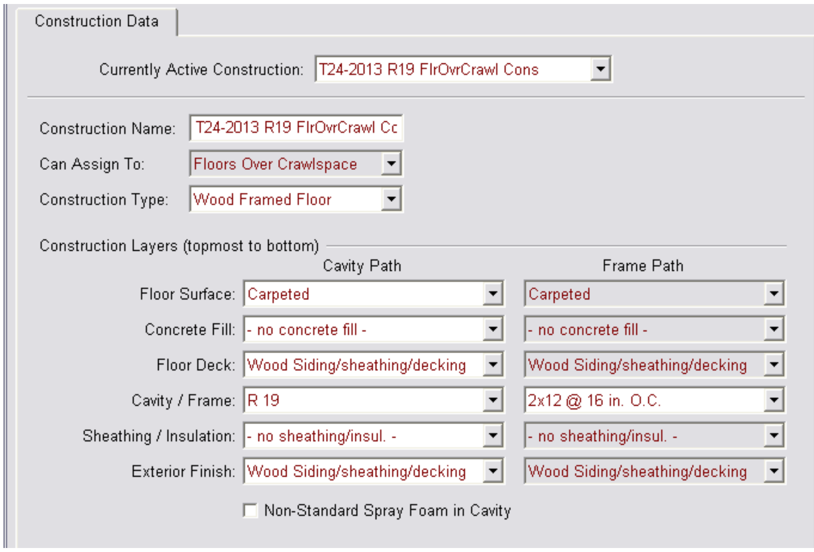
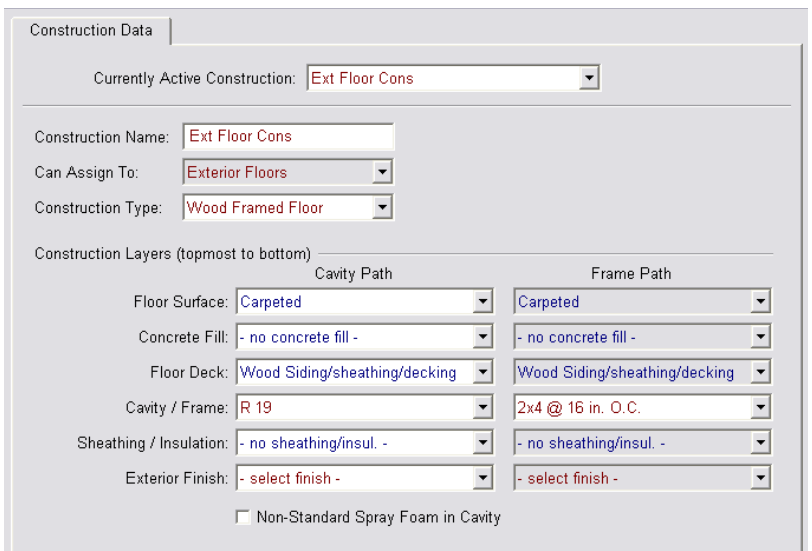


Figure 6-16: Floor over exterior



6.12.1 Raised Floor Construction Data

6.12.1.1 Construction Name

User-defined name.

6.12.1.2 Can Assign To

This is a fixed field. To create a new assembly type, at the zone level, pick <create> and make the appropriate construction assembly type.

6.12.1.3 Construction Type

Options include wood framed, SIPs, or concrete /ICF/brick constructions.

6.12.2 Raised Floor Construction Layers (top to bottom)

6.12.2.1 Floor Surface

The available floor surface types are carpeted, hardwood, tile, and vinyl.

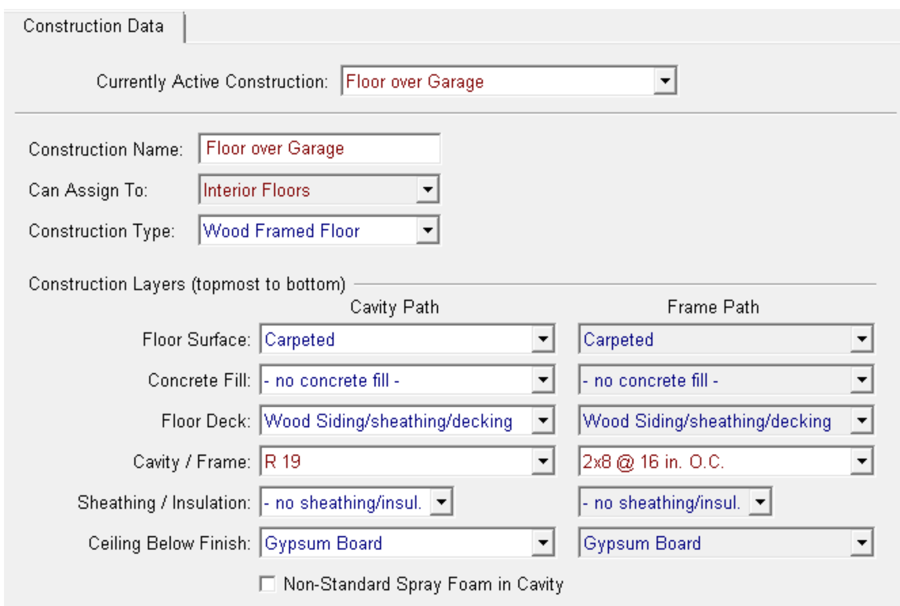
6.12.2.2 Concrete Fill

Default is no concrete fill. Select no concrete fill, or concrete fill.

6.12.2.3 Floor Deck

Select (1) no floor deck or (2) wood siding, sheathing, decking

Figure 6-17: Interior Floor



6.12.2.4 Cavity/Frame

List the R-value of cavity insulation (see Section 6.2) in the cavity column. The framing column is to indicate the size of the framing and the spacing (e.g., 2x6 with 16-inch on center framing) or panel size for SIPs.

6.12.2.5 Sheathing/Insulation

List the sheathing or insulation layer on the outside of the framing. Options are none, gypsum board, and R-1 to R-60 insulation, or specify R-value.

6.12.2.6 Exterior Finish

Optional input. The available exterior finishes are 3 coat stucco, synthetic stucco (also known as 1 coat stucco), wood siding/sheathing/decking, and all other siding.

6.12.2.7 Non-Standard Spray Foam in Cavity

This check box identifies additional documentation and ECC verification requirements due a claimed R-value that exceeds the default assumption of R-5.8 per inch for closed cell SPF and R-3.6 per inch for open cell SPF (see Section 6.5).

6.12.3 Floor Over Garage

A floor over a garage is modeled as an interior floor. When defining the building envelope, the outside surface will be set to garage rather than another conditioned zone. By modeling it as an interior floor, the ceiling below can be set to gypsum board or be left undefined ("- select inside finish -").

6.12.4 Slab and Below Grade Slab

There are no construction assemblies for slab and below grade slab floors. See Sections 7.4 and 7.5.

NOTE: On the CF1R, below grade slab floor area is not included in the general information total for slab area (which only includes the area of slab on grade). The below grade slab floor area is listed in the slab floor table.

6.13 Window Types

The window types (but only if set up correctly) can be used to update window efficiencies in an entire building in one or two steps. Do not include any details other than the U-factor and SHGC values. Be sure to enter the values, even when accepting the default values (text changes from blue to red).

Leave size, overhang and/or fin fields blank and create as few different window types as possible (see Figure 6-18). When you create the building's walls and windows (see Section 7.6) then you will specify the window sizes and any overhang/fin details.

6.13.1 Window Type Data

6.13.1.1 Window Name

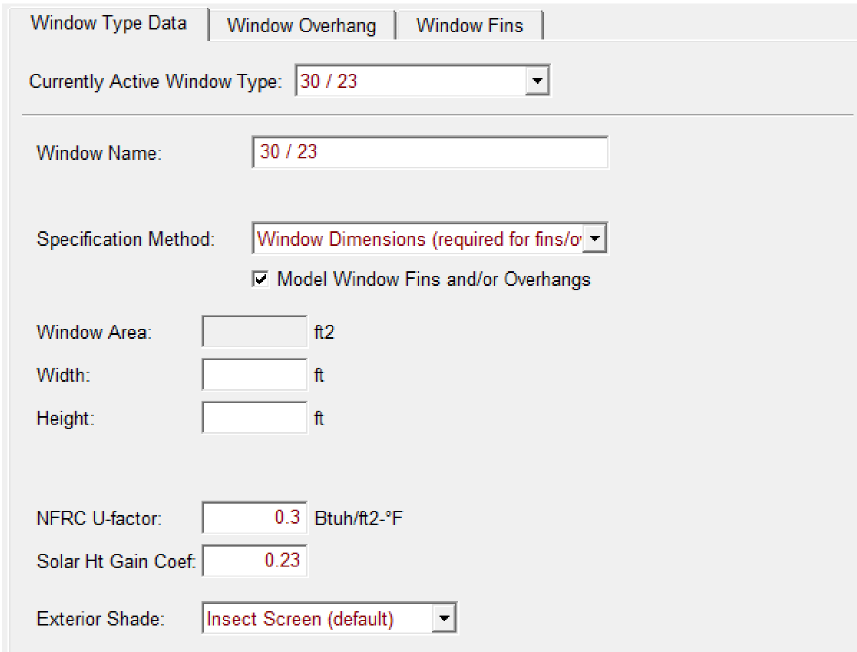
User defined name (does not appear on the CF1R). Use a brief description of the type of window or the efficiency values (30/23).

6.13.1.2 Specification Method

Window dimension or overall window area.

NOTE: This value can be changed when defining the individual windows in the building, such as if there is an asymmetric window, no overhangs, and you want to enter only the area.

Figure 6-18: Window Type



6.13.1.3 Model Window Fins and/or Overhangs

When defining the window library, it is not necessary to define an overhang. These values will be completed when defining the individual windows in the building. Check box is available only when the previous field is set to window dimensions.

6.13.1.4 Window Area

Leave blank. This value is specified when defining the windows in the building.

6.13.1.5 U-factor

Be sure to type in the value. U-factor is either from National Fenestration Rating Council (NFRC) for the fenestration product (do not use the center of glass value) (www.nfrc.org) or the default value from Section 110.6, Table 110.6-A of the Energy Code.

6.13.1.6 Solar Heat Gain Coefficient

Be sure to type in the value. Solar Heat Gain Coefficient (SHGC) is either from NFRC for the fenestration product (www.nfrc.org) or the default value from Section 110.6, Table 110.6-B of the Energy Code.

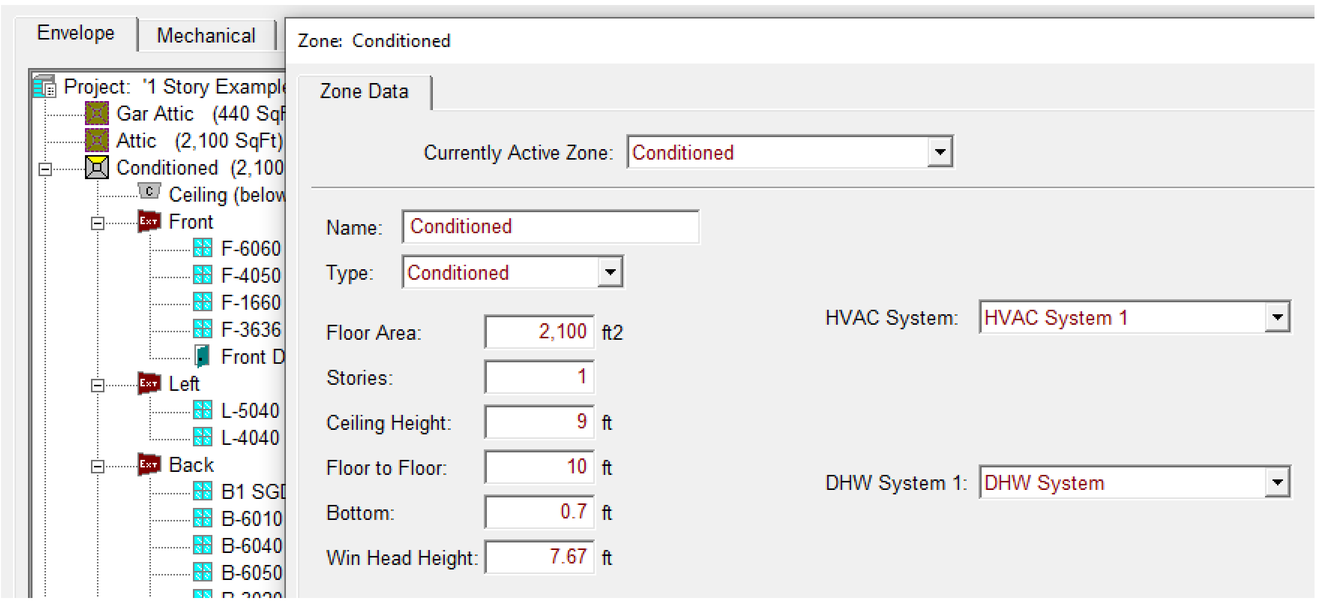
6.13.1.7 Exterior Shade

Default is insect (bug) screens withing the software, not a user input. As with overhangs, as you enter windows in the building you can change this to none.

7 Building Envelope

Once the conditioned zone is defined (Figure 7-1) the different components of the building envelope can be created or modified. If using a sample file or previously created file, you will have a library of construction assemblies from which to choose.

Figure 7-1: Conditioned Zone



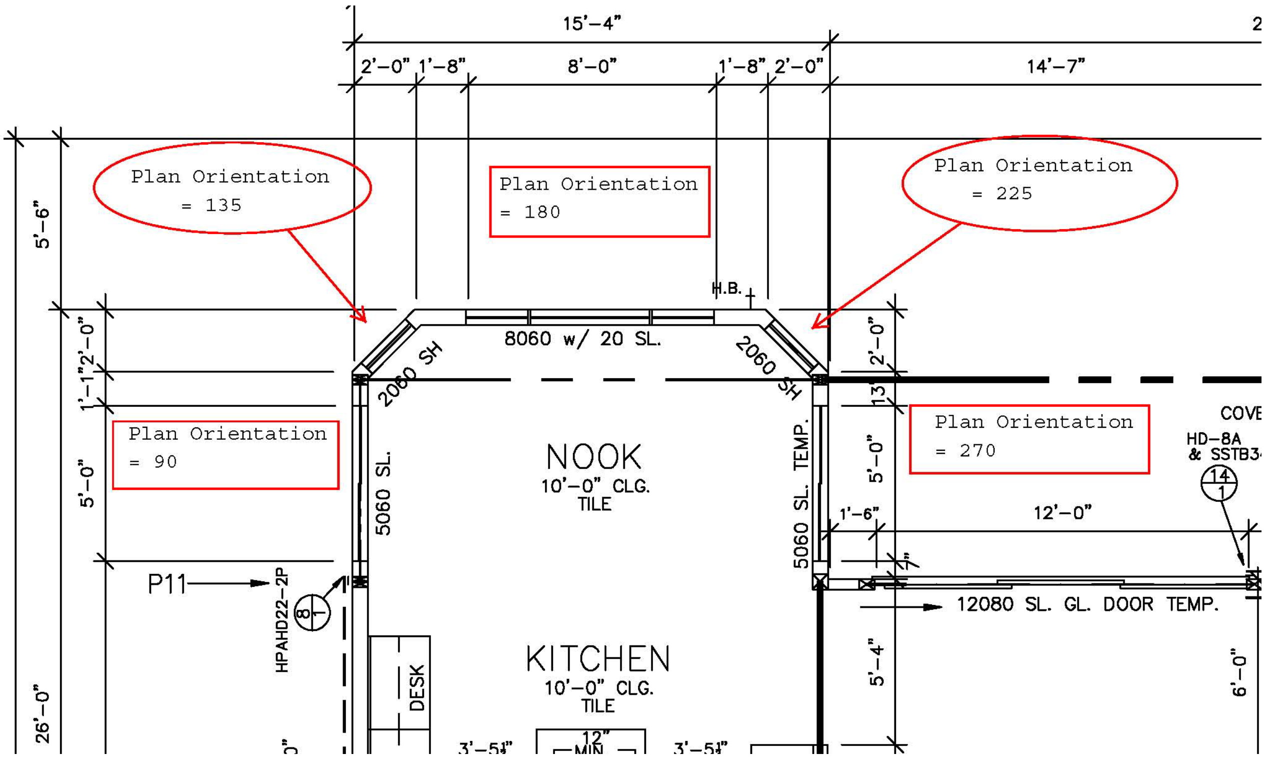
7.1 Surface Orientation

Distinct from the building front orientation from the site plan, wall surfaces (and any windows) use the plan orientation or plan view. (Try not to think about whether it faces west, simply determine if the surface is facing the front, left, back or right from the floor plan.) Numeric values are only specified when the wall is at an angle and the value is where the wall is relative to the front.

When you must specify an angled wall, the "plan orientation" values are the same for every building—front is 0, left is 90, back is 180, and right is 270. If there is a breakfast nook on the back of the building, the angled walls are entered as (180-45) 135 and (180+45) 225 (see Figure 7-2). The software adjusts these values based on the entry on the building tab for front orientation and reports the actual azimuth on the CF1R.

USER TIP: When you enter the actual orientation of a wall, the software models the "specified" value plus the front orientation. This means if the front of the building faces 90 degrees and you identify the front wall as 90 rather than front, the output will reflect 180 (user specified + building front). The CF1R report includes both the plan orientation and the actual azimuth. If you are unsure, carefully check the CF1R for accuracy.

Figure 7-2: Plan Orientation



7.2 Opaque Surfaces

Working from top down, add any ceilings below attic and any cathedral ceilings, followed by walls and floors.

7.2.1 Defining Surfaces Surrounding a Zone

CBECC-Res applies logic that requires a modeled space to have a ceiling/roof, floor and sometimes four walls. If a space/zone is adjacent to another space being modeled, the connection between these two zones is achieved by modeling an interior surface (wall, floor, or ceiling) in one of the zones. When connections are missing the file will not run.

NOTE: When the wall from the house to the garage (interior or demising wall) is modeled in the garage, an error will occur. Move the surface to the conditioned space and set the zone on the other side as the garage to get the file to successfully run. Do not duplicate the wall in both zones.

An interior surface may be a demising surface (between conditioned and unconditioned space), a party surface (the other conditioned space is not modeled), or an interior surface (both conditioned zones are modeled).

7.2.2 Addition Alone Connecting Surfaces (“Party” Surface)

If the adjacent space is not modeled, an interior surface is modeled where the new space connects to the existing space. Check the option for a “party surface” when the adjacent zone is not being modeled.

7.2.3 Ceiling below Attic

7.2.3.1 Ceiling Name

User-defined name. If the building plans have a unique identifier, that should be used here to assist in the plan checking and inspection processes.

7.2.3.2 Belongs to Zone

Select any appropriate zone already included in the building model. When copying components of one zone to another, this field automatically changes.

7.2.3.3 Surface Status (if shown)

The default is new for new construction. Other options include existing and altered.

7.2.3.4 Attic Zone

Select any appropriate attic zone or define a new zone. A separate attic zone would be needed if any of the characteristics of the attic are different, including the roofing material, above or below deck insulation, or radiant barrier.

7.2.3.5 Construction

If an appropriate construction assembly is not available, pick <create> (discussed in depth in Chapter 6, Construction Assemblies).

7.2.3.6 Ceiling Area

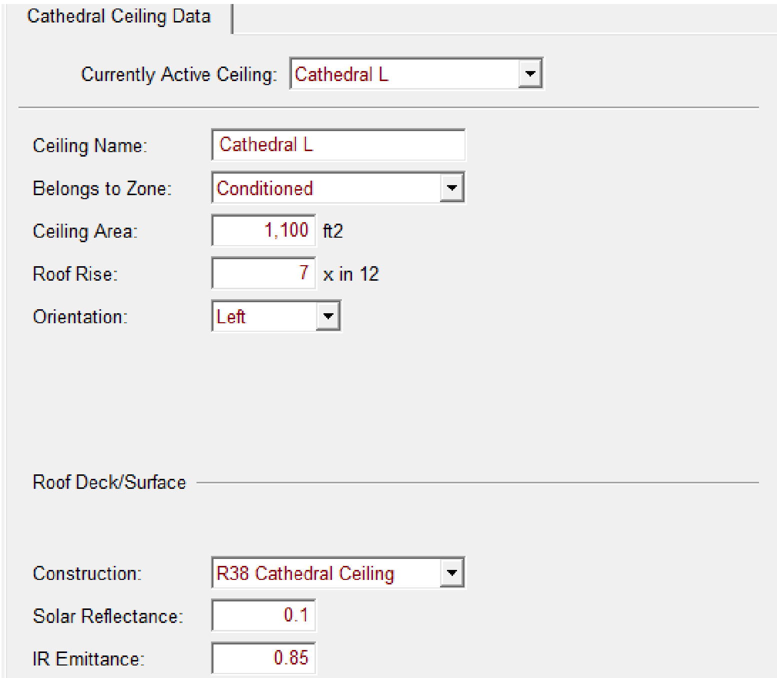
Area of the ceiling, in square feet.

USER TIP: Check the details of the attic associated with this ceiling. The construction types can be difficult to distinguish. The attic zone will include the type of roof (such as asphalt or tile), whether there is roof deck insulation, a radiant barrier, a cool roof, and roof pitch (see Figure 5-6 and Figure 5-7).

7.2.4 Cathedral Ceiling

The information needed to define a cathedral ceiling is shown in Figure 7-3. Because the orientation is entered for cathedral ceilings, the ceiling will be modeled in multiple entries, with a typical cathedral ceiling having two or more parts (e.g., left, and right).

Figure 7-3: Cathedral Ceiling



7.2.4.1 Ceiling Name

User-defined name.

7.2.4.2 Belongs to Zone

Select any appropriate zone already included in the building model. When copying components of one zone to another, this field automatically changes.

7.2.4.3 Surface Status (if Shown)

The default is new for new construction. Other options include existing and altered.

7.2.4.4 Construction

If no appropriate construction assembly is available, pick <create> (discussed in depth in Chapter 6, Construction Assemblies).

7.2.4.5 Ceiling Area

The area of the ceiling (in square feet) that meets all the same specified criteria. The area should be adjusted for the roof pitch (see Table 7-3). If parts of the roof face different orientations, model separately.

Table 7-3 Roof Pitch Multiplier

Roof Pitch	Angle	Roof Pitch Multiplier
1:12	4.76	1.0035
2:12	9.46	1.0138
3:12	14.04	1.0308
4:12	18.43	1.0541
5:12	22.62	1.0833
6:12	26.57	1.1180
7:12	30.26	1.1577
8:12	33.69	1.2019
9:12	36.37	1.2500
10:12	39.81	1.3017
11:12	42.51	1.3566
12:12	45.00	1.4142

7.2.4.6 Roof Rise

Specify the roof rise or roof pitch, which is the number of feet the roof rises in a span of 12 feet (e.g., shown on plans as 4:12 or 4 feet in 12 feet). If there are multiple pitches you can enter the roof rise of the largest area of roof

7.2.4.7 Orientation

The plan view using labels front, left, back, and right. If specifying a value, it is based on front = 0, left = 90, back = 180, and right = 270. If the cathedral ceiling is on a part of the building facing an angle, match the orientation of the walls. See Section 7.1.

7.2.4.8 Solar Reflectance

The default aged solar reflectance is 0.10 for all roof types. Alternatively, enter the aged solar reflectance for a roof product, as published by the Cool Roof Rating Council (CRRC) (www.coolroofs.org). A higher value is better in warmer climate zones, so if a specific product color is unknown use a lower value among options to avoid having to regenerate compliance documentation during construction. See also Section 5.3.1.7.

7.2.4.9 Thermal Emittance

The default thermal emittance (or emissivity) for all roofing materials is 0.85. Alternatively, enter the thermal emittance value published by CRRC (www.coolroofs.org). See also Section 5.3.1.8.

7.2.5 Knee Walls

Model any knee walls (a sidewall separating conditioned space from attic space under a pitched roof or where ceiling heights change), as an interior wall with the outside surface as attic, with insulation value typical for a wall.

7.2.6 Exterior Walls

Add the walls in a clockwise or counterclockwise direction and in the order you would like them to appear in the tree and on the reports.

7.2.6.1 Exterior Wall Name

If the building plans use a unique tag or ID, use that for the name, otherwise a simple name such as front or front wall is sufficient. Each name within a zone or on a surface must be unique.

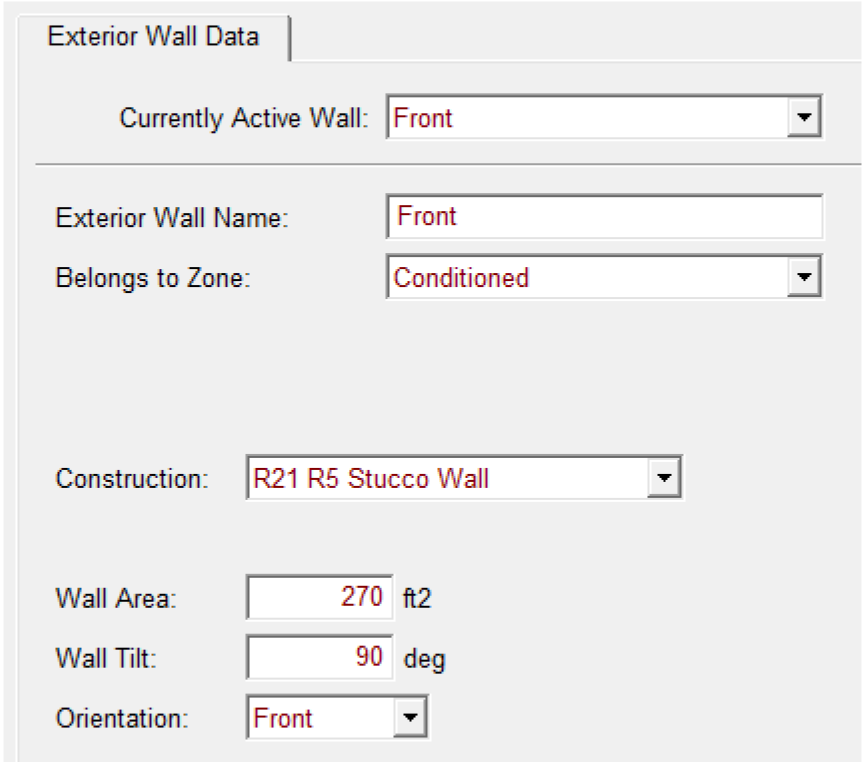
7.2.6.2 Belongs to Zone

The name of the zone in which the wall is being modeled.

7.2.6.3 Surface Status (if Shown)

Surface status is used to identify an existing, altered, or new wall. Any surfaces that are part of a new building or addition are new.

Figure 7-4: Exterior Wall



7.2.6.4 Construction

Either pick an existing construction assembly or create a new one (see Section 6.10)

7.2.6.5 Wall Area

Gross wall area, in square feet (the area of windows and doors associated with the wall will be subtracted).

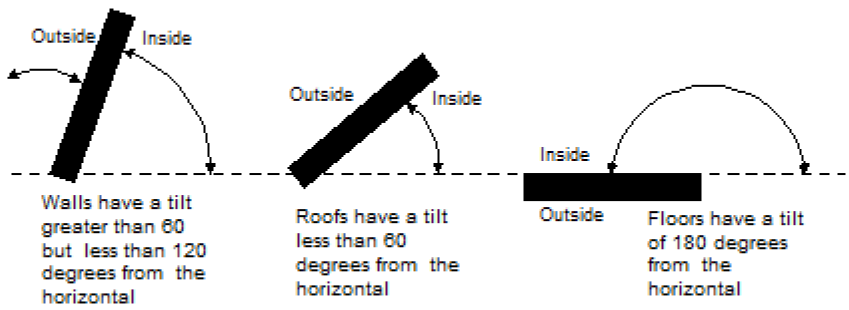
7.2.6.6 Wall Tilt

A wall typically has a tilt of 90 degrees but may range from greater than 60 degrees to less than 120 degrees (see Figure 7-5).

7.2.6.7 Orientation

The plan view orientation. Use front, left, back and right. If specifying a value, it is based on front being equal to 0, left is 90, back is 180, and right is 270, rather than the actual building orientation. The software will add the front orientation and this plan orientation to determine the actual orientation of the modeled surface. See Section 7.1.

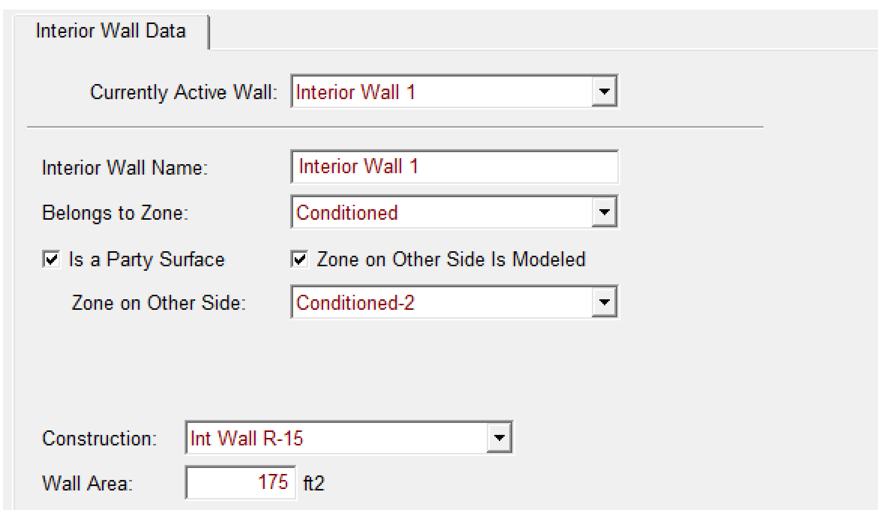
Figure 7-5: Surface Tilt



7.2.7 Party Walls and Surfaces

When a building includes multiple zones, model any interior surfaces between the zones. Both zones are identified, as well as checking the box that the zone on the other side is modeled (see Figure 7-6).

Figure 7-6: Party Wall



7.2.8 Below Grade Overview

This is an overview of the inputs scattered throughout this user manual that are related to modeling below grade surfaces, also known as basements or underground surfaces.

In the zone information, if there are below grade surfaces, determine the depth of the below grade walls and floor and enter the zone bottom as the negative of that number. For example, if the walls are 6 feet 4 inches below grade, the wall and floor depths are 6.33 feet, and the zone depth is -6.33 feet.

USER TIP: Some modeling decisions to consider: (1) Because the orientation is not an input and it is not possible to have doors or windows on below grade walls, you may be able to combine walls (as long as this does not result in a “not enough surfaces” error. (2) If the ground is sloped, use your professional judgment as to how detailed to break out the surfaces. You could either select an average, model all at the lowest level (conservative), or somewhere in between. (3) The zone type “unconditioned” cannot be modeled, so an unconditioned basement would not be modeled.

7.2.9 Below Grade Walls

Create below grade and slab floors using the right-click, create underground wall or floor. Below grade floors are described in Section 7.5.

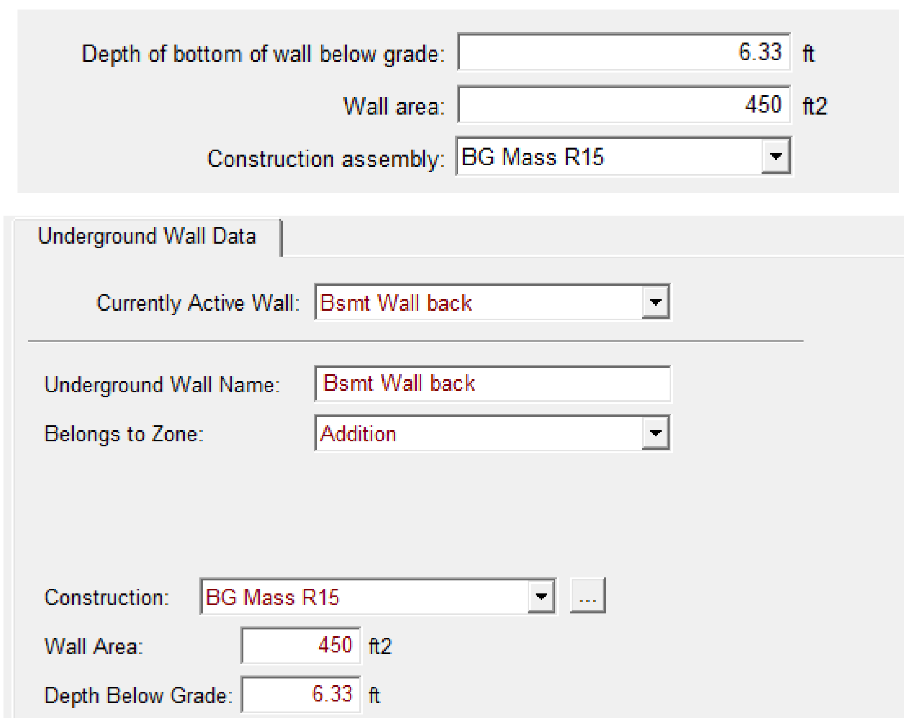
7.2.9.1 Depth of Bottom of Wall Below Grade

Measurement from grade to the bottom surface of the wall (entered as a positive number, in feet).

7.2.9.2 Wall Area

Because wall orientation is not an input, enter the combined area of walls that share the same characteristics (in feet).

Figure 7-7: Underground Walls



7.2.9.3 Construction Assembly

Pick one of the construction assemblies or create a new underground wall assembly (see Section 6.10). Construction assemblies are limited to concrete/ICF/Brick. With the exception of the exterior surface (which is assumed to be soil), for other wall inputs see Section 6.11.3 for wall inputs.

7.2.10 Garage Surfaces

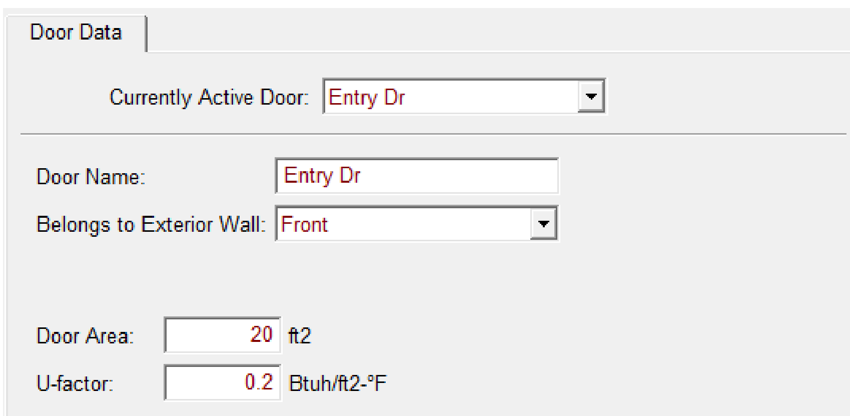
When there is a garage or attached unconditioned space (check on the building tab "has attached garage"), any surfaces between these zones are modeled in the conditioned zone. These surfaces are modeled as interior walls and interior floors (see Sections 6.11.1 and 6.12.3).

No surface is modeled more than once, so if the garage ceiling is a floor in the conditioned space zone, it is not modeled in the garage. The garage exterior surfaces are not typically insulated, and there is no need to model windows in a garage/unconditioned space. Model the area and type of ceiling, slab floor (perimeter length is only to exterior), any walls, the large metal roll-up or wood door (U-factor 1.00), and the door to outside.

USER TIP: If there are not enough surfaces, be sure you have modeled a floor, a roof (or interior floor from the house to the garage if there is conditioned space above), and all exterior walls. If there is still an inadequate number of surfaces, model one of the exterior walls in two parts.

7.2.11 Opaque Doors

Figure 7-8: Opaque Door



Doors (opaque) and windows (fenestration) are modeled separately under the wall surface with which they are associated. For doors with glass, first determine if only part of the door or the entire door is a fenestration product. If 25 percent or more of the door area is glass, the entire door area is modeled as a fenestration product using either default or NFRC-rated values.

When a door is less than 25 percent glass, calculate the glass area plus two inches on all sides (to account for a frame) and model that as a window. The opaque door area is the total door area minus the calculated glass area. The standard design building has the same area of opaque door (U-factor 0.20) as the proposed design building.

7.2.11.1 Door Name

User-defined name.

7.2.11.2 Belongs to Exterior Wall

Default is the existing wall. When copying window data to another zone, the program changes this to the new exterior wall.

7.2.11.3 Door Status

The default is new for new construction or if part of an addition. Other options include altered and existing.

7.2.11.4 Door Area

Enter the door area, in square feet.

7.2.11.5 U-factor

Default value is 0.20 for opaque doors. Fire-rated doors (from the house to the garage) may have a maximum U-factor of 0.50. Other values allowed are from *Reference Appendices,* Joint Appendix JA4, Table 4.5.1.

7.2.12 Garage Door

When modeling a garage zone, the large garage doors (metal roll-up or wood) are modeled with a 1.00 U-factor.

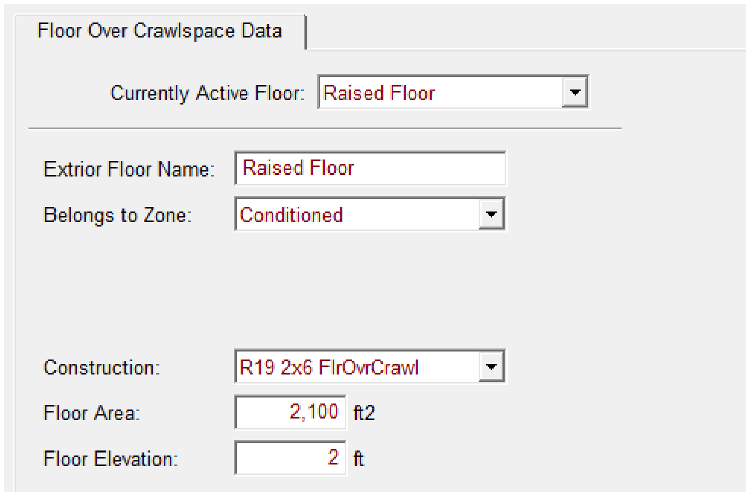
7.3 Raised Floor

When creating a raised floor over a crawl space, the software creates the crawl space zone. When a raised floor is over an unconditioned space, such as a garage, this surface is modeled in the conditioned zone as an interior (or demising) floor. The adjacent zone is the garage.

A raised floor over exterior is when there is no crawl space and no unconditioned space underneath the floor (for example, a second floor balcony).

7.3.1 Floor over Exterior or Crawl Space

Figure 7-9: Raised Floor



7.3.1.1 Exterior Floor Name

User-defined name.

7.3.1.2 Belongs to Zone

Select any appropriate zone already included in the building model. When copying components of one zone to another, this field automatically changes.

7.3.1.3 Surface Status (if Shown)

Select new, altered, or existing.

7.3.1.4 Construction

Raised floor over crawl space, exterior floor, or interior floor. If an appropriate construction assembly is not available, pick <create> (discussed in depth in Chapter 6, Construction Assemblies).

7.3.1.5 Floor Area

Area of the floor, in square feet.

7.3.1.6 Floor Elevation

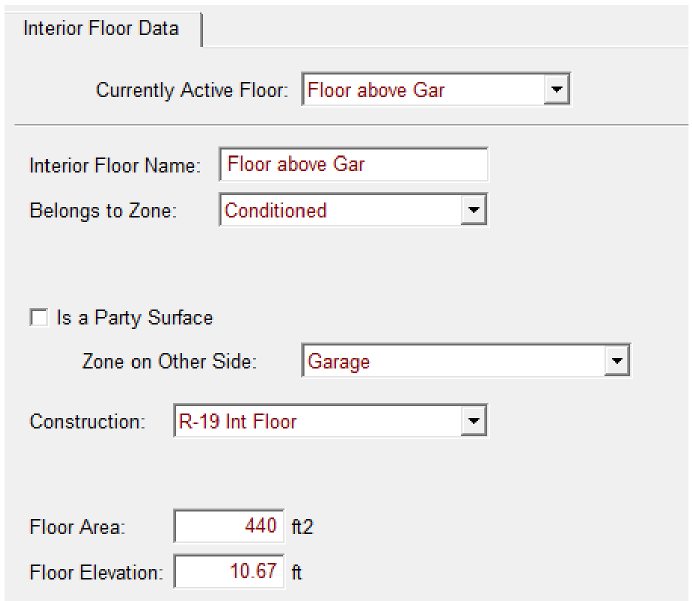
Height above grade or the depth of crawl space, in feet. This value must be consistent with the zone information. If the crawl space height is 2 feet, the zone bottom is 2, this value is also 2. If this is a second floor, and the first-floor zone has a bottom of 2, with a floor to floor height of 10, then this value for the second floor is 12. If the first and second floors are modeled as separate zones (user's choice) this value will match the zone input for bottom. See more in Section 5.1.1 and Figure 5-2

7.3.2 Interior Floor/Floor Over Garage

A raised floor over a garage or over another conditioned space is modeled as an interior floor, but with either the garage or another zone on the other side.

USER TIP: A garage floor is not a party surface. Party surface means there is conditioned space underneath.

Figure 7-10: Garage or Interior Floor



7.3.2.1 Interior Floor Name

User-defined name.

7.3.2.2 Belongs to Zone

Select any appropriate zone already included in the building model. When copying components of one zone to another, this field automatically changes.

7.3.2.3 Surface Status (if Shown)

Select new, altered, or existing.

7.3.2.4 Is a Party Surface / Zone on Other Side Is Modeled

If the surface connects two conditioned spaces, check party surface (see Figure 7-6). Indicate if the adjacent zone is modeled as part of this input file.

7.3.2.5 Zone on Other Side

Identify the name of the adjacent zone.

7.3.2.6 Construction

Interior raised floor. If an appropriate construction assembly is not available, right-click and pick <create> (discussed in depth in Chapter 6, Construction Assemblies).

7.3.2.7 Floor Area

Area of the floor, in square feet.

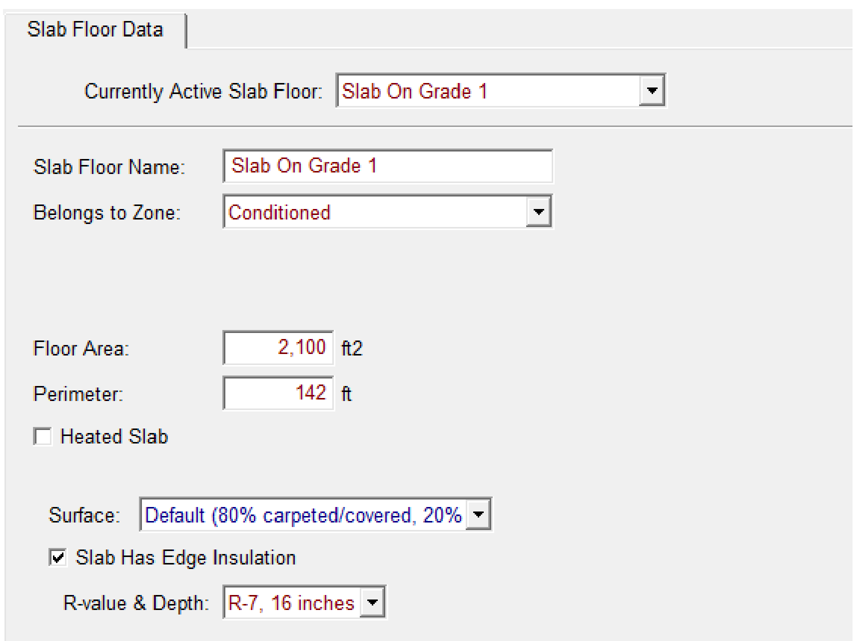
7.3.2.8 Floor Elevation

Height above grade, in feet. This value must be consistent with the zone information. If the bottom of the zone is 0.7 and the floor-to-floor height is 10, this value is 10.7.

7.4 Slab Floor

Slab on grade floors are modeled in conditioned spaces, unconditioned spaces, heated slab floors, slab floors with mandatory or optional slab edge insulation, floors with 80% covered and 20% exposed, or some other combination of exposed and covered slab.

Figure 7-11: Slab Floor Data



7.4.1 Slab Floor Name

If the building plans use a unique tag or ID, use that for the name. Each name within a zone or on a surface must be unique.

7.4.2 Belongs to Zone

The name of the zone in which the slab is being modeled.

7.4.3 Slab Floor Status

Select new, altered, or existing.

7.4.4 Floor Area

Area in square feet measured from the outside of the exterior surface of the zone.

7.4.5 Perimeter

Length of slab edge (in feet) between the space modeled and exterior only. Do not include the length of edge that occurs between the house and garage (an area that cannot be insulated if the edge is being insulated).

7.4.6 Heated slab

Check box to indicate that the slab is heated, in which case mandatory insulation requirements apply. See Section 110.8 of the Energy Code.

7.4.7 Surface

Default for conditioned spaces is 80% covered/20% exposed, otherwise specify exposed or covered slab (modeled separately). Covered slab includes carpet, cabinets, and walls. Garages must be modeled as exposed. A conditioned zone with greater than 20% exposed is reported as a special feature.

7.4.8 Slab Has Edge Insulation

Check box to indicate that the slab edge will be insulated.

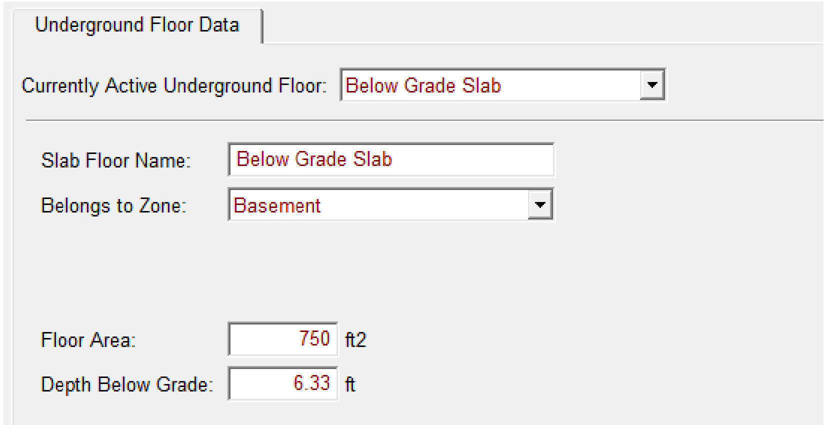
7.4.9 R-value & Depth (or Length)

When slab edge insulation is indicated in the check box, the R-value and depth of the proposed slab edge insulation is identified. Depth of insulation installed vertically is specified in inches. Horizontally installed insulation is specified in feet. A fully insulated slab is not yet implemented.

7.5 Below Grade Slab

When a slab floor is below grade, create an underground floor by right-clicking on the zone. There are no edge losses for the below grade slab.

Figure 7-12: Underground Floor Data



7.5.1 Slab Floor Name

If the building plans use a unique tag or ID, use that for the name. Each name within a zone or on a surface must be unique.

7.5.2 Belongs to Zone

The name of the zone in which the below grade slab is being modeled.

7.5.3 Slab Floor Status (if Shown)

Select new, altered, or existing.

7.5.4 Floor Area

Area in square feet measured from the outside of the exterior surface of the zone.

7.5.5 Depth Below Grade

This is the depth of the floor below grade (positive number, in feet). With the exception that this value is expressed as a positive number, this value should match the value for the zone bottom (see Section 5.1.1.8).

7.6 Windows

The Standards establish a maximum weighted average U-factor of 0.40 (Standards, §150.0(q)) for fenestration, including skylights. Per exception 1, fenestration area that is the greater of 10 ft^2 or 0.5 percent of the conditioned floor area is not required to comply with the maximum U-factor requirement.

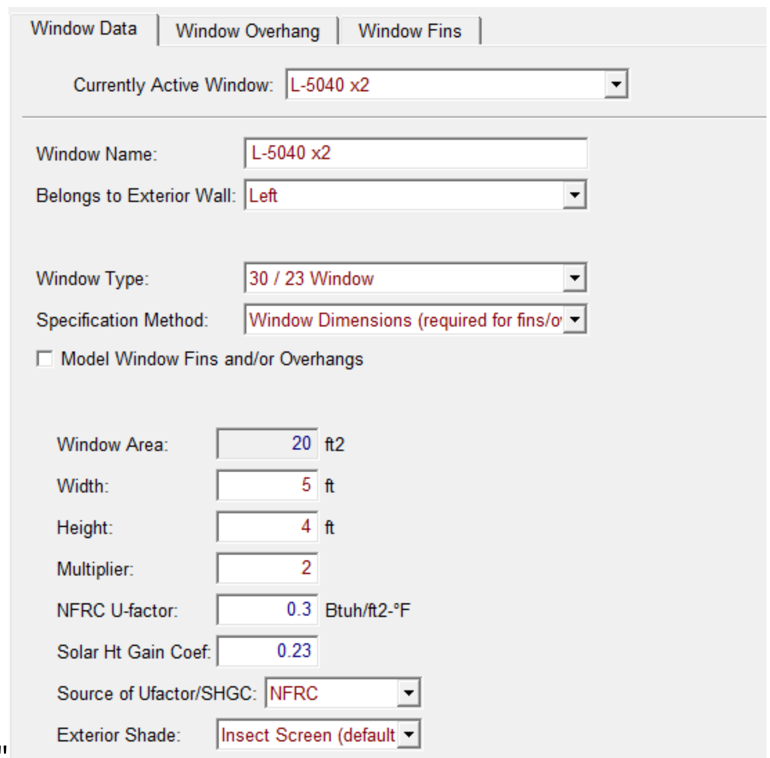
Using window types before defining the windows is a very important and time-saving step. As explained in Section 6.13, create a library of window types using only the U-factor and SHGC. Be sure to enter the value directly, even if keeping the default values (or it will not work). Because you must model each window individually, using window types in this way gives you the flexibility to update the efficiencies in one or two steps.

USER TIP: To update window efficiencies, access the window type, update the efficiency (and even the name) and every window that references that type is updated.

7.6.1 Window Data

Right-click on the wall to which you will add windows and pick <create> and select window. The screen shown in Figure 7-13 is displayed.

Figure 7-13: Window Data



7.6.1.1 Window Name

User-defined name. If the plans use a window schedule or unique identifier, that identifier can be used for the window name. Each window on a given surface must have a unique name.

7.6.1.2 Belongs to Exterior Wall

Defaults to the wall on which the window was created. When copying window data to another zone, the program changes this to the new exterior wall.

7.6.1.3 Surface Status (if Shown)

Select new, altered, or existing.

7.6.1.4 Window Type

If using a window type from the library you created, select from the valid options. See Section 6.13 for setting up and updating the window types.

If this field is "none," the window U-factor and SHGC of each window is entered directly.

7.6.1.5 Specification Method

Select either Window Dimensions (required for fins and overhangs) or Overall Window Area.

7.6.1.6 Model Window Fins and/or Overhangs

Check box is available only when the specification method is set to window dimensions.

USER TIP: Whether you model overhangs or not, if this box is checked a full row in the overhangs and fins table appears on the CF1R. To save room on the CF1R, uncheck this box for any windows without an overhang.

7.6.1.7 Window Area

If using the overall window area, enter the area of a window (in square feet). If using window dimensions once the width and height are entered, this value will autofill.

USER TIP: If using a multiplier with window dimensions, the window area is only for one window, however, the CF1R will show the width, height, multiplier, and total area for the entry.

7.6.1.8 Width

Enter the window width (in feet), if using the window dimensions method.

7.6.1.9 Height

Enter the window height (in feet), if using the window dimensions method.

7.6.1.10 Multiplier

The number of identical windows.

NOTE: Must also have identical overhang and fin conditions.

7.6.1.11 U-factor

If a window type was selected above, this value is auto-completed using the U-factor previously entered. If window type is "none," enter either the product U-factor (not the center of glass value) from NFRC (www.nfrc.org) or the default value from Section 110.6, Table 110.6-A of the Energy Code.

7.6.1.12 Solar Heat Gain Coefficient

If a window type was selected above, this value is auto completed using the Solar Heat Gain Coefficient (SHGC) previously entered. If window type is “none,” enter either the product SHGC from NFRC (www.nfrc.org) or the default value from Standards Section 110.6, Table 110.6-B of the Energy Code.

7.6.1.13 Source of U-factor/SHGC

The three valid sources are NFRC, default (Tables 110.6-A & B), or Alternate Default Fenestration Procedure (ADFP). A rarely used provision in the standards is for unrated site-built fenestration, which requires use of the *Reference Appendices*, Nonresidential Appendix NA6 to calculate both the U-factor and SHGC. Whichever source is used, the Energy Code requires a temporary label on every window. See *References Appendices* for further information and responsibilities associated with this calculation procedure.

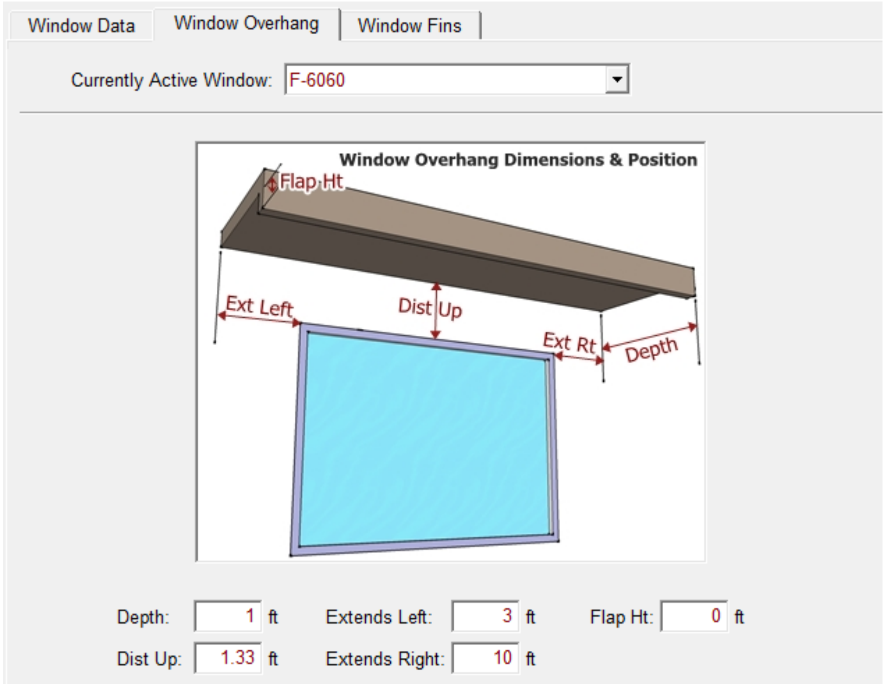
7.6.1.14 Exterior Shade

The default selection is insect screens for windows, none for skylights.

7.6.2 Window Overhang

Under the window overhang tab, enter the overhang dimensions and position. Figure 7-14 shows the inputs for the Window Overhang tab.

Figure 7-14: Overhang



7.6.2.1 Depth

Distance the overhang projects out from the wall (in feet).

7.6.2.2 Distance Up

The distance (as viewed from elevations) from the top of the window to the bottom of the overhang (in feet).

7.6.2.3 Extends Left

Distance (in feet) the overhang extends from the left edge of the window to the end of the overhang.

7.6.2.4 Extends Right

Distance (in feet) the overhang extends from the right edge of the window to the end of the overhang.

7.6.2.5 Flap Height

Default value is 0 feet. If the overhang has a flap that extends lower than the bottom of the overhang, thereby increasing the potential shading of the overhang, this added length is modeled as the flap height.

7.6.3 Window Fins

A window fin is a building feature that provides shading benefits to a window (for example, a recessed entry area). Figure 7-15 shows inputs found in the Window Fins tab.

7.6.3.1 Left Fin Depth

Depth (in feet) of the wall (fin) to the left of the window that provides shading to the window.

7.6.3.2 Distance Left

Distance (in feet) from the left edge of the window to the left fin.

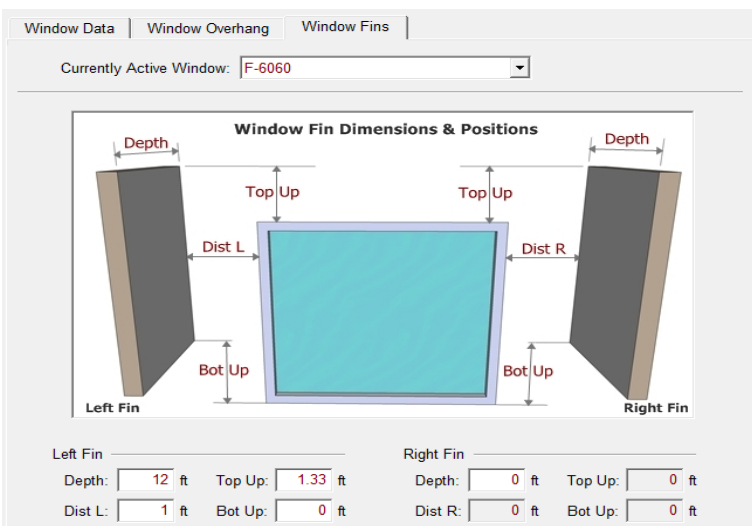
7.6.3.3 Top Up

Distance (in feet) from the top of the window to the top of the left fin (wall).

7.6.3.4 Bottom Up

Distance (in feet) from the bottom of the window to the bottom of the left fin.

Figure 7-15: Window Fin



7.6.3.5 Right Fin Depth

Depth (in feet) of the wall (fin) to the right of the window that provides shading to the window.

7.6.3.6 Distance Right

Distance (in feet) from the right edge of the window to the right fin.

7.6.3.7 Top Up

Distance (in feet) from the top of the window to the top of the right fin (wall).

7.6.3.8 Bottom Up

Distance (in feet) from the bottom of the window to the bottom of the right fin.

7.6.4 Glass Doors

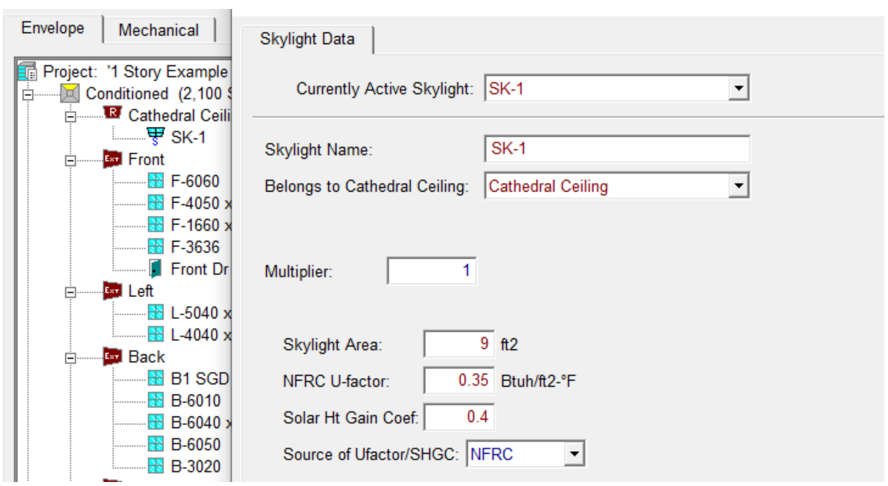
For a door with 25 percent or more glass area, or a door with an NFRC rating, the entire door area is modeled as a window.

The glass area (in square feet) of a door with less than 25 percent glass is the sum of all glass surfaces plus two inches on all sides of the glass (to account for a frame). This area is modeled as a window. The remaining area of the door is modeled as an opaque door (see Section 7.2.11).

7.7 Skylights

To create a skylight, create a section of cathedral ceiling with an area slightly larger than the skylight. Right-click on the cathedral ceiling surface and pick <create> and skylight.

Figure 7-16: Skylight



7.7.1 Skylight Name

User-defined name. If the plans use a window schedule or unique identifier, that identifier can be used for the window name. Each skylight on a given surface must have a unique name.

7.7.2 Belongs to Cathedral Ceiling

Defaults to the cathedral ceiling on which you picked <create>.

7.7.3 Skylight Area

Area of the skylight (in square feet).

7.7.4 Skylight Status (if shown)

Select new, existing, or altered.

7.7.5 Multiplier

The number of identical skylights.

7.7.6 U-factor

U-factor from National Fenestration Rating Council (NFRC) for the skylight (www.nfrc.org), or default from Section 110.6, Table 110.6-A of the Energy Code.

7.7.7 Solar Heat Gain Coefficient

Solar Heat Gain Coefficient (SHGC) from National Fenestration Rating Council (NFRC) for the skylight (www.nfrc.org), or default from Section 110.6, Table 110.6-B of the Energy Code.

7.7.8 Source of U-factor/SHGC

The three valid sources are NFRC, default (Tables 110.6-A and B), or Alternate Default Fenestration Procedure (ADFP). A rarely used provision in the standards is for unrated site-built fenestration, which requires use of *Reference Appendices*, Nonresidential Appendix NA6 to calculate both the U-factor and SHGC. Whichever source is used, the Energy Code requires a temporary label on every window. See *References Appendices* (), for further information and responsibilities associated with this calculation procedure.

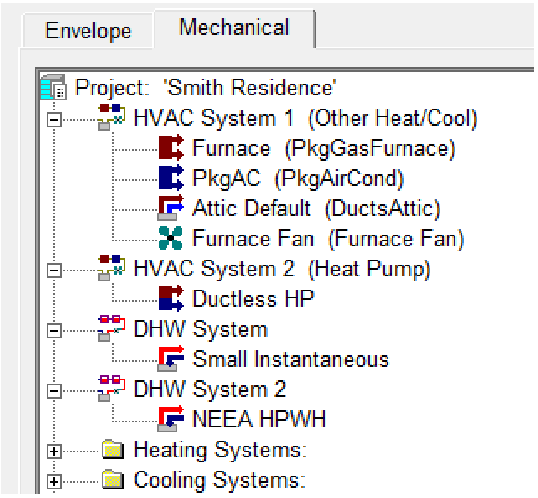
8 Mechanical Systems

8.1 Overview

The heating, cooling, duct/distribution system and space conditioning fans are assigned at the zone level of the building (see Figure 5-1 and Section 5.1.1.10) by name, such as HVAC system 1. The details of those systems assigned to the building are on the **Mechanical** tab (see Figure 8-1) as explained in this chapter.

The information in this chapter is from the point of view of the **Mechanical** tab. If changes to the system assigned to the zone are needed, it is easiest to make those changes from this area, leaving the system name intact.

Figure 8-1: Mechanical Tab



Equipment can be added to an input file for any of the systems types, however, a specific system or piece of equipment is only modeled when it is assigned to the HVAC (or water heating) system specified in the zone (see Figure 8-2).

USER TIP: Indoor air quality ventilation and cooling ventilation equipment defined on the **Mechanical** tab are only modeled in the building if they are specified on the **Indoor Air Quality (IAQ)** or **Cooling Ventilation (Cool Vent)** tabs at the project level (see Sections 4.11 and 4.12).

***USER TIP*:** Insufficiently defined equipment (such as a heat pump with no capacity), systems that would cause an error (such as ducts in attic for a building with no attic), or systems with missing components, will cause errors even if not used in the building. Consider deleting unused/unassigned HVAC systems and equipment.

8.1.1 Multiple HVAC Systems

When multiple systems of the same type serve different areas of a building, it is the user's option to separately zone the systems. However, if modeled as one zone with multiple systems, the compliance program will use the lowest efficiency.

When multiple systems of different equipment or fuel types serve the building, each type must be modeled as a separate zone to accommodate the different equipment types.

When multiple systems serve the same floor area, only one system can be modeled. The system modeled depends on the size and types of systems. If the capacity of the secondary system does not exceed 2 kW or 7,000 Btu/hr and is controlled by a time-limiting device of 30 minutes or less, the system is considered supplemental and may be ignored (*Single-Family Residential Compliance Manual*, Section 8.5.3, and §150.1(c)6). If the system does not meet these criteria, the system that is modeled is the one that consumes the most TDV energy (least efficient). For spaces with electric resistance heat in addition to another heating system, the electric resistance heat is the system that must be modeled.

8.1.2 Zonal Control (Living/Sleeping Zones)

CBECC-Res includes two different features using the phrase "zonal control." For information on zonal cooling, multi-speed compressors, meeting a lower target CFM/ton, and the presence of a bypass duct, see Zonal Cooling, Section 8.5.3. This credit is set in cooling system data.

The remainder of this section is describing the zonal control credit with living and sleeping zones modeled separately. Zonal control credit requires:

- Each habitable room must have a source of space conditioning,
- The sleeping and living zones must be separately controlled,
- A non-closeable opening between the zones cannot exceed 40 ft^2,
- Each zone must have a temperature sensor and a setback thermostat, and
- The return air for the zone must be located within the zone.

A full list of eligibility criteria for this measure is in the *Single-Family Residential Compliance Manual*, Section 4.5.2.

To model zonal control credit, check the zonal control feature on the ***Building*** tab (Figure 8-2). Once specified, the zone type can be set to Living or Sleeping (see Figure 8-3) which changes the setback thermostat settings for the heating system. Zonal control credit is not available if space heating is provided by a heat pump or combined hydronic system. Zonal control credit is not an ECC verified credit.

Figure 8-2: Zonal Control (Heating) from Section 4.7.1.11

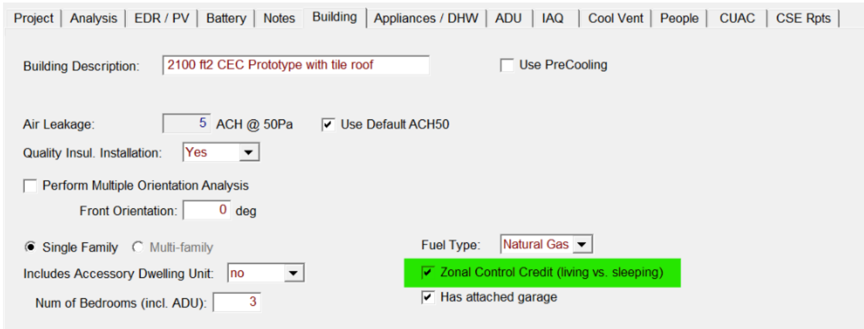
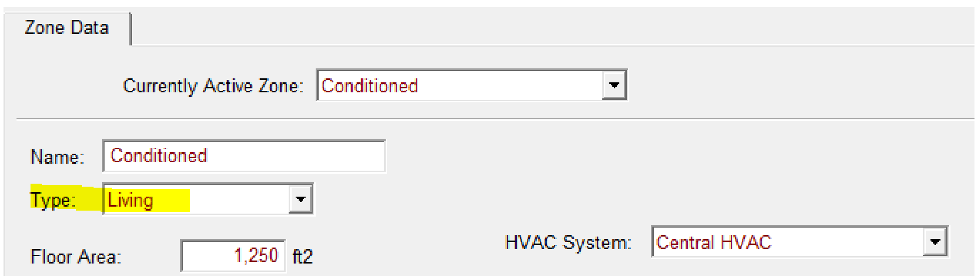


Figure 8-3: Zone Type from Section 5.1.1



8.2 HVAC System Data

8.2.1 System Name

User-defined name.

8.2.2 System Type

Select the correct system type as:

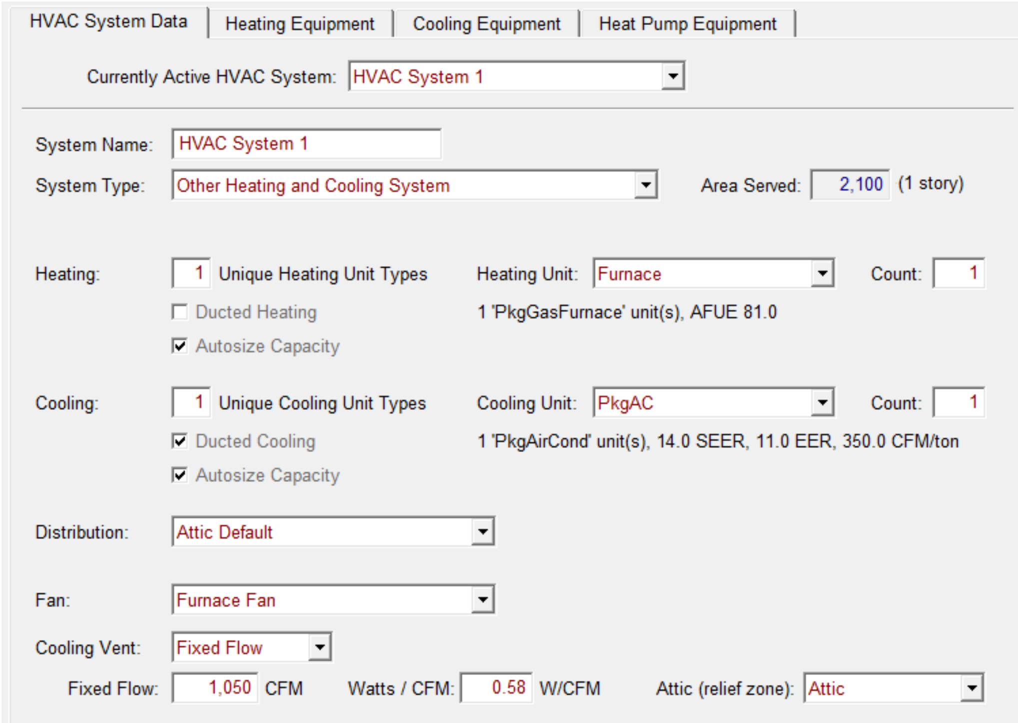
- Heat pump heating and cooling system,
- Variable outdoor air ventilation central heat/cool system

  NOTE: this option is only for central fan integrated night ventilation cooling - *variable* speed (for example, NightBreeze™), which is activated by selecting CFI on the Cool Vent Tab (Section 4.12), or
- Other heating and cooling system (for typical HVAC systems).

8.2.3 Unique Heating Unit Types

Indicate the number of unique system types. Not the same as "count" which is the number of identical systems. When modeling multiple efficiencies in a single zone, the worst-case efficiency is assumed in the compliance analysis.

Figure 8-4: HVAC System Data



8.2.4 Heating Unit

Name of the heating system.

8.2.5 Count

Number of specified heating units to be installed. This value is also noted by the ECC provider data registry when a project is uploaded.

8.2.6 Ducted Heating

For equipment types that allow either ducted or non-ducted equipment, check the box if the system is ducted (for example, combined hydronic).

8.2.7 Autosize Capacity

Not a user input.

8.2.8 Unique Cooling Unit Types

Indicate the number of unique system types. Not the same as “count” which is the number of systems. When modeling multiple efficiencies in a single zone, the worst-case efficiency is assumed in the compliance analysis.

8.2.9 Cooling Unit

Name of the cooling system.

8.2.10 Count

Number of specified cooling units to be installed. This value is also noted by the ECC provider data registry when a project is uploaded.

8.2.11 Ducted Cooling

For equipment types that allow either ducted or non-ducted equipment, check the box if the system is ducted.

8.2.12 Autosize Capacity

Not a user input.

8.2.13 Distribution

Name of the duct or distribution system. For ductless systems, including no cooling with ductless heating, pick “none.”

8.2.14 Fan

Name of the HVAC fan system. If a system type does not have a fan (e.g., combined hydronic, wall furnace), or if there is no cooling system, a value of “none” may be modeled.

If using central fan integrated night ventilation cooling, this is the fan that operates in ventilation mode.

8.2.15 Central Fan Integrated (CFI) Cooling

8.2.15.1 Cooling Vent

When displayed for a central fan integrated night ventilation cooling system, select fixed flow. See Section 8.9.3 for variable speed.

8.2.15.2 Fixed Flow (CFM)

When displayed, specify the fixed flow CFM for the system (or let the program set the default value).

8.2.15.3 Watts/CFM

When displayed, specify the Watts/CFM for the proposed central fan integrated night ventilation cooling system. The default value is 0.45 Watts/CFM. For heat pumps, the value is 0.58 Watts/CFM.

8.2.15.4 Attic (relief zone)

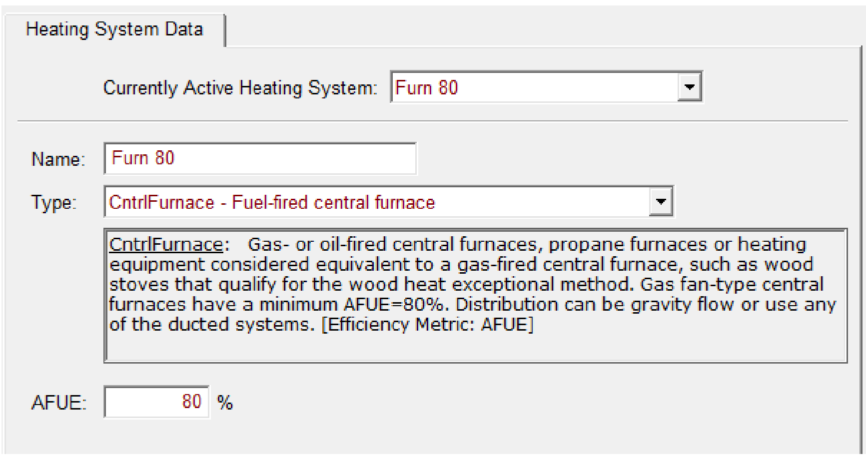
When displayed, specify the attic zone in which the CFI fan is located.

8.3 Heating Systems

The heating system is the equipment that supplies heat to an HVAC System. Heating systems are categorized by the types shown in Table 8-1.

8.3.1 Heating System Data (other than heat pump)

Figure 8-5: Heating System Data



Heating system data inputs vary slightly by equipment type.

8.3.1.1 Name

User-defined name for the heating system.

8.3.1.2 Type

Heating system type (see Table 8-1).

8.3.1.3 Efficiency

Enter an appropriate efficiency for the equipment type (e.g., 80 AFUE). The software will include the minimum efficiency for typical system types. Efficiency information for a specific model number of heating and cooling equipment is found by performing an "advanced search" in the CEC's appliance directories, https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx, or from the

Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Certified Products Directory, https://www.ahridirectory.org/.

Table 8-1: Heating Equipment

Descriptor	Heating Equipment Reference
Central Furnace	Gas- or oil-fired central furnaces, propane furnaces or heating equipment considered equivalent to a gas-fired central furnace. Gas fan-type central furnaces have a minimum AFUE=80%. Distribution can be gravity flow or use any of the ducted systems.
Wall Furnace Fan	Wall furnace, fan type. Minimum AFUE=75%. Distribution is ductless
Boiler	Gas or oil boilers. Distribution systems can be Radiant, Baseboard or any of the ducted systems. Boiler is specified for dedicated hydronic systems. Systems in which the boiler provides space heating and fires an indirect gas water heater (IndGas) may be listed as Boiler/CombHydro Boiler and shall be listed under “Equipment Type” in the HVAC Systems listing.
Wood Heat	Wood-fired stove. In areas with no natural gas available, a wood heating system with any back-up heating system may be installed if exceptional method criteria described in the *Single-Family Residential Compliance Manual* are met.
Packaged Gas Furnace	Packaged gas furnace. The furnace side of a packaged air-conditioning system. Packaged gas or propane furnaces have a minimum AFUE=81%. Distribution can be any of the ducted systems.
Electric	All electric heating systems other than space conditioning heat pumps. Included are electric resistance heaters, electric boilers, and storage water heat pumps (air-water) (StoHP). Distribution system can be radiant, baseboard or any of the ducted systems.
Combined Hydronic	Water heating system can be a boiler, storage or instantaneous gas, propane, or electric water heater. Distribution systems can be ducted or non-ducted.
Wall Furnace Gravity	Wall furnace, gravity flow. Minimum AFUE=65%. Distribution is ductless.
Floor Furnace	Floor furnace. Minimum AFUE=57%. Distribution is ductless.
Room Heater	Room heater. Minimum AFUE=61%. Distribution is ductless.

8.3.2 Non-Central Heating

Specify the appropriate system type as electric, floor furnace, room heater, fan type wall furnace, or gravity flow wall furnace.

It is important to look in AHRI or the CEC directory for the actual efficiency for the equipment type selected because 80% AFUE may not be an achievable efficiency for a gravity wall furnace or a floor furnace. The minimum efficiency for the product type (also displayed on the CBECC-Res screen) is:

System Type	Minimum AFUE %
Wall furnace, fan type	75
Wall furnace, gravity flow	65
Floor furnace	57
Room heater	61

Assuming the cooling is also ductless, model both the distribution system and fan as “none.” If there is no cooling system, see Section 8.3.2 for the proper way to model no cooling (“none” or blank will not run).

NOTE: If electric heating is selected, the default efficiency assumed by the program is 3.413 HSPF. This equipment is not required to be certified.

8.3.3 Wood Heat

When all the qualifications for the wood heat exceptional method are met (see *Single-Family Residential Compliance Manual*, Section 4.7.6), the heating system (which includes any back-up heating system) receives neither a penalty nor a credit. A hypothetical heating system that meets prescriptive requirements is simulated by the program and the back-up heating system is ignored.

8.3.4 Hydronic Distribution Systems and Terminals

The only combined hydronic systems currently implemented are those that have 10 feet or less of piping in unconditioned space.

When hydronic systems have more than 10 feet of piping (plan view) located in unconditioned space, additional information about the distribution system is needed.

Other information reported includes:

- *Piping Run Length (ft).* The length (plan view) of distribution pipe located in unconditioned space, in feet, between the primary heating/cooling source and the point of distribution.
- *Nominal Pipe Size (in.).* The nominal (as opposed to true) pipe diameter in inches.
- *Insulation Thickness (in.).* The thickness of the insulation in inches. Enter "none" if the pipe is uninsulated.

- *Insulation R-value (hr-ft^2- °F/Btu).* The installed R-value of the pipe insulation. Minimum pipe insulation for hydronic systems is as specified in §150.0(j).

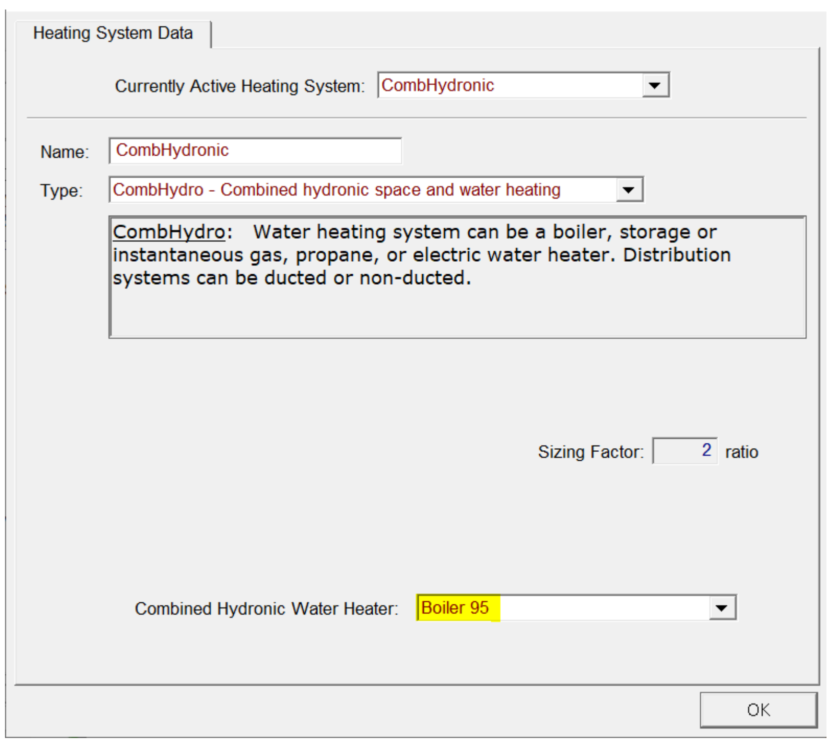
8.3.5 Combined Hydronic

A combined hydronic system uses the same device to provide both space heating and water heating. If the system is a hydronic system with separate water heating, model the space heating as "boiler."

USER TIP: A heat pump water heater cannot currently be modeled as the heat source in a combined hydronic system. Instead, consider an air-to-water or ground source heat pump system (Section 8.4.5).

Define the system type from the type option as 'CombHydro'. In the field labeled Combined Hydronic Water Heater, specify the device that is providing the source for the space and water heating (currently limited to large gas water heater or gas boiler). Figure 8-6 shows the heat source as a 100 gallon boiler with a 0.95 thermal efficiency (see also example file 2StoryExampleCombHydNoCool).

Figure 8-6: Combined Hydronic Heating Data



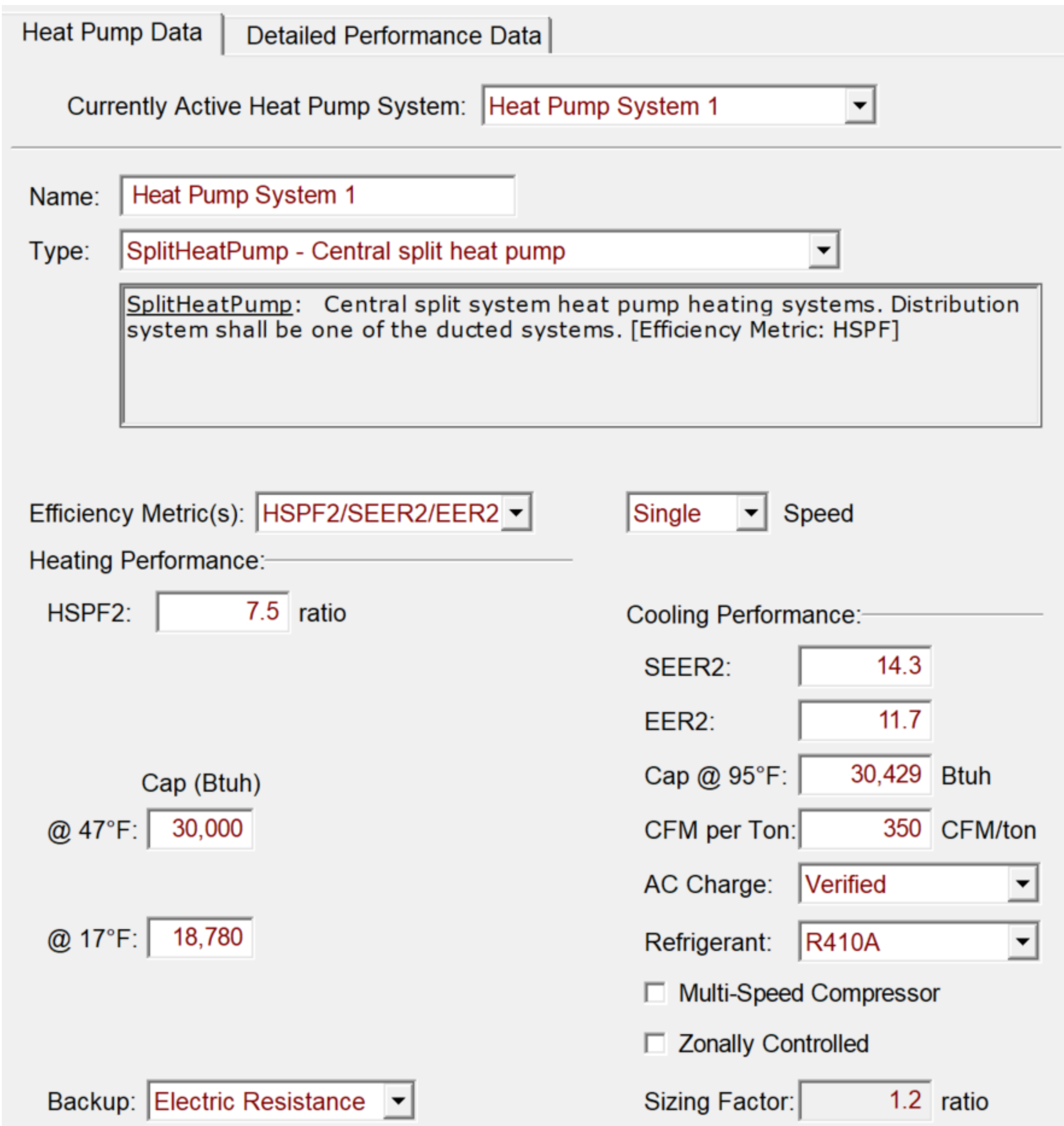
NOTE: For the water heating system, define a system using the same water-heating device (such as the boiler) as the water heating system.

8.4 Heat Pumps

Heat pump options appear when the System Type (Section 8.2.2) is set to Heat Pump Heating and Cooling System. Data inputs vary by equipment type.

8.4.1 Heat Pump System Data

Figure 8-7: Heat Pump Data



8.4.1.1 Name

User-defined name for the system.

8.4.1.2 Type

Heat pump system type (see Table 8-2).

Table 8-2: Heat Pump Equipment

Descriptor	Heating Pump Equipment Reference
Split Heat Pump	Central split system heat pump heating systems. Distribution system shall be one of the ducted systems. [Efficiency Metric: HSPF/HSPF2]
Packaged Terminal Heat Pump	A packaged terminal air conditioner that uses reverse cycle refrigeration as its primary heat source, that has a supplementary heating source available, with the choice of electric resistant heat. [Efficiency Metric: EER/EER2, COP47]
Single Packaged Vertical Heat Pump	A single package vertical air conditioner that uses reverse cycle refrigeration as its primary heat source, may include secondary supplemental heating by means of electrical resistance. [Efficiency Metric: EER/EER2, COP47]
SDHV Split Heat Pump	Small Duct, High Velocity, (SDHV) central split system that produces at least 1.2 inches of external static pressure when operated at the certified air volume rate of 220–350 CFM per rated ton of cooling and uses high velocity room outlets generally greater than 1,000 fpm that have less than 6.0 square inches of free area. [Efficiency Metric: HSPF/HSPF2]
Ductless Mini-Split Heat Pump	A heat pump system that has single outdoor section and one or more ductless indoor sections. The indoor section(s) cycle on and off in unison in response to a single indoor thermostat. [Efficiency Metric: HSPF/HSPF2]
Ductless Multi-Split Heat Pump	A heat pump system that has a single outdoor section and two or more ductless indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats. [Efficiency Metric: HSPF/HSPF2]
Ductless VRF Heat Pump	A variable refrigerant flow (VRF) heat pump system that has one or more outdoor sections and two or more ductless indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats. [Efficiency Metric: HSPF/HSPF2]
Ducted Mini-Split Heat Pump	A heat pump system that has single outdoor section and one or more ducted indoor sections. The indoor section(s) cycle on and off in unison in response to a single indoor thermostat. [Efficiency Metric: HSPF/HSPF2]

Descriptor	Heating Pump Equipment Reference
Ducted Multi-Split Heat Pump	A system that has a single outdoor section, and two or more ducted indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats. [Efficiency Metric: SEER/SEER2, HSPF/HSPF2]
Ducted + Ductless Multi-Split Heat pump	A system with both ducted and ductless multi-split heat pumps. A multi-split heat pump being a system that has a single outdoor section, and two or more ducted/ductless indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats. [Efficiency Metric: SEER/SEER2, HSPF/HSPF2]
Packaged Heat Pump	Central packaged heat pump systems. Central packaged heat pumps are heat pumps in which the blower, coils and compressor are contained in a single package, powered by single phase electric current, air-cooled, and rated below 65,000 Btu/hr. Distribution system shall be one of the ducted systems. [Efficiency Metric: HSPF/HSPF2]
Large Package Heat Pump	[*Not yet enabled*] Large packaged units rated at or above 65,000 Btu/hr (heating mode). Distribution system shall be one of the ducted systems. These include water source and ground source heat pumps. [Efficiency Metric: COP]
Room Heat Pump	Non-central room air conditioning systems. These include packaged terminal (commonly called “through-the-wall”) units and any other ductless heat pump system. [Efficiency Metric: CEER]
Air-to-Water Heat Pump	An indoor conditioning coil, a compressor, and a refrigerant-to-water heat exchanger that provides heating and cooling functions. Also, able to heat domestic hot water. [Efficiency Metric: COP, EER/EER2]
Ground Source Heat Pump	An indoor conditioning coil with air moving means, a compressor, and a refrigerant-to-ground heat exchanger that provides heating, cooling, or heating and cooling functions. Also, able to heat domestic hot water. [Efficiency Metric: COP, EER/EER2]
VCHP	Meets all the requirements of the VCHP compliance option.[Not available]

8.4.1.3 Efficiency Metric

Indicate the efficiency metric of the equipment. Select HSPF/SEER/EER or HSPF2/SEER2/EER2.

8.4.1.4 Heating Performance HSPF/HSPF2

Enter the heating seasonal performance factor (HSPF/HSPF2). Find efficiency information for a specific model number by performing an "advanced search" in the CEC's appliance directories, or from the AHRI Certified Products Directory.

8.4.1.5 Capacity at 47 Degrees F

This is a required value (from AHRI). CBECC-Res uses the capacities to determine the energy use of the backup electric resistance heat. In a multifamily building indicate the capacity and specify the number of units of that given capacity assigned to the zone (see Section 8.1.1.5).

8.4.1.6 Capacity at 17 Degrees F

When displayed, this is a value from AHRI. For VCHP equipment, this is an optional input.

8.4.1.7 Dual Fuel Heat Pump

Checkbox to indicate dual fuel heat pump.

8.4.1.8 AFUE

Enter the efficiency of the backup gas furnace (e.g., 80 AFUE). Efficiency information for a specific model number of gas furnaces is found by performing an "advanced search" in the CEC's appliance directories, https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx, or from the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Certified Products Directory, https://www.ahridirectory.org/.

8.4.1.9 Has Lockout Temperature

Checkbox to indicate equipment with a lockout temperature. If checked, enter the lockout temperature of the equipment.

8.4.1.10 Cooling Performance – SEER/SEER2

Cooling equipment Seasonal Energy Efficiency Ratio (SEER/SEER2). For equipment tested only with an EER/EER2, enter the EER/EER2 as the SEER/SEER2. When a value higher than 15 SEER or 14.3 SEER2 for "Compliance 2023" is modeled, it triggers a ECC Verification of High SEER/SEER2. Find efficiency information from an advanced search of the CEC's appliance directories or from the AHRI Certified Products Directory.

8.4.1.11 Cooling Performance – EER/EER2

Cooling equipment Energy Efficiency Ratio (EER/EER2). CBECC-Res has default values for the EER/EER2 based on the SEER/SEER2 value modeled. An EER higher than 12.2 or EER2 higher than 11.7 requires verification by a ECC Rater. EER/EER2 ratings are from AHRI.

8.4.1.12 CFM per Ton

The mandatory requirement for cooling airflow is 350 CFM/ton for ducted cooling systems (also assumed for dwellings with no cooling), or 150 CFM/ton for zonal single speed systems. Users may model a higher airflow. All cooling systems require ECC verified system airflow using diagnostic testing procedures from *Reference Appendices*, Residential Appendix RA3.

8.4.1.13 AC Charge

Verified refrigerant charge. Select Not Verified, Verified, or Fault Indicator Display (FID). There is no mandatory requirement for verified refrigerant charge, however, the standard design in climate zones 2 and 8-15 includes proper refrigerant charge for most equipment types (see §150.1(c)7 of the Energy Code).

8.4.1.14 Refrigerant Type

Default R410A assumed for all refrigerant containing equipment.

8.4.1.15 Multi-Speed Compressor

Use this field to indicate if the cooling system is a zonally controlled multi-speed compressor. An exception for single speed compressors would leave this box unchecked and specify 150 CFM/ton (see Section 8.4.1.8).

8.4.1.16 Zonally Controlled

Checkbox to indicate zonally controlled cooling equipment. A ECC rater will verify the modeling assumptions associated with a bypass duct, CFM/ton, and single- or multi-speed compressor (Section 8.5.3).

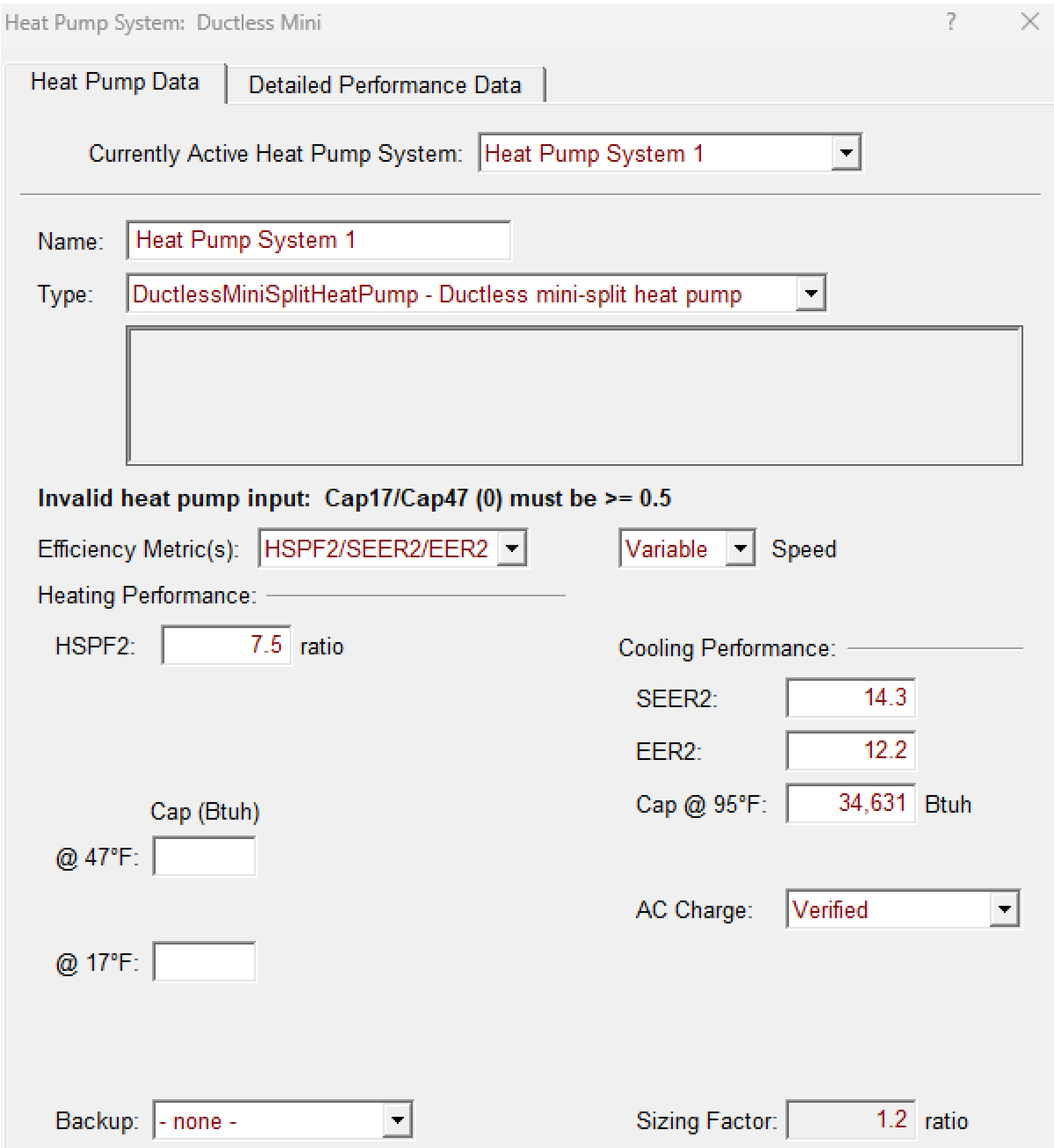
8.4.2 Mini-Split, Multi-Split, and VRF Heat Pump

NOTE: Ducted and ductless mini-split, multi-split and variable refrigerant flow equipment is assumed to have minimum efficiency regardless of the efficiency modeled. This is consistent with requirements of Section 2.4.6 of the *2025 Single-Family Residential ACM Reference Manual.*

USER TIP: Ducted or partially ducted equipment may achieve better compliance results using the new variable capacity heat pump compliance option (Section 8.4.3)

Ducted, ductless, and combinations of distribution systems can be modeled for mini-split, multi-split, and variable refrigerant flow (VRF) heat pumps. The systems are modeled as minimum efficiency systems. When higher than minimum SEER/SEER2 or EER/EER2 values are modeled, although reported on the CF1R, they have no effect on compliance. Ducted systems are required to meet mandatory requirements for airflow (default 350 CFM/ton) and fan efficacy (0.58 W/CFM).

Figure 8-8: Ductless Mini-Split Heat Pump Data



An example file (1StoryExampleHVAC.ribd22) is included in the projects folder. For ductless equipment, the distribution system and fan can be set to “none” on the HVAC System Data screen.

See Section 8.4.1 for input values.

8.4.2.1 HSPF/HSPF2, SEER/SEER2, EER/EER2

As noted in Figure 8-10, the efficiency values default to 7.5 HSPF2, 14.3 SEER2, and 11.7 EER2.

8.4.2.2 Capacity at 47 Degrees F

This is a required value from AHRI. Capacity is used to determine the energy use of the backup electric resistance heat.

8.4.2.3 Capacity at 17 Degrees F

This is an optional value from AHRI.

8.4.2.4 AC Charge

Verified refrigerant is always required.

8.4.2.5 Ducts

Select Unducted, Ducted, or Partially Ducted.

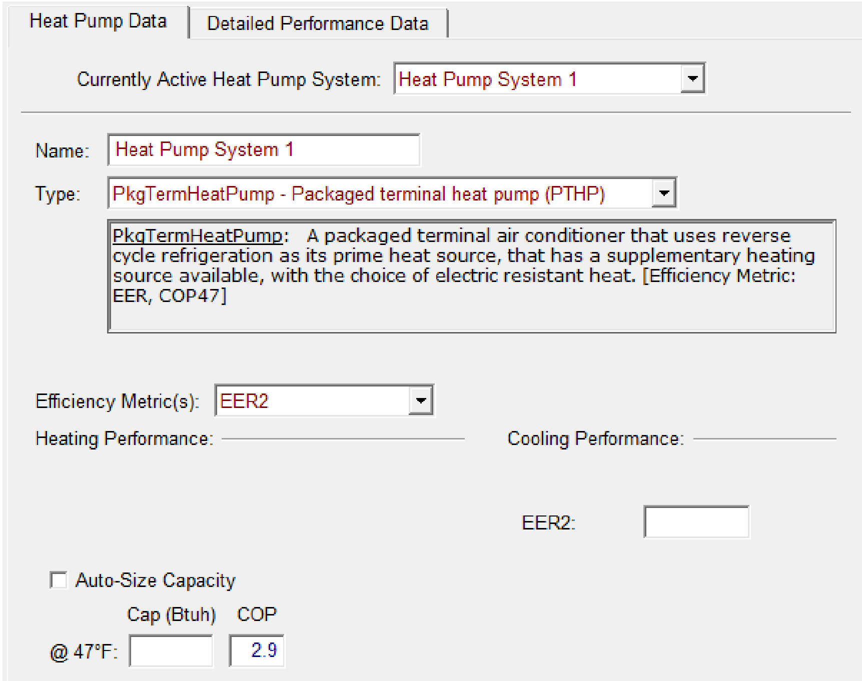
8.4.2.6 Certified Auto-Fan

Optional input for ducted equipment. As part of their certification, the manufacturer specifies the default setting for the fan. If no, the fan does not operate continuously by default, check the box for the certified auto-fan. If yes, the fan does operate continuously by default, do not check the box for a certified auto-fan.

8.4.3 Package Terminal Heat Pumps / Single Package Vertical Heat Pumps

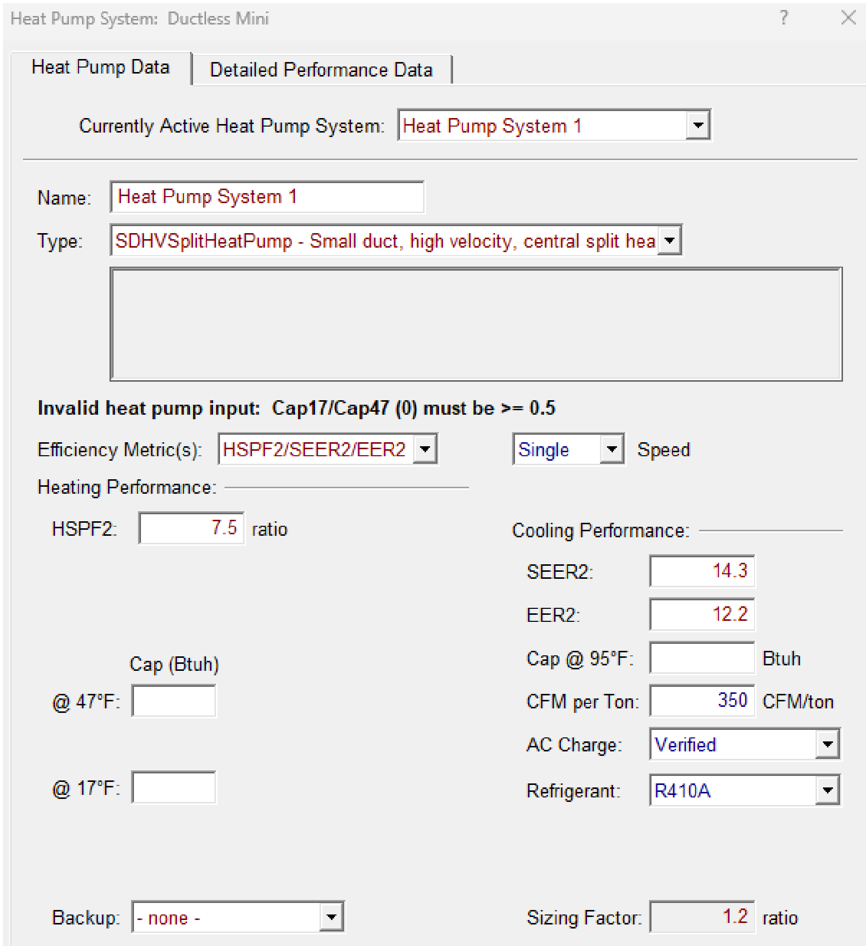
Package terminal heat pumps (PTAC) (a ductless system) and single package vertical heat pumps (a ducted system) are rated with COP and EER/EER2. The capacity at 47 degrees is a required input. See also Section 8.4.1 for input values.

Figure 8-9: Package Terminal Heat Pump



8.4.4 Small Duct High Velocity Split Heat Pump

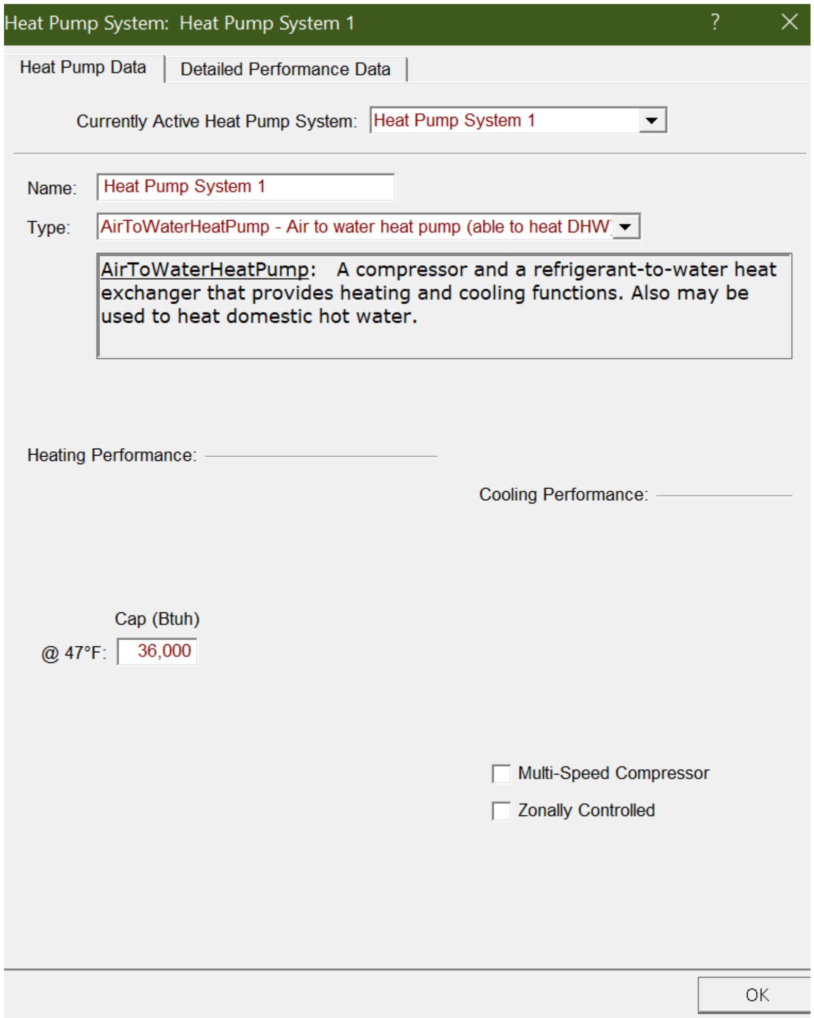
Figure 8-10: SDHV Split Heat Pump



See Section 8.4.1 for input values.

8.4.5 Air-to-Water Source Heat Pump

Figure 8-11: Air-to-Water Source Heat Pump



An example file included with the program (1StoryExampleHVAC) contains an air-to-water source heat pump system. If the system provides water heating, see Section 9.11. These appliances are listed in the CEC's appliance directory as central heat pumps, heat pump water heating packages.

8.4.5.1 Name

User-defined name for the system.

8.4.5.2 Type

Heat pump system type (see Table 8-2).

8.4.5.3 Capacity at 47 Degrees F

This is a required value from AHRI. Capacity is used to determine the energy use of the backup electric resistance heat.

8.4.6 Ground Source Heat Pump

An example file included with the program (1StoryExampleHVAC) contains a ground source heat pump system. If the system provides water heating, see Section 9.11.

8.4.6.1 Name

User-defined name for the system.

8.4.6.2 Type

Heat pump system type is Ground Source Heat Pump (as shown in Table 8-2).

8.4.6.3 EER/EER2

Cooling equipment Energy Efficiency Ratio (EER/EER2).

8.4.6.4 Capacity

Enter the capacity of the proposed heat pump model.

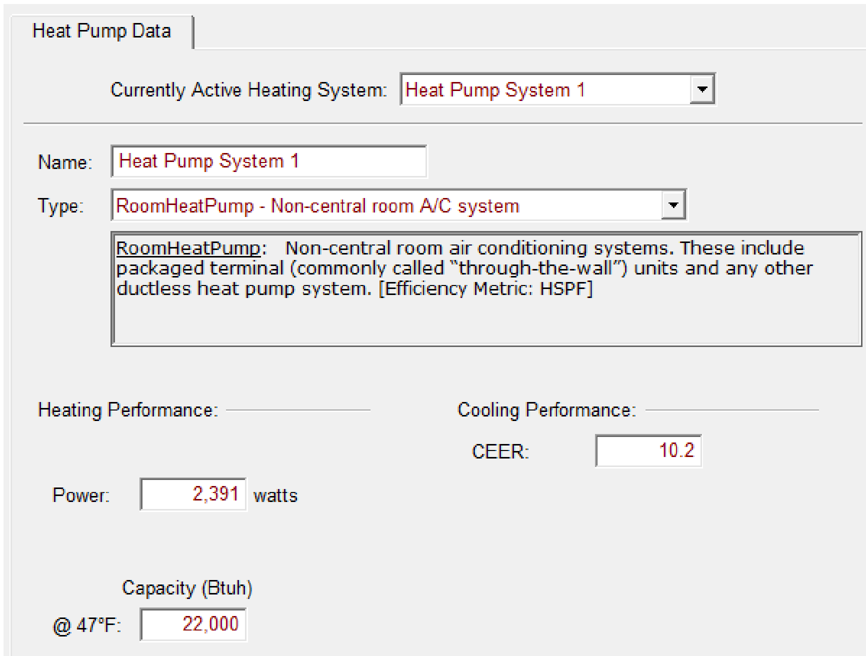
8.4.6.5 COP

Enter the Coefficient of Performance (COP). Efficiency information for a specific model number found by performing an "advanced search" in the CEC's appliance directories or from the AHRI Certified Products Directory.

There are two additional options on the HVAC System Data screen (one level higher on the input screen). If the system is ducted, check the "Ducted Ht Pump(s)" box before specifying a distribution system. If the system also provides water heating, check the box "System Heats DHW" and enter the tank volume, insulation R-value and ambient conditions.

8.4.7 Room Heat Pumps

Figure 8-12: Room Heat Pump



8.4.7.1 Name

User-defined name for the system.

8.4.7.2 Type

Select Room Heat Pump as the system type (see Table 8-2).

8.4.7.3 Heating Performance Power (Watts)

Power in watts (available from the CEC's appliance directories).

8.4.7.4 Capacity at 47 Degrees F

This is a required value.

8.4.7.5 Cooling Performance - CEER

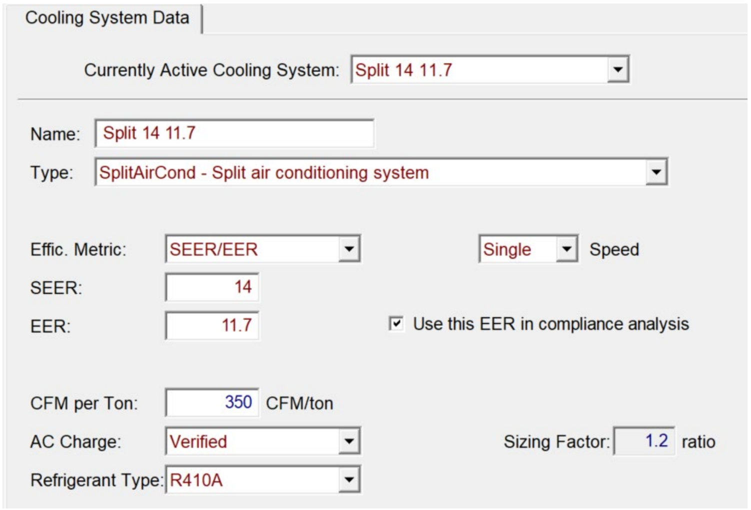
Enter the Combined Energy Efficiency Ratio (CEER).

8.5 Cooling Systems

The cooling system is the equipment that supplies cooled air to an HVAC System. Cooling systems are categorized according as shown in Table 8-3. See Table 8-4 for which measures (some of which are mandatory) require ECC verification.

8.5.1 Cooling System Data

Figure 8-13: Cooling System Data



8.5.1.1 Name

User-defined name for the cooling system.

8.5.1.2 Type

Cooling system type (see Table 8-3).

8.5.1.3 Efficiency Metric

Indicate the efficiency metric of the cooling equipment. Select SEER/EER or SEER2/EER2.

8.5.1.4 SEER/SEER2

Cooling equipment Seasonal Energy Efficiency Ratio (SEER/SEER2). For equipment tested only with an EER/EER2, enter the EER/EER2 as the SEER/SEER2. When a value higher than 15 SEER or 14.3 SEER2 for "Compliance 2026" is modeled, it triggers a ECC Verification of High SEER/SEER2. Efficiency information can be obtained from the CEC's appliance directories, or from AHRI Certified Products Directory.

8.5.1.5 EER/EER2

Cooling equipment Energy Efficiency Ratio (EER/EER2). CBECC-Res has default values for the EER/EER2 based on the SEER/SEER2 value modeled. An EER higher than 12.2 or an EER2 higher than 11.7 requires verification by a ECC Rater. EER ratings are from AHRI.

8.5.1.6 AC Charge

Verified refrigerant charge. Select Not Verified, Verified, or Fault Indicator Display (FID). There is no mandatory requirement for verified refrigerant charge, however, the standard design in climate zones 2 and 8-15 includes proper refrigerant charge in the standard design for most equipment types (see Standards §150.1(c)7.).

Table 8-3: Cooling Equipment

Descriptor	Cooling Equipment Reference
No Cooling	No cooling equipment. Distribution is ducted (either the same system as heating or default ducts in attic). (See also Section 8.3.2).
Split Air Conditioner	Split air conditioning systems. Distribution is ducted.
Packaged Terminal Air Conditioner	Packaged terminal air conditioner (PTAC). Distribution is ductless [Efficiency Metric: EER/EER2]
Single Packaged Vertical Air Conditioner	Single packaged vertical air conditioner. Distribution is ducted or ductless [Efficiency Metric: EER/EER2]
Package Air Conditioner	Central packaged air conditioning systems less than 65,000 Btu/hr cooling capacity. Distribution is ducted.
Large Package Air Conditioner	[*Not yet implemented*] Systems rated at or above 65,000 Btu/hr (cooling capacity). Distribution is ducted.
SDHV Split Air Conditioner	Small duct, high velocity, split AC system.
Ductless Mini-Split Air Conditioner	Ductless mini-split AC.
Ductless Multi-Split Air Conditioner	Ductless multi-split AC.
Ductless VRF Air Conditioner	Ductless Variable Refrigerant Charge AC.
Ducted Mini-Split Air Conditioner	Air conditioning system that has single outdoor section and one or more ducted indoor sections. The indoor section(s) cycle on and off in unison in response to a single indoor thermostat. [Efficiency Metric: SEER/SEER2, EER/EER2]
Ducted Multi-Split Air Conditioner	Air conditioning system that has a single outdoor section and two or more ducted indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats. [Efficiency Metric: SEER/SEER2, EER/EER2]
Ducted + Ductless Multi-Split Air Conditioner	Air conditioning system that has a single outdoor section and two or more ducted/ductless indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats. [Efficiency Metric: SEER/SEER2, EER/EER2]

Descriptor	Cooling Equipment Reference
Room Air Conditioner	A factory encased air conditioner that is designed as a unit for mounting in a window, through a wall, or as a console. Distribution is ductless. [Efficiency Metric: CEER]
EvapCondenser	Evaporatively-cooled condenser. The default distribution system is duct in attic; evaporatively cooled condenser duct insulation requirements are the same as those for air conditioner ducts. EER verification, and compliance with *Reference Appendices,* Residential Appendix RA4.3.1. [Efficiency metric: EERa and EERb]

8.5.1.7 Refrigerant Type

Default R410A assumed for all refrigerant containing equipment.

8.5.1.8 Multi-Speed Compressor

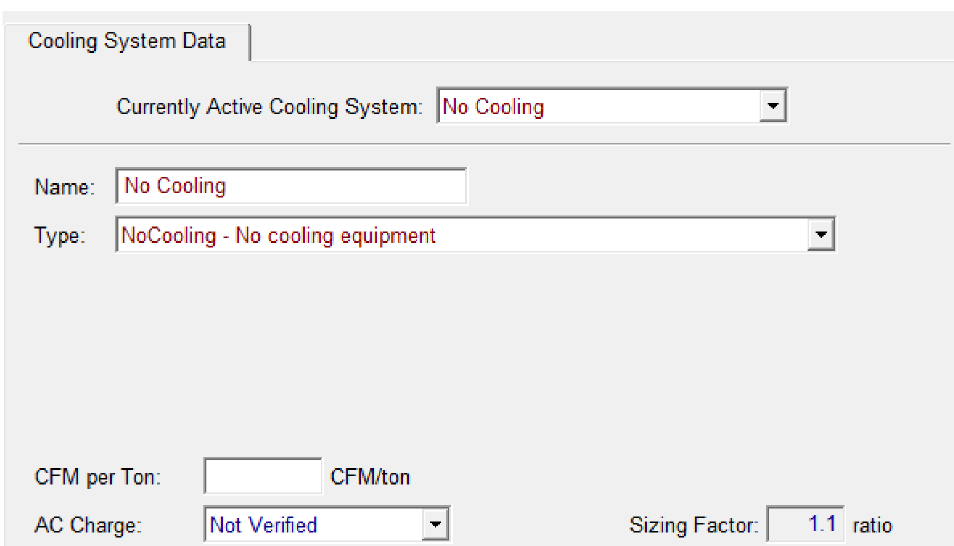
Use this field to indicate if the system is a multi-speed compressor. Zonally controlled multi-speed compressors must meet 350 CFM/ton. The exception for zonally controlled single speed compressors would leave this box unchecked and specify a value as low as 150 CFM/ton (see Section 8.3.1.5).

8.5.1.9 Zonally Controlled

Checkbox to indicate zonally controlled cooling equipment. A ECC rater will verify the modeling assumptions associated with a bypass duct, CFM/ton, and single- or multi-speed compressor (Section 8.5.3).

8.5.2 No Cooling

Figure 8-14: No Cooling System



When there is no cooling system in a dwelling, create a cooling system using the system type NoCooling. The distribution system is the same as the heating system (if any). If the heating system has no ducts, set the distribution and fan system for the HVAC system to “none.” Ignore the remaining inputs. There are no CFM/ton or refrigerant charge requirements.

8.5.3 Zonal Cooling

Figure 8-15: Zonal Control (Cooling)

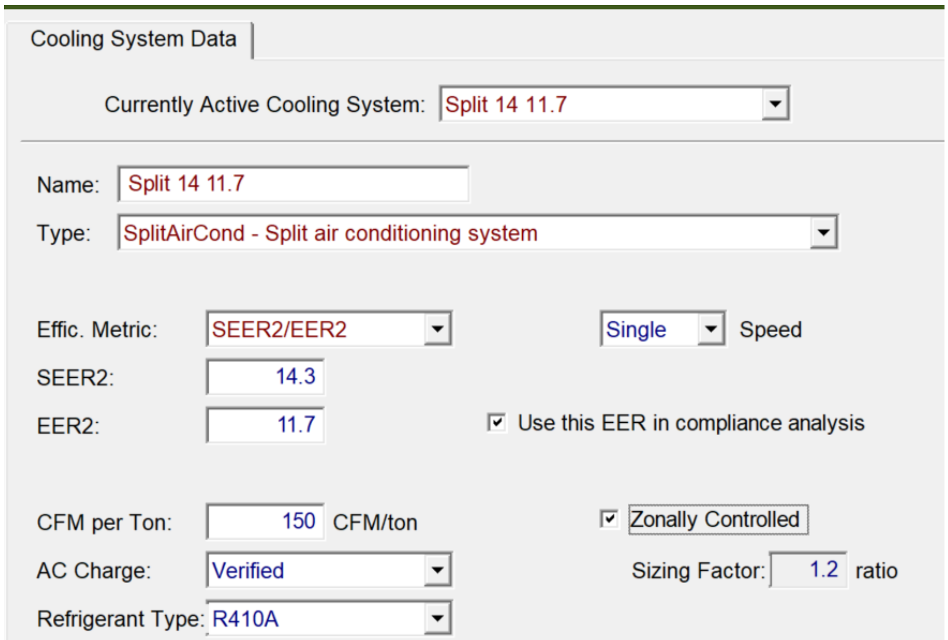


Table 8-4: HVAC Measures Requiring ECC **Verification**

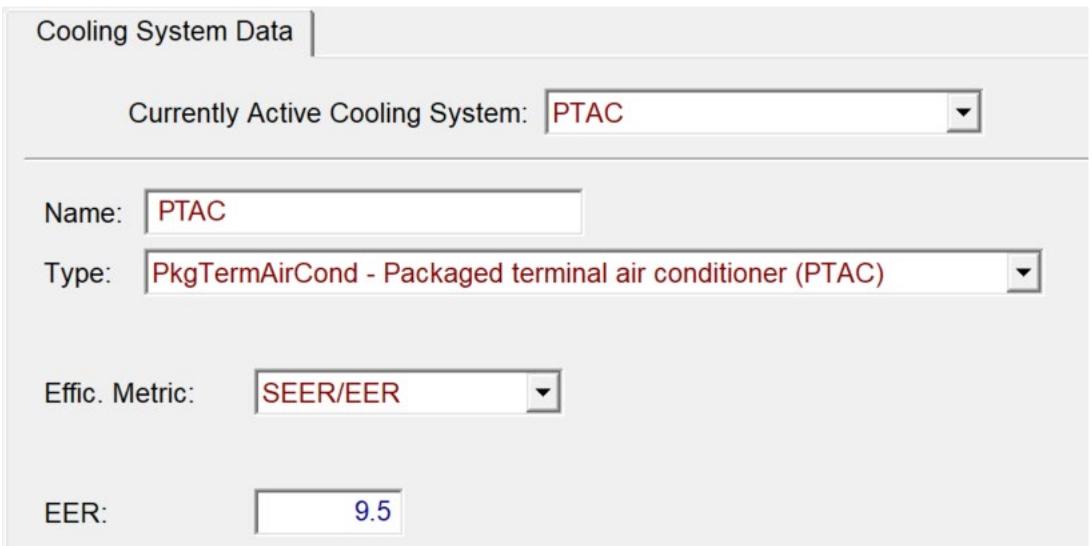
Measure	Description
Refrigerant Charge	Air-cooled air conditioners and air-source heat pumps must be diagnostically tested to verify that the system has the correct refrigerant charge.
Fault Indicator Display	A Fault Indicator Display (FID), alternative to refrigerant charge testing.
System Airflow	Ducted systems require a verified system airflow greater than or equal to 350 CFM/ton (mandatory requirement) or another specified value.
Air-Handling Unit Fan Efficacy	To verify that fan efficacy is less than or equal to 0.45 Watts/CFM (a mandatory requirement) or another specified value.
EER/EER2	Credit for higher than minimum EER/EER2 by installation of specific air conditioner or heat pump models.
SEER/SEER2	Credit for higher than minimum SEER/SEER2.
Rated Heat Pump Capacity	When using performance compliance, the rated capacity is verified to be greater than or equal to the values specified on the CF1R.
Evaporatively Cooled Condensers	Compliance credit for installation of evaporatively cooled condensers. Field verification of duct leakage, refrigerant charge, and EERa is reported as EER and is required if ≥ 14 EER, EERb is reported as SEER and is required if > 16 SEER.
HSPF/HSPF2	Credit for higher than minimum HSPF/HSPF2.
Whole House Fan	When using performance compliance with a whole house fan the CFM and fan efficacy are verified to be equal to or better than specified (optional to receive full credit).
Central Fan Ventilation Cooling System	When using performance compliance with a central fan ventilation cooling system (CFVCS), the installed CFVCS ventilation airflow rate (CFM) and fan efficacy (W/CFM) are verified to be equal to or better than the specified values.
VCHP Compliance Option	When using performance compliance with a variable capacity heat pump (VCHP), the installed VCHP must meet the eligibility requirements in the *Reference Appendices*, Residential Appendix RA3.4.4.3 which includes field verification. [Not Available]

CBECC-Res can model zonally controlled cooling equipment (different than the compliance option that involves living and sleeping zones). Some of the choices with this modeling option include the ability to specify if the equipment is a single-speed or multi-speed compressor. A single-speed compressor with a bypass duct has an exception that allows modeling a cooling airflow as low as 150 CFM/ton (an energy penalty). It is important to know the details of the system because in some cases it may not be possible to meet 350 CFM/ton when in zonal mode. See Sections 8.3.1.5, 8.3.1.8 and 8.3.1.9. Specify a bypass duct as shown in Section 8.6.1.3. See also *Reference Appendices*, Residential Appendix RA3.1.4.6.

8.5.4 Package Terminal Air Conditioners

Package terminal air conditioners (PTAC) are a ductless system rated with an EER/EER2. If a value higher than the default minimum 9.5 EER/EER2 is modeled, ECC verification of the EER/EER2 is required.

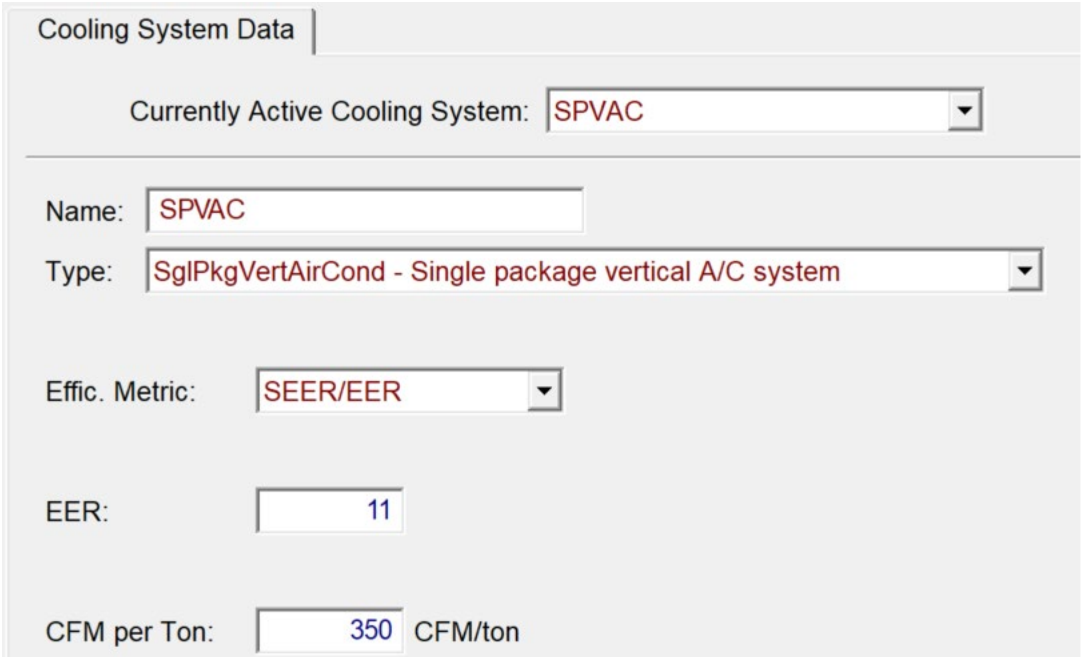
Figure 8-16: Package Terminal Air Conditioner



8.5.5 Single Package Vertical Air Conditioners

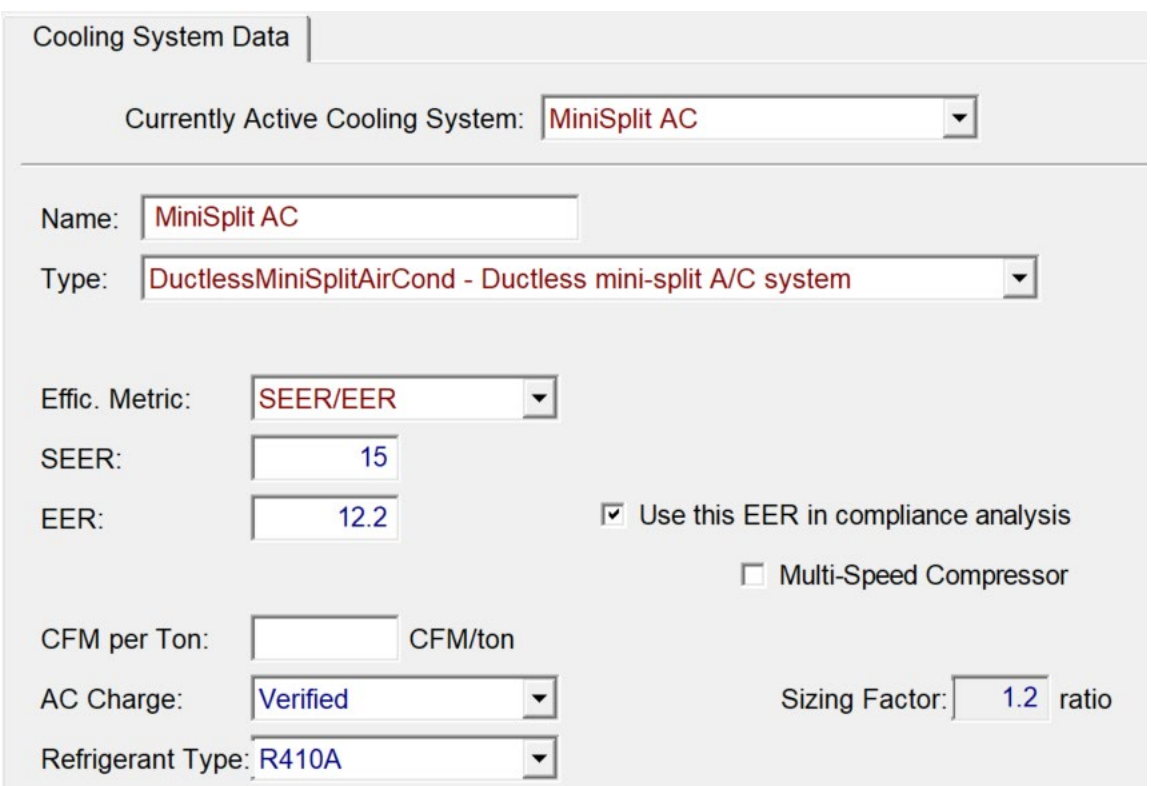
Single package vertical air conditioners are a ducted system rated with an EER/EER2. They are simulated as a minimum efficiency cooling system.

Figure 8-17: Single Package Vertical Air Conditioners



8.5.6 Mini-split, Multi-split, VRF Air Conditioners

Figure 8-18: Minisplit System



NOTE: Ducted and ductless mini-split, multi-split, and variable refrigerant flow (VRF) equipment is assumed to have minimum efficiency regardless of the efficiency modeled. This is consistent with requirements of Section 2.4.5 of the *2025 Single-Family Residential ACM Reference Manual.*

Ducted, ductless, and combinations of distribution systems can be modeled for mini-split, multi-split, and variable refrigerant flow (VRF) air conditioners. The systems are modeled as minimum efficiency systems. When higher than minimum SEER/SEER or EER/EER2 values are modeled, although reported on the CF1R, they have no effect on compliance. Ducted systems are required to meet mandatory requirements for airflow (default 350 CFM/ton) and fan efficacy (0.45 W/CFM).

8.5.7 Evaporatively Cooled Condenser

This type of air conditioning is best suited for hot dry climates. The efficiencies are reported as multiple EER values at different conditions. More information can be obtained from the *2025 Single-Family Residential Compliance Manual*, Section 4.7.8 and a full list of compliance requirements is included in the *2025 Residential Appendices*, Residential Appendix RA4.3.1. This system type requires ECC verification of EER, refrigerant charge, and duct leakage testing.

An example file (1StoryExampleEvapCond) is included in the projects folder.

8.5.7.1 EERa

EER at 95°F dry bulb and 75°F wet bulb, obtained from AHRI Certified Products Directory.

8.5.7.2 EERb

EER at 82°F dry bulb and 65°F wet bulb. This value must be tested and published by the manufacturer according to AHRI guidelines.

8.5.8 Room Air Conditioners

8.5.8.1 Name

User-defined name for the cooling system.

8.5.8.2 Type

Cooling system type is selected from Table 8-3.

8.5.8.3 CEER

Enter the CEER for the proposed equipment, minimum efficiency is 9.0.

8.5.9 Evaporative Cooling

8.5.9.1 Name

User-defined name for the cooling system.

8.5.9.2 Type

Cooling system type is selected from Table 8-3.

8.5.9.3 Efficiency Metric

Enter either EERa/EERb or EERa2/EERb2.

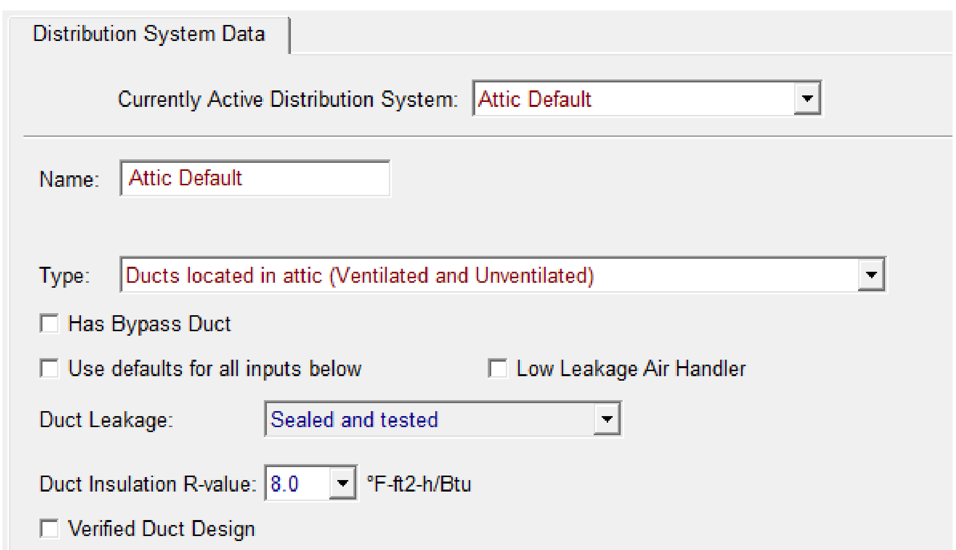
8.6 Distribution System Data

Model the distribution system (ducts) associated with the HVAC system within a given zone. When modeled as one system, assume the worst case conditions.

For systems without ducts, the most reliable method is to set the Distribution to “none” on the HVAC system data screen rather than define a “distribution system without ducts.”

When modeling a multi-story building, the computer model already assumes that some ductwork is between floors and inside the conditioned space.

Figure 8-19: Distribution System Data



8.6.1.1 Name

User-defined name.

8.6.1.2 Type

Indicate the type of duct system and location (see Table 8-5).

Table 8-6 summarizes the duct conditions that require ECC verification, including sealed and tested ducts, which are a mandatory requirement.

Proposed HVAC systems with ducts in the crawl space or a basement must have supply registers within two feet of the floor and show the appropriate locations for the ducts. Ducts in a crawl space or basement can be verified by the local enforcement agency (no ECC verification or duct design).

8.6.1.3 Has Bypass Duct

If the system is zonally controlled, indicate if the system has a bypass duct. This is a ECC verified feature (*Reference Appendices*, Residential Appendix RA3.1.4.6).

8.6.1.4 Use defaults for all inputs below

By checking this option, the detailed information about the supply and return ducts is completed based on other building inputs, including climate zone.

NOTE: If you change the climate zone to one with a different prescriptive duct insulation value, the program will change to match the prescriptive requirement, which may not match the plans.

Table 8-5: Distribution Type

Descriptor	Distribution Type and Location
Ducts located in attic (Ventilated and Unventilated)	Ducts located overhead in the attic space, whether the attic is ventilated or unventilated (and default condition for no cooling).
Ducts located in a crawl space	Ducts located in crawl space.
Ducts located in a garage	Ducts located in garage space.
Ducts located within the conditioned space (except < 12 lineal feet)	Less than 12 linear feet of ducting is outside of the conditioned space.

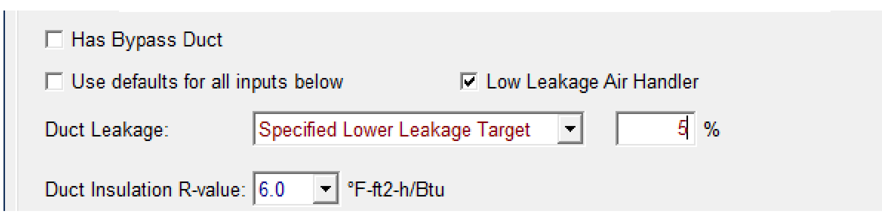
Descriptor	Distribution Type and Location
Ducts located entirely in conditioned space	HVAC equipment and all ducts (supply and return), furnace cabinet and plenums, located within the conditioned space. Location of ducts in conditioned space eliminates conduction losses but does not change losses due to leakage. Leakage from either ducts that are not tested for leakage or from sealed ducts is modeled as leakage to outside the conditioned space.
Distribution system without ducts	Air distribution systems without ducts such as window air conditioners, wall furnaces, floor furnaces, radiant electric panels or combined hydronic heating equipment.
Ducts located in outdoor locations	Ducts located in exposed locations outdoors.
Verified low-leakage ducts entirely in conditioned space	Verified low-leakage ducts entirely in conditioned space - defined as duct systems for which air leakage to outside conditions is equal to or less than 25 CFM when measured in accordance with *Reference Appendices*, Residential Appendix RA3.1.
Ducts located in multiple places	Allows a different location for supply and return ducts.

Table 8-6: Summary of Verified Air Distribution Systems

Measure	Description
Duct Sealing	Mandatory measures require that space conditioning ducts be sealed. Field verification and diagnostic testing is required.
Supply Duct Location, Reduced Surface Area, and R-value	Compliance credit for improved supply duct location, reduced surface area and R-value. Field verification that the duct system was installed according to the duct design, including location, size and length of ducts, duct insulation R-value, and installation of buried ducts. For buried ducts, this measure also requires quality insulation installation (QII) and duct sealing.
Low Leakage Ducts in Conditioned Space	When space conditioning ducts are located entirely in directly conditioned space, this is verified by diagnostic testing. Compliance credit can be taken for verified duct

Measure	Description
	systems with low air leakage to the outside. Field Verification for ducts in conditioned space and duct sealing are required (*Reference Appendices*, Residential Appendix RA3.1.4.3.8).
Low Leakage Air-Handling Units	Compliance credit can be taken for installation of a factory sealed air handling unit tested by the manufacturer and certified to the CEC to have met the requirements for a Low Leakage Air-Handling Unit. Field verification of the air handler's model number is required. Duct sealing is also required.
Return Duct Design	Verification to confirm that the return duct design conforms to the criteria given in Table 150.0-B or Table 150.0-C. as an alternative to meeting 0.45 W/CFM (0.58 for non-gas heating) fan efficacy of §150.0(m)12 of the Energy Code.
Bypass Duct Condition	Verification to determine if the system is zonally controlled and to confirm that bypass ducts condition modeled matches installation.

Figure 8-20: Duct Leakage



8.6.1.5 Low Leakage Air Handler

Checking the option for a low leakage air handler enables specifying a lower leakage target value.

8.6.1.6 Duct Leakage

Select sealed and tested. To specify a target leakage number, select Low Leakage Air Handler (see Figure 8-20). ECC verification is required for this mandatory measure.

8.6.1.7 Duct Insulation R-value

Specify the R-value of HVAC system ducts. The mandatory minimum R-value allowed is R-6 for ducts located in unconditioned space. Valid options are R-0, R-2.1, R-4.2, R-6.0, R-8.0, R-10.0, R-12.0. For new construction, the default value is based on the climate zone and high performance attic option B, which is R-6 in climate zones 3, and 5-7 and R-8 for all other climate zones.

8.6.1.8 Verified Duct Design

If use defaults for all inputs below is unchecked the option for verified duct design becomes available. See Section 8.6.2 for verified duct design inputs.

8.6.1.9 Supply Duct Attic

If use defaults for all inputs below is unchecked the supply and return duct locations may be specified.

8.6.1.10 Return Duct Attic

Enter the location of the return duct. If verified duct design is selected, also enter the area and R-value of return ducts.

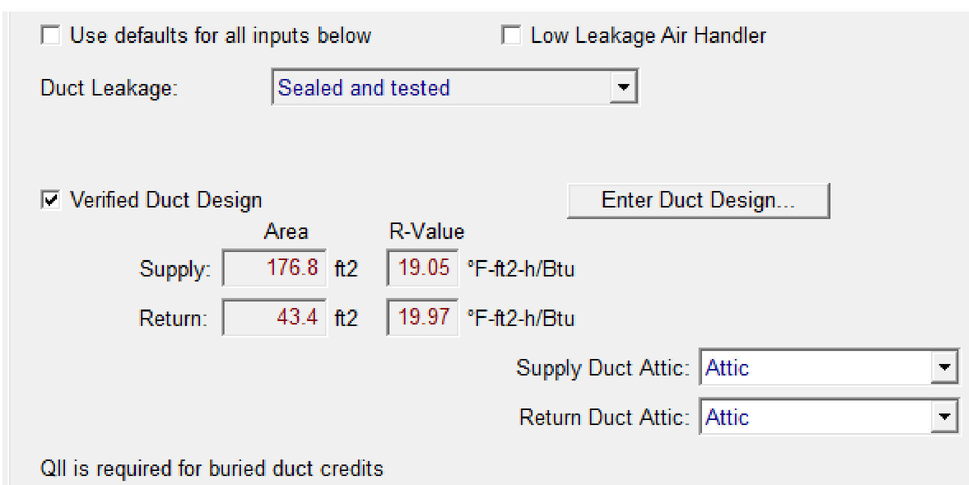
The calculations assume that the return duct is located entirely in the attic, unless it meets one of two conditions:

(a) The return duct is located entirely in the basement, in which case the calculation shall assume basement conditions for the return duct efficiency calculation, or
(b) The return duct is located entirely in conditioned space and the system meets the requirements for Verified Low Leakage Ducts in Conditioned Space, in which case the return duct is assumed to be in conditioned space.

8.6.2 Verified Duct Design/Buried Ducts

Ducts partly or completely buried under blown attic insulation may take credit for increased effective duct insulation. Requirements that apply include a duct design, verification of the duct design/layout, quality insulation installation (QII), duct leakage testing, and ECC verification at specific points during construction (see Reference Appendices, Residential Appendix RA3.1.4).

Figure 8-21: Verified Duct Design



To enter duct system details, uncheck the box labeled “use defaults for all inputs below,” select verified duct design, and click enter duct design. Based on the details input, the area and R-value for supply and return ducts are determined by CBECC-Res based on the information input in the duct design grid (see Figure 8-22).

Activate the grid by clicking in the first box, and either selecting from the pull-down menu or entering data in each field of the grid. Add rows by clicking on the +DuctSeg (bottom left); delete rows by clicking on the Del – X field for the row to be deleted.

Based on the inputs, CBECC-Res determines if the duct is fully or partially buried (if applicable) and the effective duct R-value. When all the various entries for the duct segments are included, close the grid by clicking on the X in the upper right corner. When it returns to the Distribution System Data screen, the supply and return duct values are displayed, including the effective R-value. For details about how the buried duct calculations are determined, see the *Single-Family Residential ACM Reference Manual*, Section 2.4.7.)

Figure 8-22: Duct Design Grid

Describe each duct segment of HVACDist 'Attic Default': Supply duct area 177, R-value 19.1 / Return duct area 43, R-value 20.0

	Name	Supply / Return	Buried (per ACM)	Diameter	Length (ft)	Duct Insulation	Attic Insulation	Attic Insul Type	Containment System	Buried Level	#	Del
1	seg	Supply	Yes	8 in	8	R-8	R-49	Fiberglass	n/a	Fully	1	X
2	seg 2	Supply	Yes	10 in	20	R-8	R-49	Fiberglass	n/a	Fully	2	X
3	seg 3	Supply	Yes	6 in	10	R-8	R-49	Fiberglass	not required	Deeply	3	X
4	seg 4	Return	Yes	8 in	12	R-8	R-49	Fiberglass	n/a	Fully	4	X
5	seg 5	Return	Yes	6 in	7.5	R-8	R-49	Fiberglass	not required	Deeply	5	X
6	seg 6	Supply	Yes	8 in	11	R-8	R-49	Fiberglass	n/a	Fully	6	X
7	seg 7	Supply	Yes	6 in	7	R-8	R-49	Fiberglass	not required	Deeply	7	X
8	seg 8	Supply	Yes	10 in	12	R-8	R-49	Fiberglass	n/a	Fully	8	X
9	+ DuctSeg											

8.6.3 Low Leakage Air Handlers

Credit can be taken for installation of a factory sealed air handling unit tested by the manufacturer and certified to the CEC to meet the requirements for a low leakage air-handler. Field verification of the air handler’s model number is required.

A low leakage air handler is reported on the compliance report and field verified in accordance with the procedures specified in *Reference Appendices,* Joint Appendix JA9.

8.6.4 Ducts in Conditioned Space

While there are varying amounts of credit based on attic construction and duct location, the only time ducts are inside the conditioned space is when they are installed on the conditioned space side of the ceiling separating occupiable space from the attic. It should be noted that if the standard and proposed design roof assembly includes roof deck insulation (more extreme climates), the attic temperature is very close to conditioned space temperature (a high of 85 degrees F).

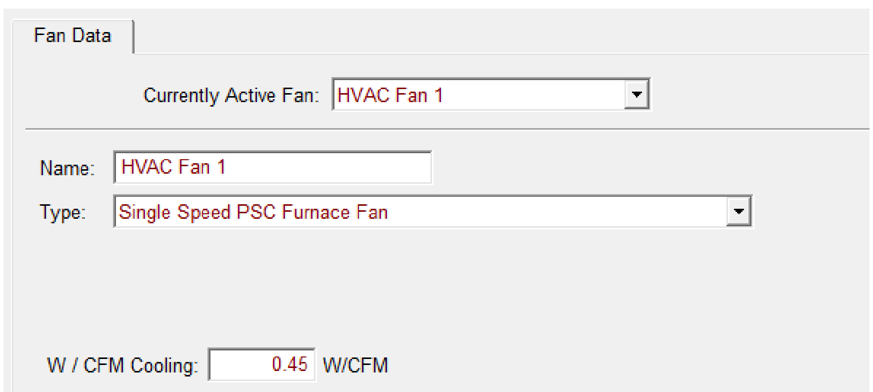
There are two categories (1) ducts in conditioned space and (2) low-leakage ducts entirely in conditioned space. Ducts in conditioned space involve a visual verification of duct location and duct leakage testing. Low leakage ducts are assumed to have no leakage and no conduction losses, which is verified by measurements showing duct leakage to outside conditions is equal to or less than 25 CFM when measured in accordance with *Reference Appendices*, Residential Appendix RA3.

8.7 HVAC Fan System

The HVAC fan system moves air for the air conditioning and heating systems.

8.7.1 HVAC Fan System Data

Figure 8-23: HVAC Fan



8.7.1.1 Name

User-defined name.

8.7.1.2 Type

Default single speed furnace fan.

8.7.1.3 Watts/CFM Cooling

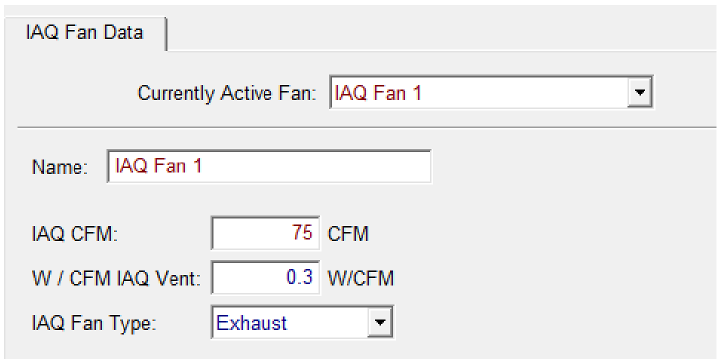
The mandatory requirement is an air-handling unit fan efficacy less than or equal to these values from §150.0(m)13 of the Energy Code as verified by a ECC rater:

- ≤ 0.45 Watts/CFM for most equipment with gas heating
- ≤ 0.58 Watts/CFM for heat pumps
- ≤ 0.62 W/CFM for small duct high velocity

The alternative to ECC verification of watts/CFM is ECC verification of a return duct design that conforms to the specification given in Table 150.0-B or C. However, if a value less than the mandatory requirement is modeled for compliance credit, the fan efficacy value must be verified, and the alternative is not allowed.

8.8 Indoor Air Quality (IAQ) Fans

Figure 8-24: IAQ Fan Data



Mechanical ventilation is required to meet minimum indoor air quality (IAQ) requirements of ASHRAE Standard 62.2 (see *Single-Family Residential Compliance Manual*, Section 4.6, and CF2R-MCH-27). The IAQ system requires ECC verification meeting *Reference Appendices*, Residential Appendix RA3.7.

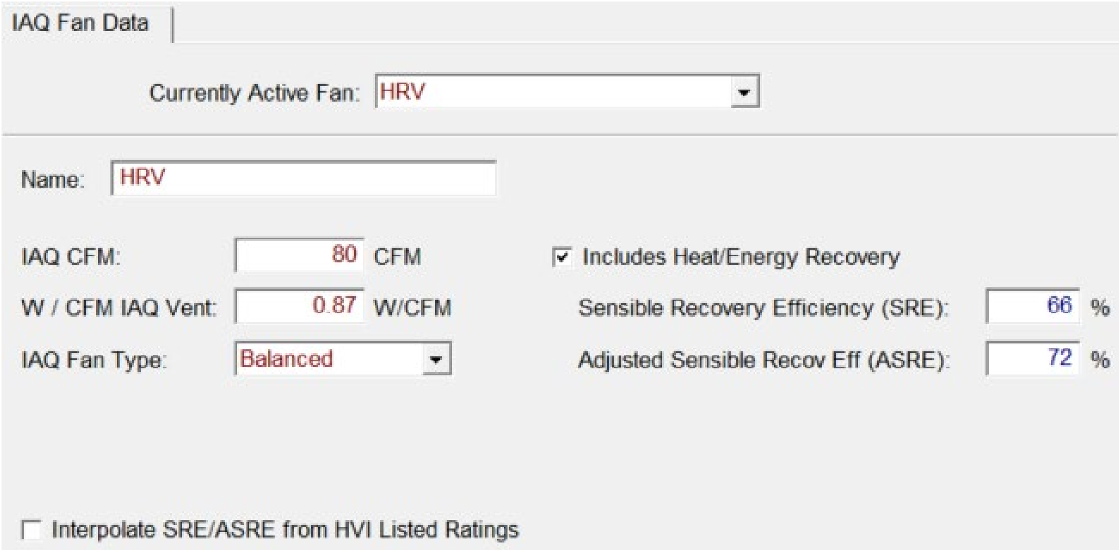
IAQ fan system options include (1) an exhaust fan, such as a bathroom fan that meets the criteria in ASHRAE Standard 62.2 for air delivery and low noise, and that operates continuously; (2) supply; or (3) a balanced system which has both supply and exhaust fans with equal airflow. Balanced systems can also have heat/energy recovery in the case of a heat recovery ventilator (HRV) or energy recovery ventilator (ERV).

The energy impact of this mandatory requirement depends primarily on the fan efficacy of the proposed system, which is compared against a 0.35 W/CFM standard design for unbalanced systems (exhaust or supply) or 0.70 W/CFM for balanced systems, with or without heat/energy recovery.

8.8.1 HRV/ERV Fans

When a heat recovery ventilator (HRV) or energy recovery ventilator (ERV) is modeled in CBECC-Res, the fan type is "balanced." Performance data for these fans is published in the Home Ventilating Institute (HVI) Certified Products Directory [https://www.hvi.org/hvi-certified-products-directory/].

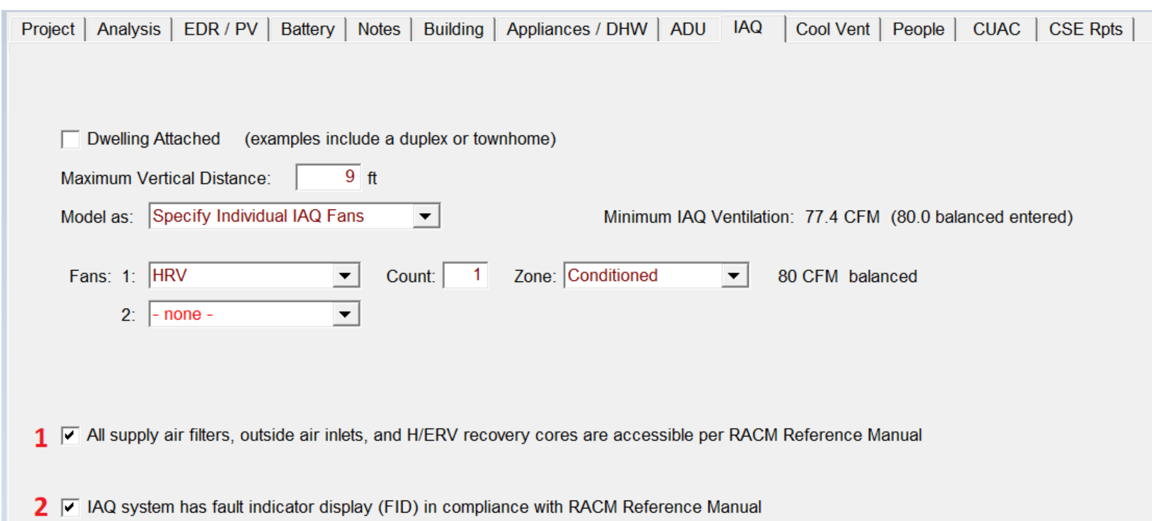
Figure 8-25: ERV/HRV



8.8.1.1 Name

User-defined name. In order for the program to recognize an IAQ fan defined on the **Mechanical** tab, the name must be specified on the project level IAQ tab (Figure 8-26) (see Section 4.9 for more information).

Figure 8-26: IAQ Tab



8.8.1.2 IAQ System Accessibility Checkbox

Input labeled “2” in Figure 8-26 above. Applicable to supply and balanced IAQ systems. Use this checkbox to indicate whether the system meets the accessibility requirements in the table below (copied from IAQ section of the Single-Family Residential ACM Reference Manual). If the checkbox is unchecked the IAQ system will not get credit and could be penalized depending on the proposed system W/CFM. If unchecked, the standard design W/CFM will match the proposed or default, whichever is lower, and if the proposed has heat recovery the standard will have heat recovery with SRE and ASRE equal to the proposed system.

Table 8-7: IAQ System Component Accessibility Criteria

Dwelling Unit Ventilation System Component	Location	Accessible Determination
Outdoor Air Intake	All locations	Intakes louvers, grilles, or screens shall be >3/8 inches except where prohibited by local jurisdictions or other code requirements.
Outdoor Air Intake	Exterior wall, soffit, or gable end	For single family, a point on the perimeter of the outdoor air intake shall be located within 10 feet of a walking surface or grade or the system shall meet the IAQ System FID requirements in the Single-Family Residential ACM Reference Manual. For multifamily, complies.
Outdoor Air Intake	Roof	Access shall be provided in accordance with California Mechanical Code Section 304.3.1 requirements for appliances.
Filters and Heat Exchangers	Serviceable from conditioned space, unconditioned basements, or mechanical closets. Heat exchangers may also be serviceable from unconditioned attics if the IAQ system meets the FID requirements in the Single-Family Residential ACM Reference Manual.	The H/ERV or supply ventilation system access panel shall be located within 10 feet of the walking surface.

8.8.1.3 Fault Indicator Display Checkbox

Input labeled “1” in Figure 8-26 above. Applicable to all IAQ systems with fault indicator displays (FID). Use this checkbox to indicate whether the system has an FID that meets the requirements of the Single-Family Residential ACM Reference Manual (requirements copied below). If the system has a compliant FID system, then credit will increase due to SRE, ASRE and W/CFM not being derated by 10% (see Single-Family Residential ACM Reference Manual for details).

IAQ SYSTEM FAULT INDICATOR DISPLAY REQUIREMENTS

1. Fault indication responding to the following categories:
    a. Filter check or maintenance, either based on performance or a predetermined schedule.
    b. Low supply airflow.
    c. Low exhaust airflow.
    d. Sensor failure for sensors that assist in monitoring or controlling for the following operations, where such operations are provided: airflow regulation, frost control, supply air tempering, and economizing.
2. Fault indication using one or more of the following means:
    a. A visual display that is readily accessible to occupants of the dwelling unit and located on or within one foot of the IAQ system control.
    b. An electronic application.
    c. An audible alarm accompanied by a visual display.
3. Instrumentation and reporting of the following:
    a. Airflow.
    b. Fan power.
4. FID certified to CEC by the manufacturer as meeting the above requirements.

8.8.1.4 IAQ CFM

Enter the design airflow rate of the IAQ system in CFM, which must meet or exceed the mandatory ventilation requirements (found under Building in Section 4.5). Only one fan per zone may be modeled. For a balanced fan, this value is the net airflow in CFM.

Standard design airflow will match proposed airflow up to 125% of the minimum IAQ ventilation rate. Going above 125% of minimum will result in a compliance penalty. For example, if the minimum ventilation rate is 100 CFM and the proposed design specifies 135 CFM, the standard will only have 125 CFM of airflow.

NOTE: Balanced fans meet a different IAQ requirement than unbalanced supply or exhaust systems. You can check whether you have met the requirement on the IAQ tab. For example, a 2,100 ft^2 home requires a 90.3 CFM exhaust fan, but only 77.4 CFM for a balanced fan.

8.8.1.5 W/CFM IAQ Vent

For unbalanced systems (exhaust or supply), the default value and standard design is 0.35 W/CFM. For balanced systems (with or without heat/energy recovery), the default value and standard design is 0.70 W/CFM. IAQ W/CFM is calculated based on the design wattage divided by the design CFM. For example, 74 watts divided by 54 CFM = 1.37 W/CFM.

8.8.1.6 IAQ Fan Type

Select exhaust, supply, or balanced (system with both exhaust and supply fans with equal/balanced airflow). If multiple fan types are installed, model exhaust or the building must be zoned.

8.8.1.7 Includes Heat/Energy Recovery

Check box to indicate if a balanced fan includes heat or energy recovery. Used for HRV or ERV fans.

8.8.1.8 Sensible Recovery Efficiency (SRE)

Enter a sensible recovery efficiency (SRE) using the performance data published in the Home Ventilating Institute (HVI) directory, https://www.hvi.org/hvi-certified-products-directory. SRE entered should match the design airflow or the next higher airflow from the HVI directory energy rating table for the installed HRV/ERV. For example, using the below table with a design airflow of 80 CFM the SRE entered into CBECC-Res should be 65.0 which is based on the next higher rating point than the 80 CFM design. For cases where the design CFM is in between rating points, using the optional interpolate SRE/ASRE will give more accurate SRE/ASRE values.

Table 8-8: Example HRV Data from HVI Directory Energy Rating Table

Brand Name	Model	Temp Mode	°C	°F	Net Airflow (L/S)	Net Airflow (CFM)	Power Consumed (Watts)	SRE	ASRE
Brand A	HRV160	Heating	0	32	31.0	66	67	67.0	74
Brand A	HRV160	Heating	0	32	40.0	85	74	65.0	71

Brand A	HRV160	Heating	0	32	54.0	114	90	61.0	66
Brand A	HRV160	Heating	-25	-13	38.0	81	87	60.0	64

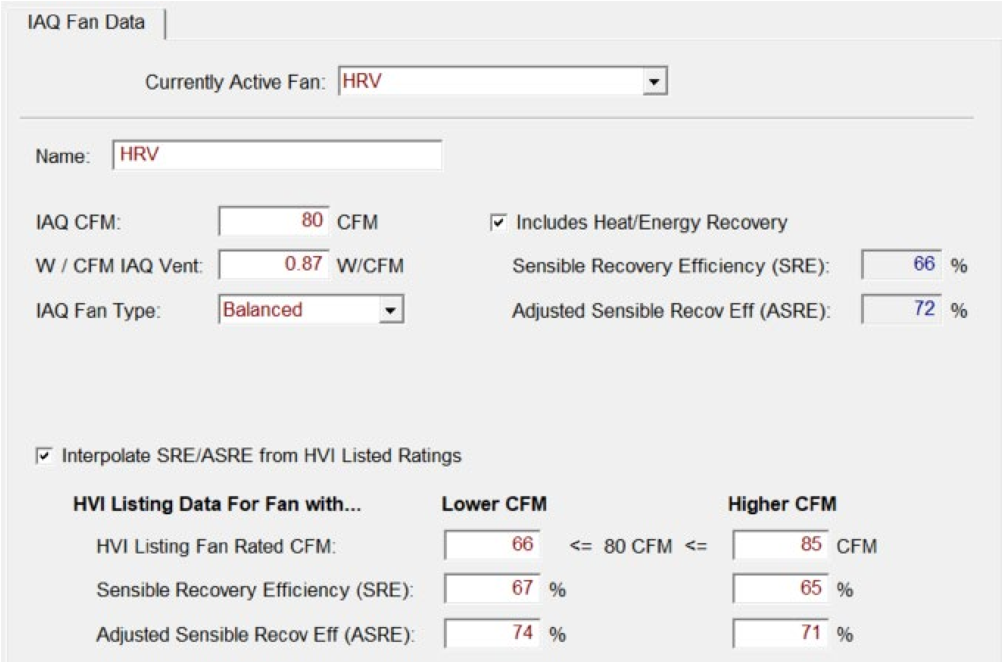
8.8.1.9 Adjusted Sensible Recovery Efficiency (ASRE)

Enter an adjusted sensible heat recovery efficiency (ASRE) using the performance data published in the Home Ventilating Institute (HVI) directory, https://www.hvi.org/hvi-certified-products-directory. ASRE follows the same logic as SRE and the values entered should be from the same HVI rating point. ASRE entered should match the design airflow or the next higher airflow from the HVI directory energy rating table for the installed HRV/ERV. For example, using the above table with a design airflow of 80 CFM the ASRE entered into CBECC-Res should be 71 which is based on the next higher rating point than the 80 CFM design and is from the same rating point as the SRE described in the previous section. For cases where the design CFM is in between rating points using the optional interpolate SRE/ASRE will give more accurate SRE/ASRE values.

8.8.1.10 Interpolate SRE/ASRE from HVI Listed Ratings

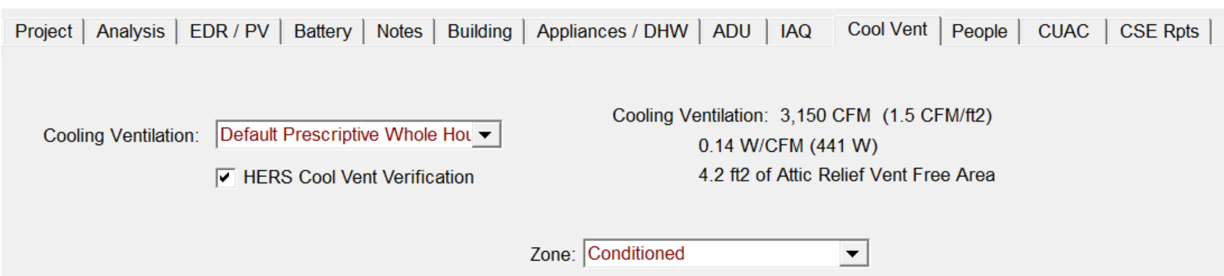
For cases where the design CFM is in between HVI rating points CBECC-Res gives the option to interpolate SRE and ASRE instead of using the values from the next higher rating point.
Enter the CFM, SRE, and ASRE for the rating point above and below the design CFM. For example, see below screenshot of inputs which use the above HVI directory data and a design CFM of 80 CFM.

Figure 8-28: Interpolate SRE/ASRE from HVI Listed Ratings



8.9 Cooling Ventilation/Whole House Fans

Figure 8-29: Cooling Ventilation



Although not a mandatory requirement, a whole house fan (WHF) (one of the types of cooling ventilation) is included in the standard design building in climate zones 8-14. Options for a WHF include attic venting or venting directly to outside (meaning that a WHF can be modeled for a building with cathedral ceilings), and central fan ventilation cooling system. Whether or not additions include a WHF depends on the compliance approach (see Chapter 10). A slightly reduced amount of credit is available if ECC verification is not selected. *Reference Appendices,* Residential Appendix RA3.9 contains the verification requirements for a whole house fan and RA3.3.4 contains the verification requirements for a central fan ventilation cooling system.

How these systems save energy is they bring in outside air to cool the house, reduce cooling loads, and thereby save cooling energy. Whole house fans involve window operation and either attic venting or direct venting. Central fan integrated (CFI) systems use the HVAC duct system to distribute ventilation air similar to an economizer in a commercial building. If the system exhausts air through the attic it requires a minimum of 1 ft^2 of free attic ventilation area per 750 CFM of rated capacity for relief (based on §150.1(c)12 of the Energy Code). The amount of attic venting is not a user input.

As noted in Table 4-1, CBECC-Res can model system types:

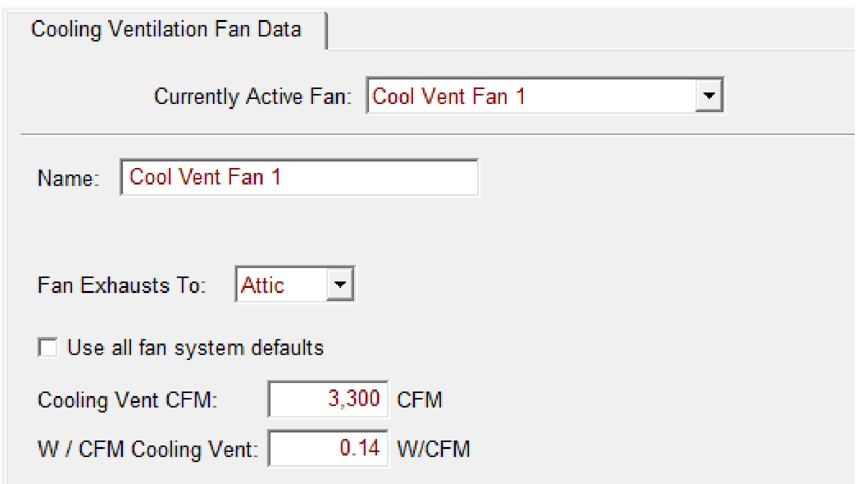
1. Whole house fan,
2. Central fan ventilation cooling (fixed speed), and
3. Central fan ventilation cooling (variable speed).

8.9.1 Whole House Fan

There are two methods for modeling a whole house fan (WHF). From the cooling ventilation drop down menu (see Section 4.10), select “default prescriptive whole house fan” or “default WHF exhausting to outside.” This fan size exactly meets the prescriptive requirement of 1.5 CFM/ft^2. To include the full benefit of the WHF check ECC verification. No further details are needed.

Alternatively, from the cooling ventilation drop down menu, select “specify individual whole house fan.” Either pick a fan defined on the **Mechanical** tab or create one with the data shown. When this option is selected, ECC+ verification is required.

Figure 8-30: Cooling Ventilation



A useful resource for WHF details is the [CEC’s appliance directory](). An [advanced search]() allows you to export the contents of your search to an excel file for sorting and selecting. From the directory of fans and dehumidifiers check the fields of data needed (airflow CFM) and export the results to an excel spreadsheet. This resource will have the details about available fan sizes.

8.9.1.1 Name

User-defined name. Unless none or the default fan is specified, this name must match the input in Section 4.12.

8.9.1.2 Fan Exhausts to

Select Attic or Outside.

8.9.1.3 Use all fan system defaults

Sets the default minimum to 1.5 CFM/ft^2. If use all fan system defaults is unchecked the cooling ventilation airflow (CFM) and fan efficacy (W/CFM) may be specified.

8.9.1.4 Cooling Vent CFM

Select either system default (for whole house fans) or enter the actual CFM of the proposed fan.

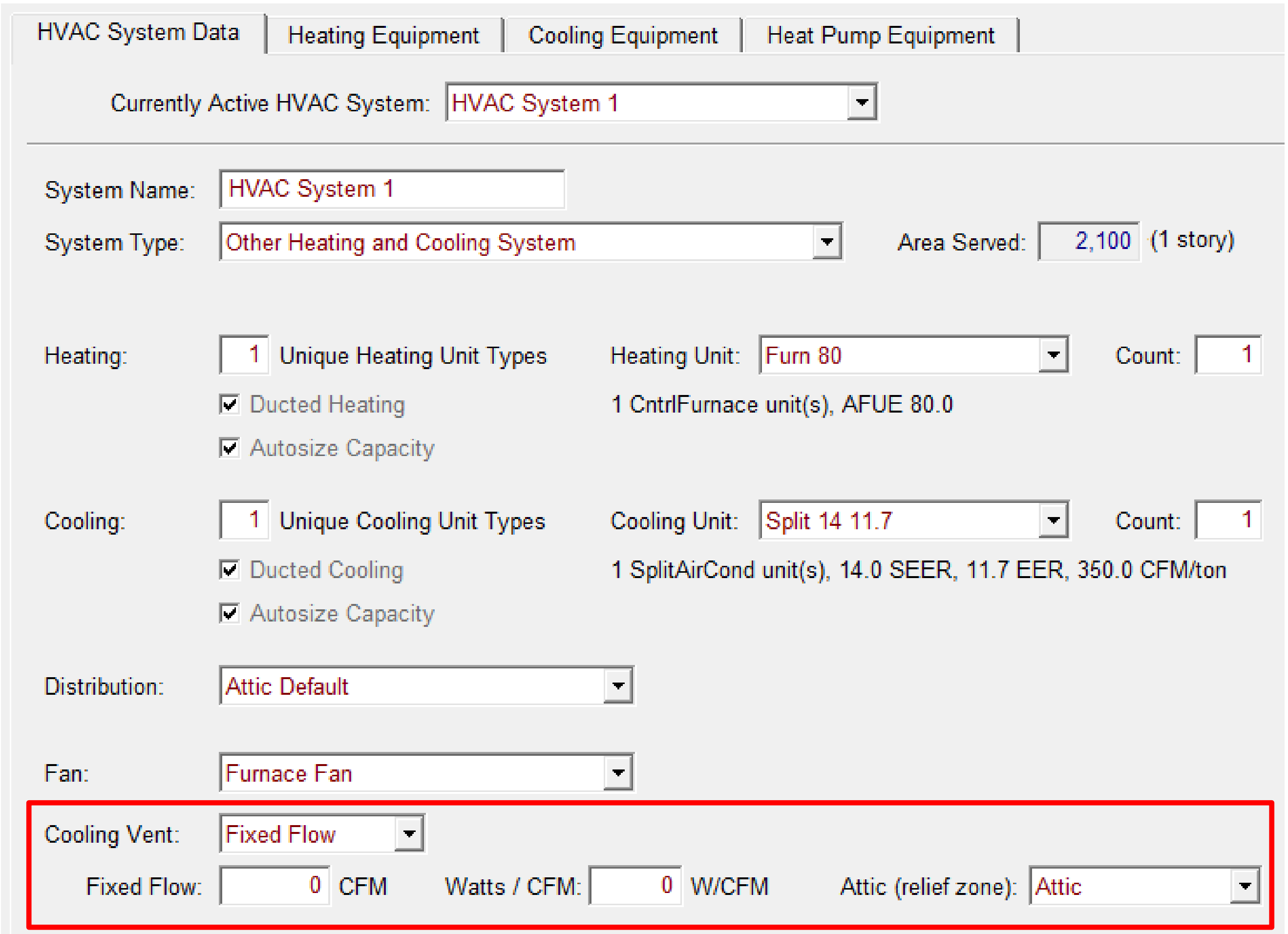
8.9.1.5 W/CFM Cooling Vent

Select either system default (for whole house fans) or enter the Watts/CFM of the proposed fan.

8.9.2 Central Fan Integrated (CFI) Fixed Flow

For central fan integrated (CFI) night ventilation, fixed flow (e.g., SmartVent™), select central fan ventilation cooling system on the **Cool Vent** tab (see Section 4.12). This exposes fields on the HVAC System data screen. Inputs are described in Sections 8.2.15.

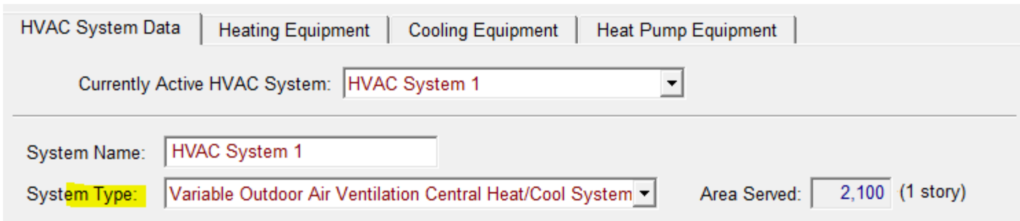
Figure 8-31: CFI Fixed Flow



8.9.3 Central Fan Integrated (CFI) Variable Speed

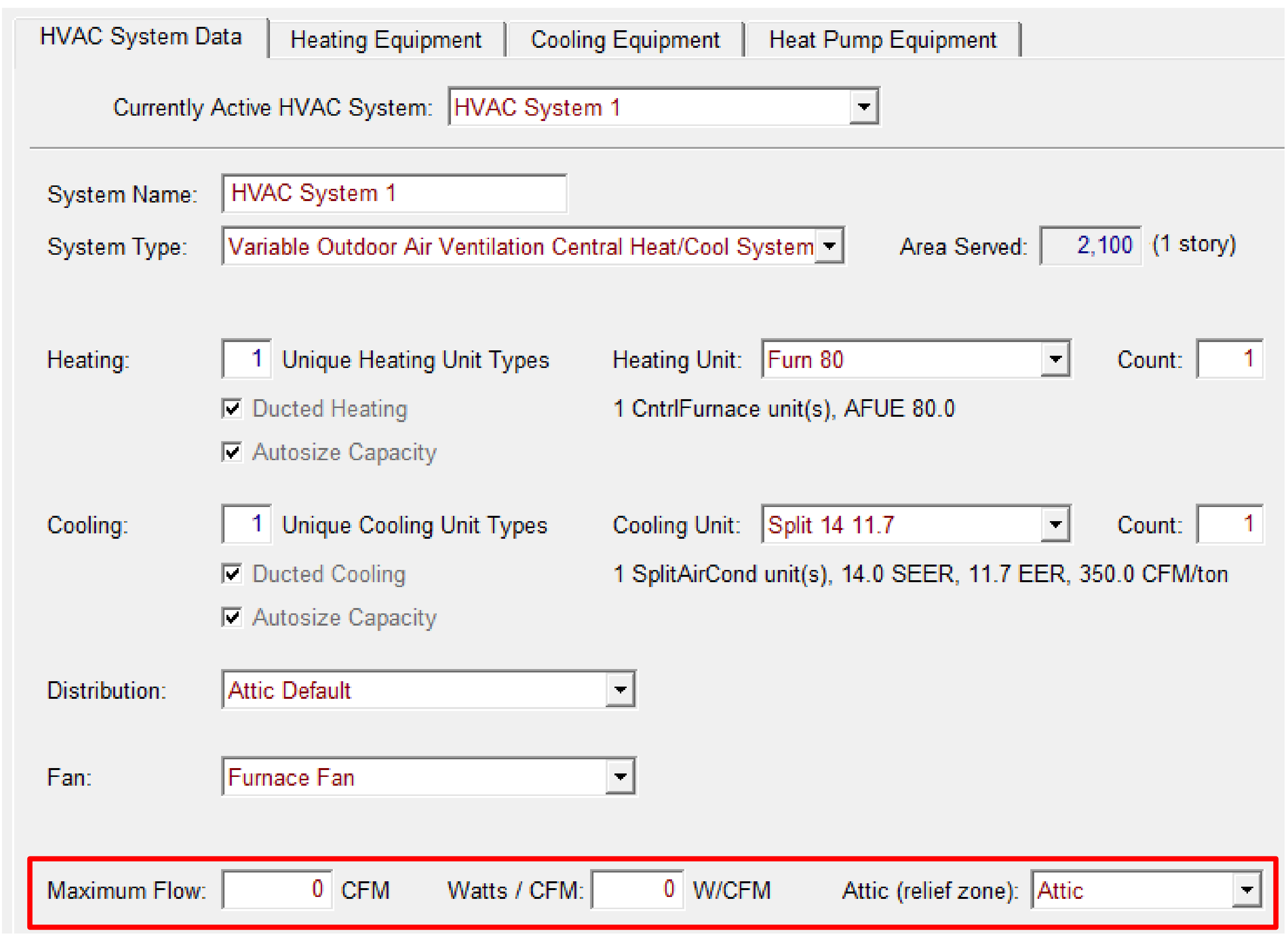
For central fan integrated (CFI) night ventilation, variable speed (such as NightBreeze™), select CFI (central fan integrated) on the **Cool Vent** tab (see Section 4.12). Define the HVAC System Type (see Section 8.2.2) as a variable outdoor air ventilation system (versus the typical “other heating and cooling system”).

Figure 8-32: Variable Outdoor Air Ventilation
Central Heating/Cooling System



This exposes additional fields. Inputs are described in Section 8.2.15.

Figure 8-33: CFI Variable Flow



9 Domestic Hot Water (DHW)

The water heating system is defined at the zone level (see Section 5.1.1.11), while the details of the systems are contained under the **Mechanical** tab.

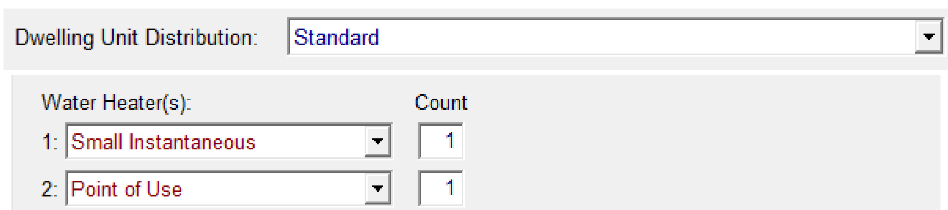
In all cases, the standard design is a UEF-rated heat pump water heater (UEF=2.0).

Climate zones 1 & 16 also include compact distribution basic credit. And Climate Zone 16 (only) includes a drain water heat recovery system.

9.1 Multiple Water Heaters

The correct way to model multiple water heaters depends on the distribution system. If the water heaters share the same distribution system, they are modeled as one system with multiple water heaters (see Figure 9-1). If the water heaters are the same type, enter the appropriate count.

Figure 9-1: Multiple Water Heaters, one distribution



If there are multiple distribution systems, create a separate zone for each water heating system.

USER TIP: The current water heating analysis includes electrical energy for tankless water heaters. While in previous codes, the number of tankless water heaters made no difference in compliance results. That is no longer the case.

9.2 Efficiency Information

Water heaters must be certified to the CEC or the Air-Conditioning, Heating and Refrigeration Institute (AHRI). Inputs are found by conducting an advanced search in the certified appliance directory, (https://cacertappliances.energy.ca.gov/Pages/Search/AdvancedSearch.aspx) based on any number of variables (type, manufacturer, brand). Results can be exported to a spreadsheet format for sorting and searching. For heat pump water heaters, see also Section 9.7.

To search the AHRI directory, visit https://www.ahridirectory.org/.

Heat pump water heaters rated by the Northwest Energy Efficiency Alliance (NEEA) can be found by searching for "qualified products" at the NEEA website (https://neea.org/resources-reports/browse?q=list+of+heat+pump+water+heater).

9.3 Water Heater and Tank Types

In 2017, the appliance certification program began using the new designations shown in Table 9-1 and Table 9-2. Only additions and alterations using older equipment can use the old designations.

Table 9-1: Gas Water Heater Types

Old Designation	New Designation	Input (Btu/hr)	Efficiency Rating	Storage Volume	Standby Loss	Recovery Efficiency (%)
Small Instantaneous	Consumer Instantaneous	≤ 200,000	UEF	< 2 gallons	N/A	80 to 99
Large Instantaneous	Commercial Instantaneous	> 200,000	Thermal Efficiency	≥ 0 gallons	N/A	N/A
Small Storage	Consumer Storage	≤ 75,000	UEF	20 to ≤ 100 gallons	N/A	70 to 99
Large Storage	Commercial Storage	> 75,000 or > 120-gallon storage	Thermal Efficiency + Standby Loss	See Input	< 0.1	N/A
	Residential-Duty Commercial Storage (Gas only)	> 75,000 to ≤ 105,000	UEF	≤ 120 gallons	N/A	80 to 99

Table 9-2: Electric/Heat Pump Water Heaters

Old Designation	New Designation	Input (kW)	Efficiency Rating	Storage Volume	Standby Loss	Recovery Efficiency (%)
Small Instantaneous	Consumer Instantaneous	≤ 12 kW	UEF	< 2 gallons	N/A	90 to 99
Large Instantaneous	Commercial Instantaneous	> 12 kW	Thermal Efficiency	≥ 0 gallons	N/A	N/A
Small Storage	Consumer Storage	≤ 12 kW	UEF	20 to ≤ 100 gallons	N/A	90 to 99

Old Designation	New Designation	Input (kW)	Efficiency Rating	Storage Volume	Standby Loss	Recovery Efficiency (%)
Large Storage	Commercial Storage	> 12 kW or >120 gal	Thermal Efficiency + Standby Loss	See Input	< 0.1	N/A
	Residential-Duty Commercial Instantaneous (Electric only)	≤ 58.6 kW	UEF	< 2 gallons	N/A	N/A
Heat Pump Water Heater	Heat Pump Water Heater	≤ 12 kW	UEF	< 100 gallons	N/A	N/A
	Commercial Heat Pump Water Heater	> 12kW	N/A	N/A	N/A	N/A

Other equipment types include:

- Boiler is a hot water supply boiler (not a space heating boiler intended for space heating).
- Indirect is a water heater consisting of a storage tank with no heating elements or combustion devices, connected via piping and recirculating pump to a heat source consisting of a boiler.
- Mini-tank is an electric water heater used with instantaneous water heaters to regulate temperature fluctuations.

9.4 Distribution

9.4.1 Compact Distribution System

On the **Appliances/DHW** tab (see Section 4.9) select one of the compact distribution credits.

The specifications listed under the “Specify Distances to Fixtures” establish the amount of credit.

Users can either specify the fixture distances or enter a custom compactness factor if the distances to each fixture are unknown. If “Specify Distances to Fixture” is selected, the distance inputs shown in Figure 9-2 are displayed.

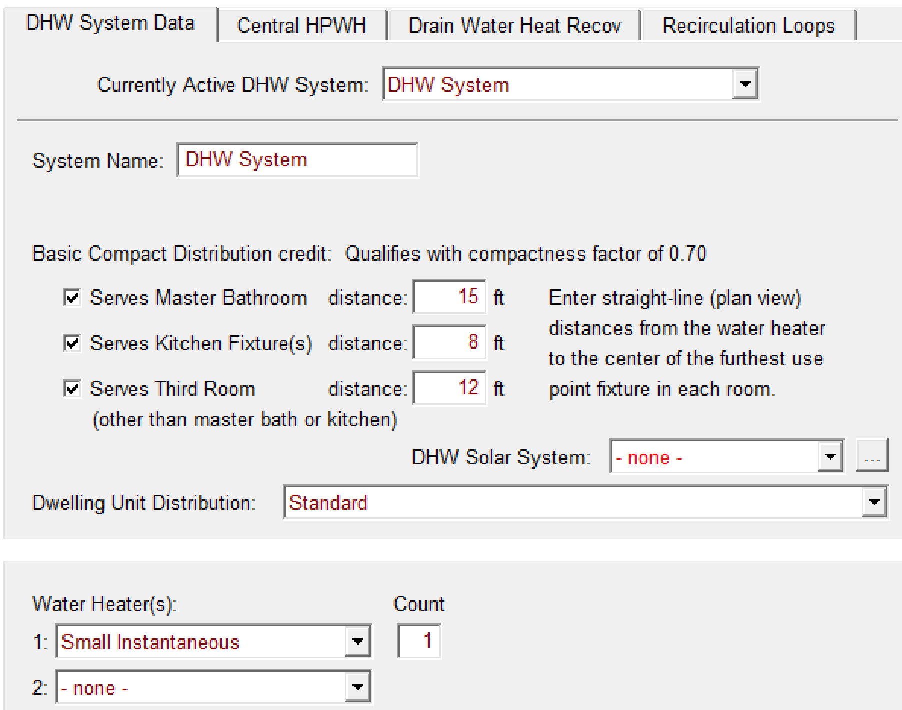
If the distances are unknown, deselect ‘Specify Fixture Distances’, and the Basic or Expanded Credit can be applied without fixture distances. If distances are not input, the user must enter the expected compactness factor. Keep in mind, the actual fixture distances will be required on the CF2R, and the calculated factor will need to be less than or equal to the value used in CBECC-Res or a revision of the proposed model and a re-run will be required.

9.4.1.1 Specify Distances to Fixtures

Plan view distance (in feet) from the center of the water heater to the master bathroom, kitchen, and furthest fixture other than the master bath or kitchen (if any).

According to the eligibility criteria from Reference Appendices, Residential Appendix RA4.4.6, the measurements are from the center of the water heater to the center of the use point.

Figure 9-2: Compact Distribution Inputs



NOTE: In a small building with no third room, uncheck the "serves third room" box.

Installation requirements are found in *Reference Appendices,* Residential Appendix RA4.4.6 (basic credit) and RA3.6.5/4.4.16 (expanded credit). The ECC credit also requires:

(1) No piping greater than 1" diameter,

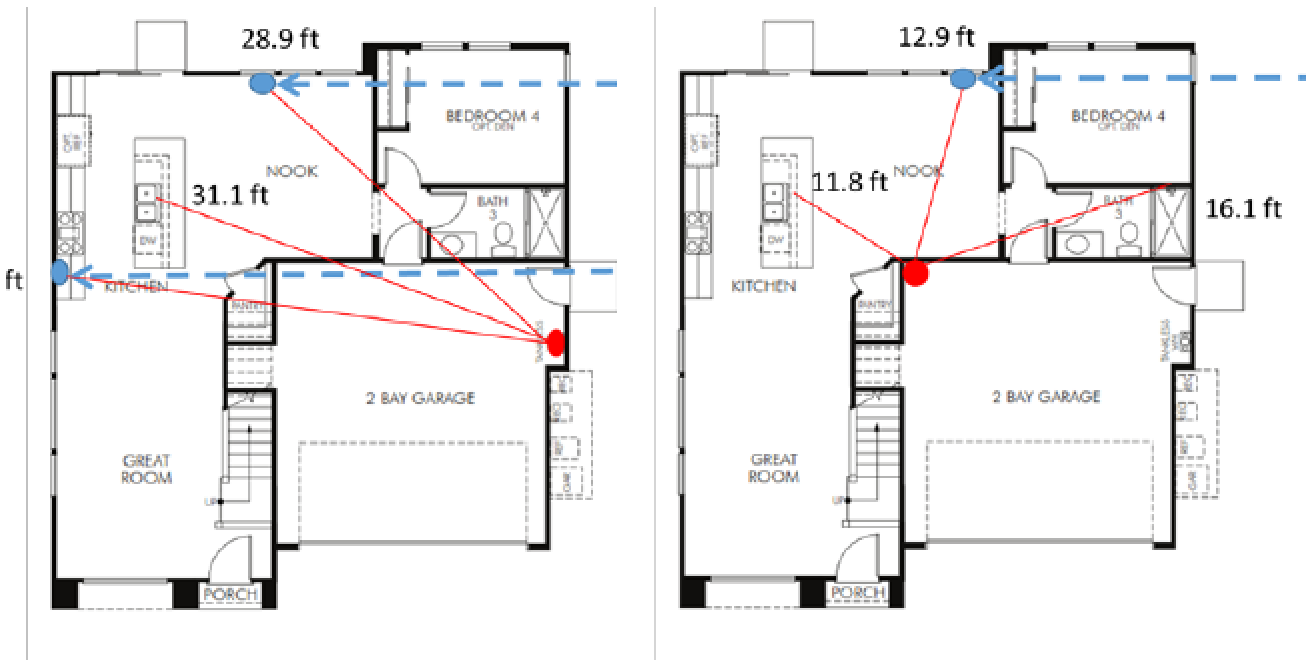
(2) Length of 1" diameter piping is limited to 8 feet or less,

(3) Unless the water heater is located in the attic, no piping in 2- and 3-story buildings can be in the attic, and

(4) If there is a recirculation system, it must be a ECC-verified demand recirculation: manual control (*Reference Appendices,* Residential Appendix RA4.4.17).

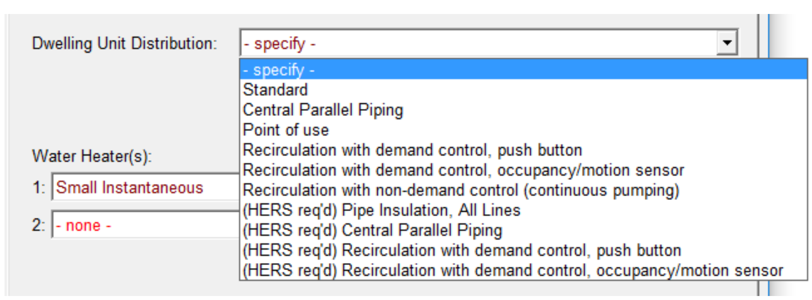
The inputs for distribution compactness are part of the DHW system data (see Section 9.4.1.1) when 'Specify Fixture Distances' is checked on the **Appliances/DHW** tab (see Section 4.9).

Figure 9-3: Water Heater Location



9.4.2 Dwelling Unit Distribution Type

Figure 9-5: Single Family Distribution Systems



The standard design distribution system includes pipe insulation (as required by the California Plumbing Code).

See Table 9-3 for all distribution system options and a comparison of the multiplier (the lower the number the more efficient the system). More information about distribution types is in *Single-Family Residential Compliance Manual* and *Reference Appendices*. When compact distribution is specified, some options from Table 9-3 are not available (for example, point of use).

For recirculation systems, the recirculation pump can be located external to or integral to the water heater. Pick the appropriate recirculation distribution system based on the control strategy. Systems that do not meet the criteria for Demand Control Push Button, or Demand Control Occupancy/ Motion must be modeled using the Non-Demand Control option.

Table 9-3: Water Heater Distribution System Multipliers

Distribution System	Distribution System Multiplier
NO ECC **INSPECTION REQUIRED**	
Standard	1.00
Central Parallel Piping	1.10
Point of Use	0.30
Recirculation, Demand Control Push Button	1.75*
Recirculation, Demand Control Occupancy/Motion Sensor	2.60*
Recirculation, Non-demand Control (continuous pumping)	9.80*
OPTIONAL CASES: ECC **INSPECTION REQUIRED**	
Pipe Insulation, All Lines	0.85
Central Parallel Piping	1.00
Compact Distribution System	0.70
Recirculation, Demand Control Push Button	1.60*
Recirculation, Demand Control Occupancy/Motion	2.40*
*Reduced hot water consumption is reflected in the distribution system multiplier for recirculation systems.	

9.5 Water Heating System Data

The water heating system is identified on the conditioned zone data tab.

9.5.1 System Name

User-defined name. This is the same name that was provided under the Zone Data tab.

9.5.2 Dwelling Unit Distribution (type)

Specify one distribution system from the drop-down menu (see Section 9.4.2 and Table 9-3). For installation and compliance requirements see *Single-Family Residential Compliance Manual,* Chapter 5 and *Reference Appendices*, Residential Appendix RA3.6 and RA4.4.

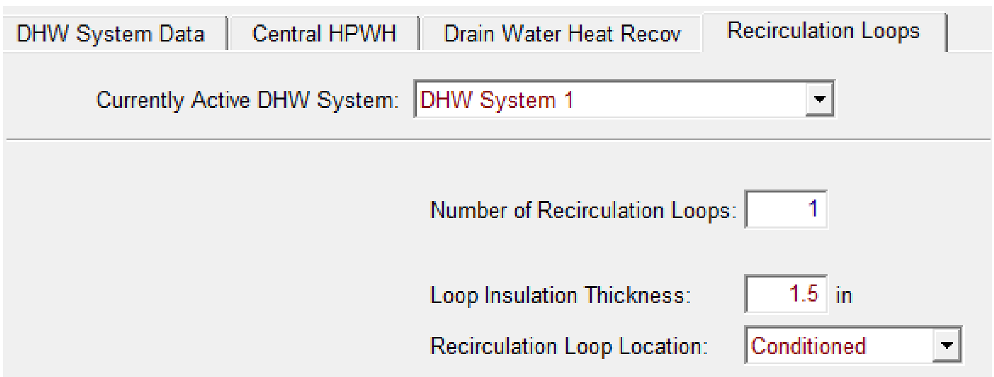
9.5.3 Water Heater(s)

The name of the water heater (this name holds the details about the water heater).

9.5.4 Count

The number of water heaters named in the adjacent field. Include different water heater types or different water heater efficiencies on a different row.

Figure 9-6: Recirculation Loops



9.6 Water Heater Data (Gas and Electric Resistance)

Inputs for the water heater data vary by the tank type selected. See Section 9.2 for links to product directories from which all inputs can be obtained.

Tank types include boiler, indirect, consumer instantaneous (UEF), commercial instantaneous (TE), consumer storage (UEF), commercial storage (TE & SBL), residential duty commercial storage (UEF) (gas only), and residential duty commercial instantaneous (UEF) (electric only).

Additional tank types are allowed only for existing water heaters. They are small or large storage and small or large instantaneous.

USER TIP: The rated input of a water heater is used to determine which tank type to model (see Table 9-1 or Table 9-2). However, the CF1R reports the maximum rated input for that tank type, but typically no specific input value (the exception is “commercial storage”). This change was made to prevent inconsistencies between the value modeled and the value installed for a characteristic that makes no difference.

9.6.1 Consumer Instantaneous

Figure 9-7: Consumer Instantaneous Water Heater Data (gas)

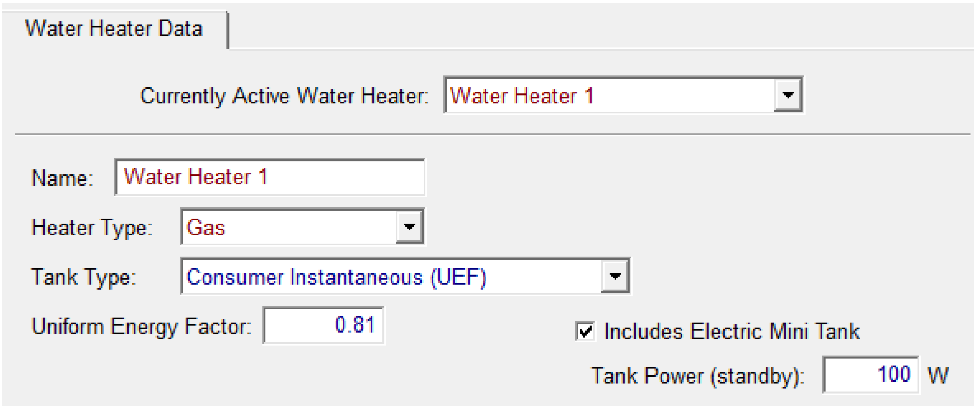
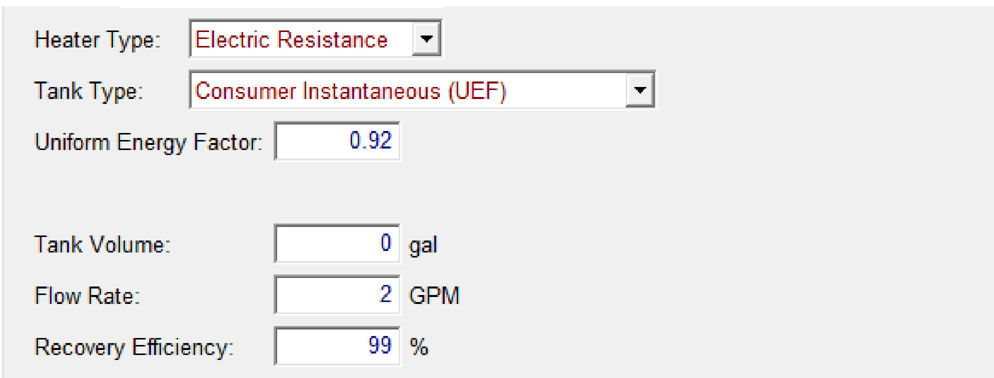


Figure 9-8: Consumer Instantaneous Water Heater Data (electric)



9.6.1.1 Name

User-defined name that is specified in the water heating system data.

9.6.1.2 Heater Type

Choose gas (natural gas, propane, or oil), or electric resistance (for heat pump water heater see Section 9.7).

9.6.1.3 Tank Type

Choose consumer instantaneous (UEF).

9.6.1.4 Uniform Energy Factor (UEF)

Value entered as a decimal, such as 0.81. Certified efficiency from one of the sources listed in Section 9.2. Once the tank type is selected, the input values are customized to that category.

9.6.1.5 Includes Electric Mini Tank

For instantaneous water heaters, check if the system includes a mini tank which helps regulate temperature fluctuations.

9.6.1.6 Tank Power (standby)

Mini tank watts from the CEC's appliance directories (see Section 9.2).

9.6.1.7 Tank Volume

The volume (in gallons) from one of the listed sources in Section 9.2.

9.6.1.8 Flow Rate

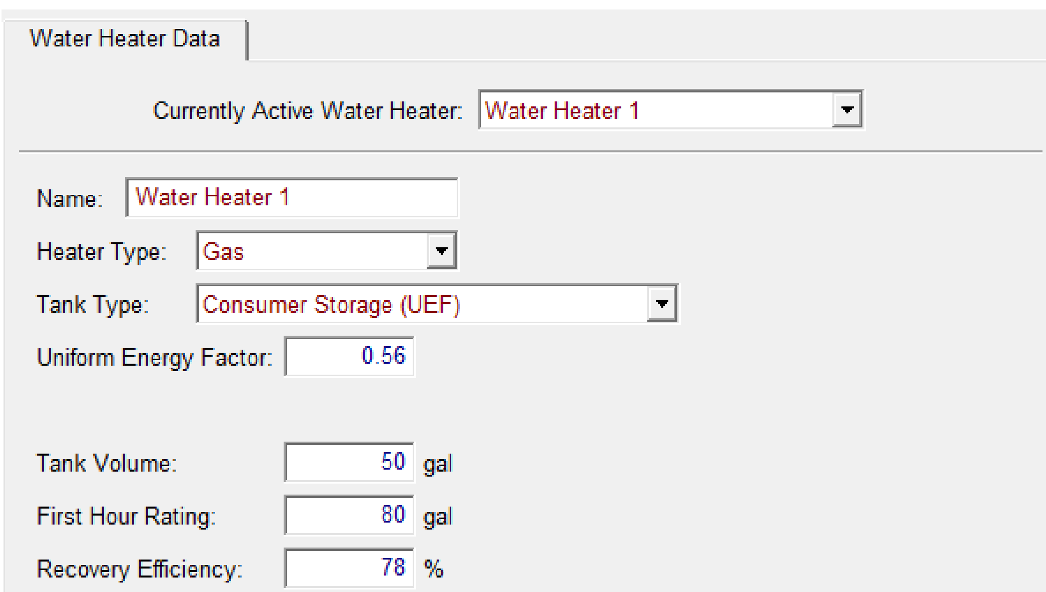
The flow rate in gallons per minute (GPM) from one of the listed sources in Section 9.2.

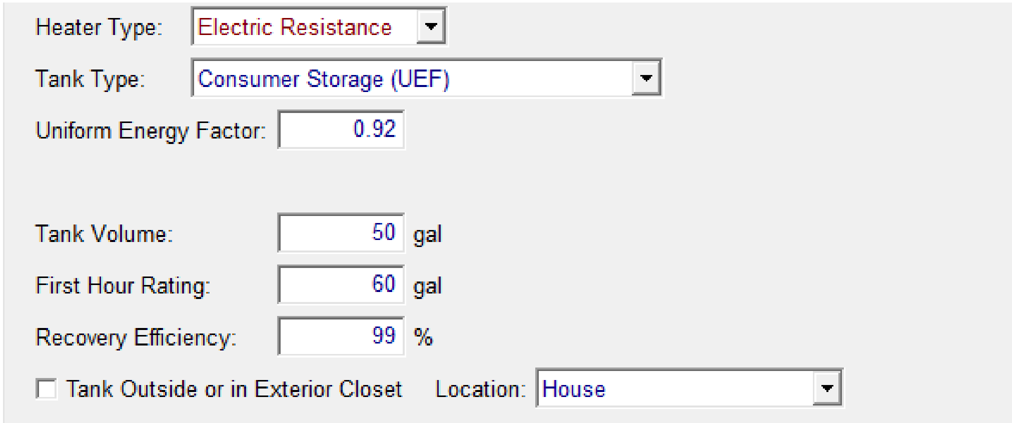
9.6.1.9 Recovery Efficiency

Enter the recovery efficiency (or thermal efficiency or AFUE) for water heating type. Entered as a percent, such as 80 or 95. The value comes from one of the listed sources in Section 9.2.

9.6.2 Consumer Storage

Figure 9-9: Consumer Storage (gas or electric)





9.6.2.1 Name

User-defined name that is specified in the water heating system data.

9.6.2.2 Heater Type

Choose gas (natural gas, propane, or oil), or electric resistance (for heat pump water heater see Section 9.7).

9.6.2.3 Tank Type

Choose consumer storage (UEF).

9.6.2.4 Uniform Energy Factor (UEF)

Value entered as a decimal, such as 0.81. Certified efficiency from one of the sources listed in Section 9.2.

9.6.2.5 Tank Volume

The volume (in gallons) from one of the listed sources in Section 9.2.

9.6.2.6 First Hour Rating

The first hour rating (in gallons) from one of the listed sources in Section 9.2.

9.6.2.7 Recovery Efficiency

Enter the recovery efficiency as a percent, such as 79 or 81. The value comes from one of the listed sources in Section 9.2.

9.6.2.8 Tank Outside or in Exterior Closet / Location

For electric resistance water heaters, indicate if the tank is outside, or its location in the building.

9.6.3 Residential-Duty Commercial

To find products, the CEC's appliance directory allows a search of the category "residential-duty commercial water heaters" which contains both gas storage products and electric instantaneous.

Figure 9-10: Residential Duty Commercial Storage (gas)

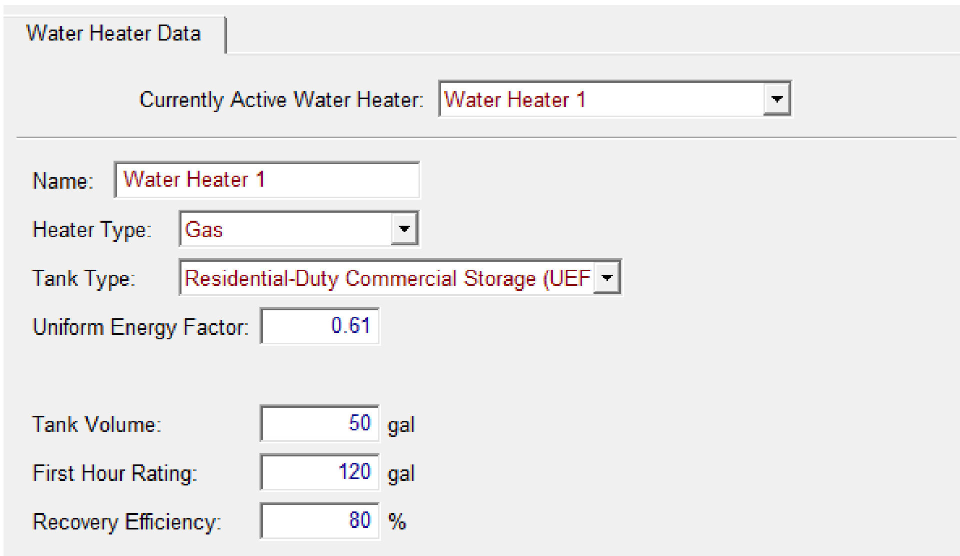
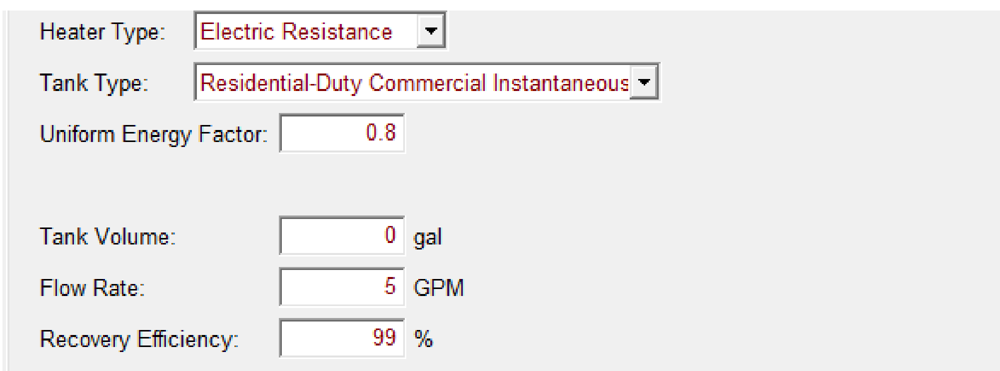


Figure 9-11: Residential Duty Commercial Instantaneous (electric)



9.6.3.1 Name

User-defined name that is specified in the water heating system data.

9.6.3.2 Heater Type

Choose gas (natural gas, propane, or oil), or electric resistance (for heat pump water heater see Section 9.7).

9.6.3.3 Tank Type

Choose residential duty commercial storage (UEF) (gas only) or residential duty commercial instantaneous (UEF) (electric only).

9.6.3.4 Uniform Energy Factor (UEF)

Value entered as a decimal, such as 0.81. Certified efficiency from one of the sources listed in Section 9.2.

9.6.3.5 Tank Volume

The volume (in gallons) from one of the listed sources in Section 9.2.

9.6.3.6 First Hour Rating

For storage water heaters, the first hour rating (in gallons) from one of the listed sources in Section 9.2.

9.6.3.7 Flow Rate

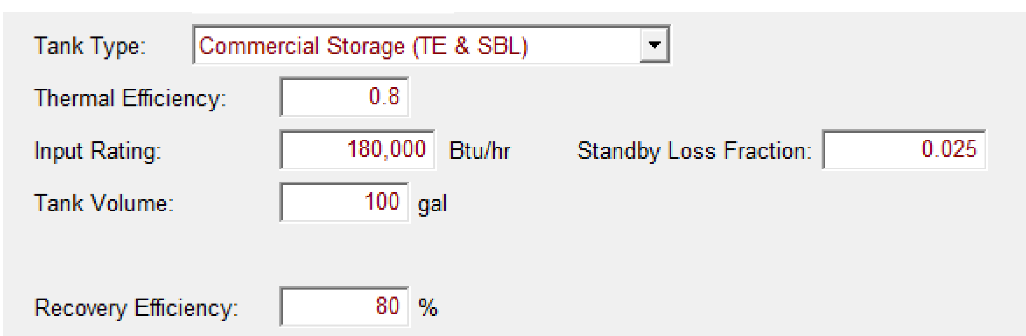
For instantaneous water heaters, the flow rate in gallons per minute (GPM) from one of the listed sources in Section 9.2.

9.6.3.8 Recovery Efficiency

Enter the recovery efficiency (or thermal efficiency or AFUE) for water heating type. Entered as a percent, such as 80 or 95. The value comes from one of the listed sources in Section 9.2.

9.6.4 Commercial Storage

Figure 9-12: Commercial Storage Water Heater Data



9.6.4.1 Name

User-defined name that is specified in the water heating system data.

9.6.4.2 Heater Type

Choose gas (natural gas, propane, or oil) or electric resistance (for heat pump water heaters see Section 9.7.

9.6.4.3 Tank Type

Choose commercial storage (TE & SBL).

9.6.4.4 Thermal Efficiency

Value entered as a decimal, such as 0.76 or 0.81. Certified efficiency from one of the sources listed in Section 9.2.

9.6.4.5 Input Rating

The input rating (consistent with the tank type from Table 9-1 or Table 9-2) from one of the listed sources from Section 9.2.

9.6.4.6 Tank Volume

The volume (in gallons) from one of the listed sources in Section 9.2.

9.6.4.7 Recovery Efficiency

Enter the recovery efficiency (or thermal efficiency or AFUE) for water heating type. Entered as a percent, such as 80 or 95. The value comes from one of the listed sources in Section 9.2.

9.6.4.8 Standby Loss Fraction

Required input for large storage water heaters. Find the standby loss by conducting an advanced search in the CEC's appliance efficiency database of water heating equipment (see Section 9.2). The input into the software depends on what is available for the specified equipment based on the search as follows:

For large storage water heaters where the standby loss is reported in percent per hour, the standby loss fraction is calculated by dividing the percent by 100 (3% is entered as 0.03).

For large storage water heaters where the standby loss is reported in Btu/hr, the standby loss fraction is calculated as:

Standby Loss Fraction = (standby loss Btu/hr) / (8.25 x volume x 70)

For gas and oil large storage water heaters that do not have a reported standby loss, the standby loss fraction is calculated as:

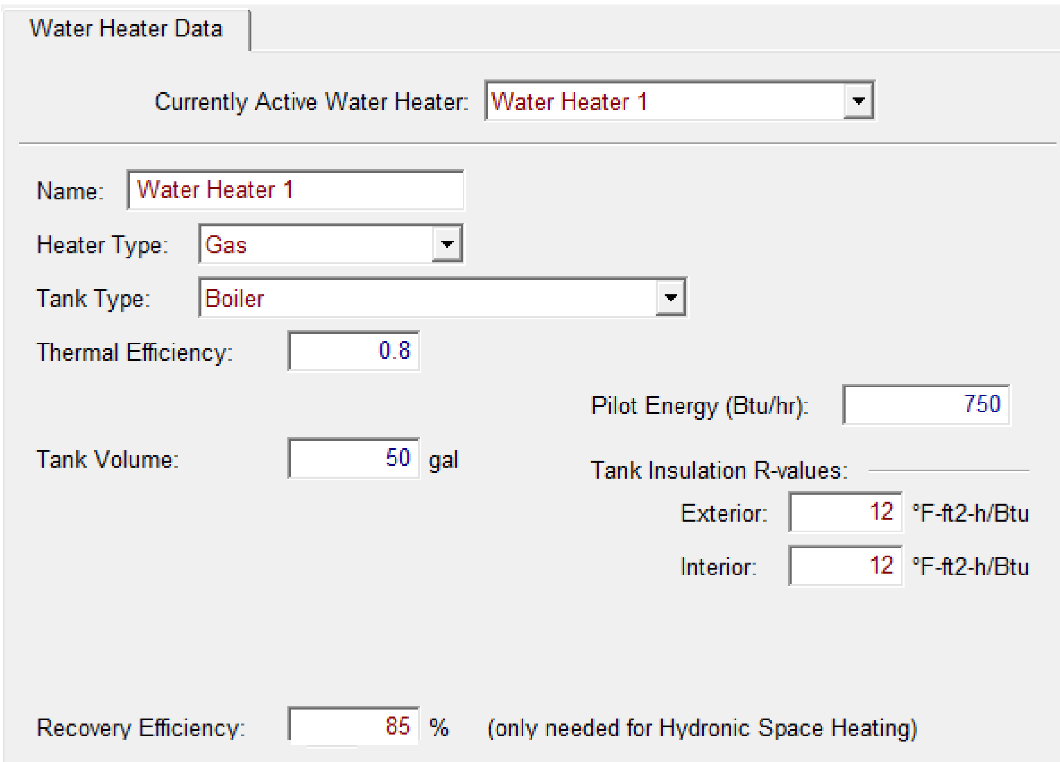
Standby Loss Fraction = (rated input / 800) + (110 x (volume)^0.5) / (8.25 x Volume x 70)

For electric large storage water heaters that do not have a reported standby loss, the standby loss fraction is calculated as:

Standby Loss Fraction = (0.3 + (27/volume)) / 100

9.6.5 Boiler

Figure 9-13: Boiler



9.6.5.1 Name

User-defined name that is specified in the water heating system data.

9.6.5.2 Heater Type

Choose gas (natural gas, propane, or oil).

9.6.5.3 Tank Type

Choose boiler.

9.6.5.4 Thermal Efficiency

Value entered as a decimal, such as 0.76 or 0.81. Certified efficiency from one of the sources listed in Section 9.2.

9.6.5.5 Tank Volume

The volume (in gallons) from one of the listed sources in Section 9.2.

9.6.5.6 Recovery Efficiency

Enter the recovery efficiency (or thermal efficiency or AFUE) for water heating type. Entered as a percent, such as 80 or 95. The value comes from one of the listed sources in Section 9.2.

9.6.5.7 Pilot Energy

Required input for boiler, large instantaneous and indirect water heaters. Find the pilot energy by conducting an advanced search in the CEC's appliance efficiency database (see Section 9.2) or in manufacturer's literature.

The value input may need to be modified. If pilot energy is in Btu/hr, model that value. If pilot energy is in percent, convert as:

Pilot energy = ((pilot energy percent) / 100) x (8.25 x Volume x 70) Btu/hr

If no pilot energy information is found, calculate the value using the applicable equation as described in Table 9-5 (based on Table F-4 of the *Appliance Efficiency Regulations)*.

For electric powered water heaters, where Table F-2 reports the maximum standby loss as a percent, convert to Btu/hr using the following calculation:

Pilot energy = ((0.3 + (27/Volume)) / 100) x (8.25 x Volume x 70) Btu/hr

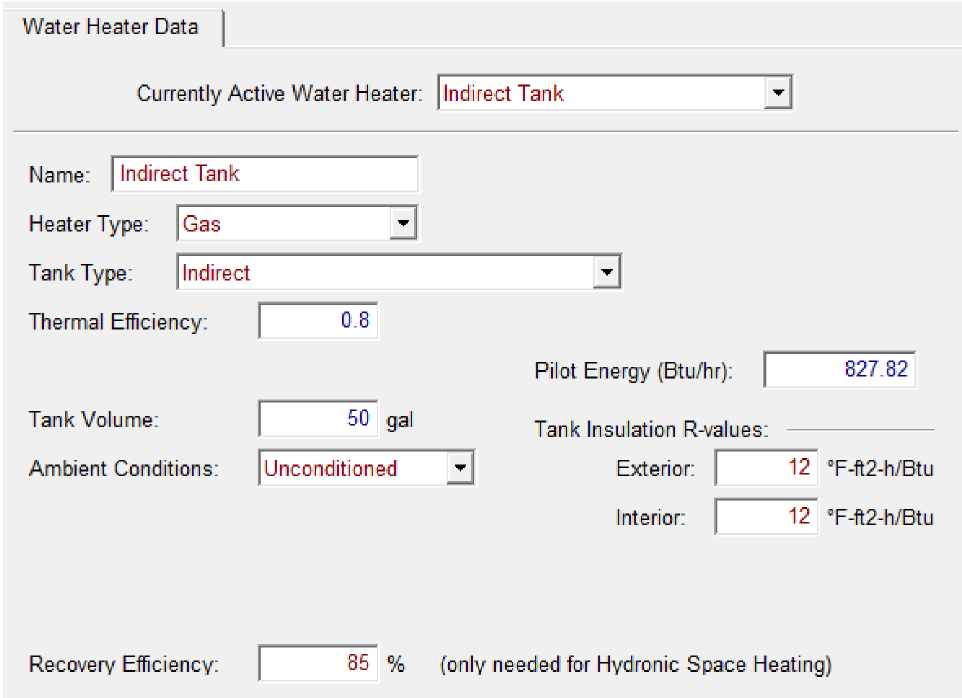
9.6.5.8 Tank Insulation R-values

For boilers (and indirect water heaters), enter exterior and interior tank insulation R-values.

9.6.6 Indirect or unfired tanks

Efficiency and performance information for indirect tanks comes from the device which is heating the water for which the indirect tank is serving as storage.

Figure 9-14: Indirect (unfired)



9.6.6.1 Name

User-defined name that is specified in the water heating system data.

9.6.6.2 Heater Type

Choose gas (natural gas or propane).

9.6.6.3 Tank Type

Choose indirect.

9.6.6.4 Thermal Efficiency

Value entered as a decimal, such as 0.76 or 0.81. Certified efficiency from one of the sources listed in Section 9.2.

9.6.6.5 Tank Volume

The volume (in gallons) from one of the listed sources in Section 9.2.

9.6.6.6 Ambient Conditions

For an indirect water heater, specify whether it is installed in unconditioned or conditioned space.

9.6.6.7 Recovery Efficiency

Enter the recovery efficiency (or thermal efficiency or AFUE) for water heating type. Entered as a percent, such as 80 or 95. The value comes from one of the listed sources in Section 9.2.

9.6.6.8 Pilot Energy

Required input for indirect water heaters. See also Section 9.6.5.7.

9.6.6.9 Tank Insulation R-values

For boilers, or indirect water heaters, enter exterior and interior tank insulation R-values.

Table 9-4: Pilot Energy Calculation

Appliance	Input to Volume Ratio	Size (Volume)	Maximum Standby Loss [1,2]
Gas storage water heater	< 4,000 Btu/hr/gal	Any	$Q/800 + 110(V_r)^{1/2}$Btu/hr
Gas instantaneous water heaters	≥ 4,000 Btu/hr/gal	< 10 gal	--
		≥ 10 gal	$Q/800 + 110(V_r)^{1/2}$Btu/hr
Gas hot water supply boilers	≥ 4,000 Btu/hr/gal	< 10 gal	--
		≥ 10 gal	$Q/800 + 110(V_r)^{1/2}$Btu/hr
Oil storage water heaters	< 4,000 Btu/hr/gal	< 10 gal	--
		≥ 10 gal	$Q/800 + 110(V_r)^{1/2}$Btu/hr
Oil instantaneous water heaters	≥ 4,000 Btu/hr/gal	< 10 gal	--
		≥ 10 gal	$Q/800 + 110(V_r)^{1/2}$Btu/hr
Oil hot water supply boilers	≥ 4,000 Btu/hr/gal	< 10 gal	--
		≥ 10 gal	$Q/800 + 110(V_r)^{1/2}$Btu/hr
Electric storage water heaters	< 4,000 Btu/hr/gal	Any	$0.3 + 27/V_m$%/hr

[1] V_r is rated volume in gallons, V_m is measured volume in gallons, and Q is the nameplate input rate in Btu/hr.

[2] Water heaters and boilers > 140 gallons of storage capacity are not required to meet the standby loss requirement if the tank surface is thermally insulated to R-12.5, if a standing pilot light is not installed, and for gas- or oil-fired storage water heaters, there is a flue damper or fan-assisted combustion.

9.7 Individual Heat Pump Water Heater Data

Heat pump water heaters (HPWH) are a viable option for electric water heating, unlike electric resistance for which is very difficult to overcome the negative effect on water heating compliance. When an electric resistance or HPWH is modeled, the standard design is a HPWH (see §150.1(c)8Av of the Energy Code for the full list of criteria which varies by climate zone).

CBECC-Res includes two options for modeling heat pump water heaters. A UEF or Non-UEF rated heat pump certified to the CEC or AHRI (Figure 9-15), or products rated by the Northwest Energy Efficiency Alliance (NEEA) (Figure 9-16). CBECC-Res uses a different calculation method to simulate the NEEA water heaters which includes benefits beyond their UEF rating. Equipment is rated from Tier 1 to Tier 4 (higher equals better). To model NEEA rated equipment, find a brand and model number from the list of qualified products (see Section 9.2), check the NEEA rated box and select the brand and model.

NOTE: For NEEA water heaters, the installer will either confirm the model number shown on the CF1R is installed or select from a list of products previously determined to be equivalent.

Figure 9-15: Generic Heat Pump Water Heater

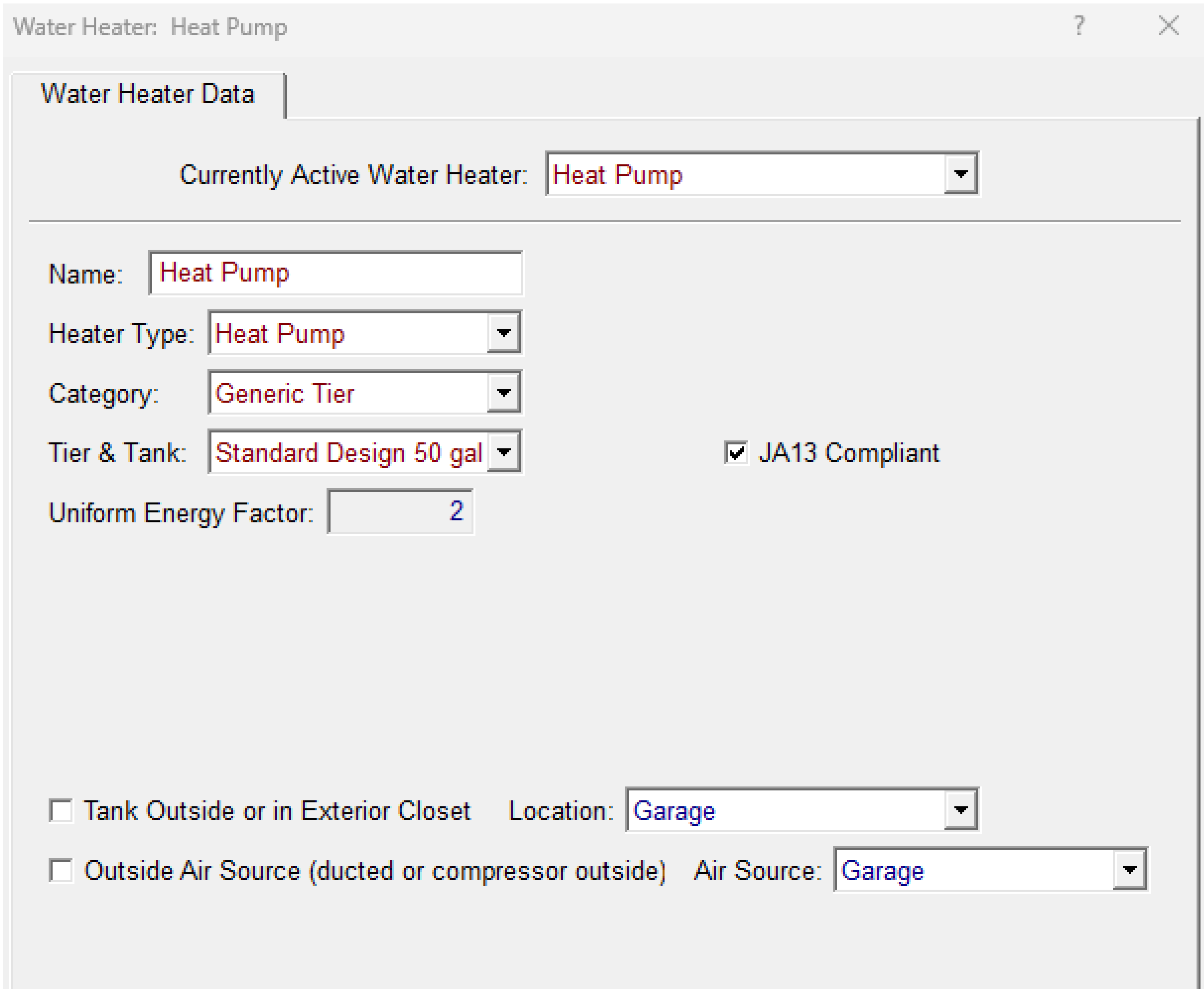
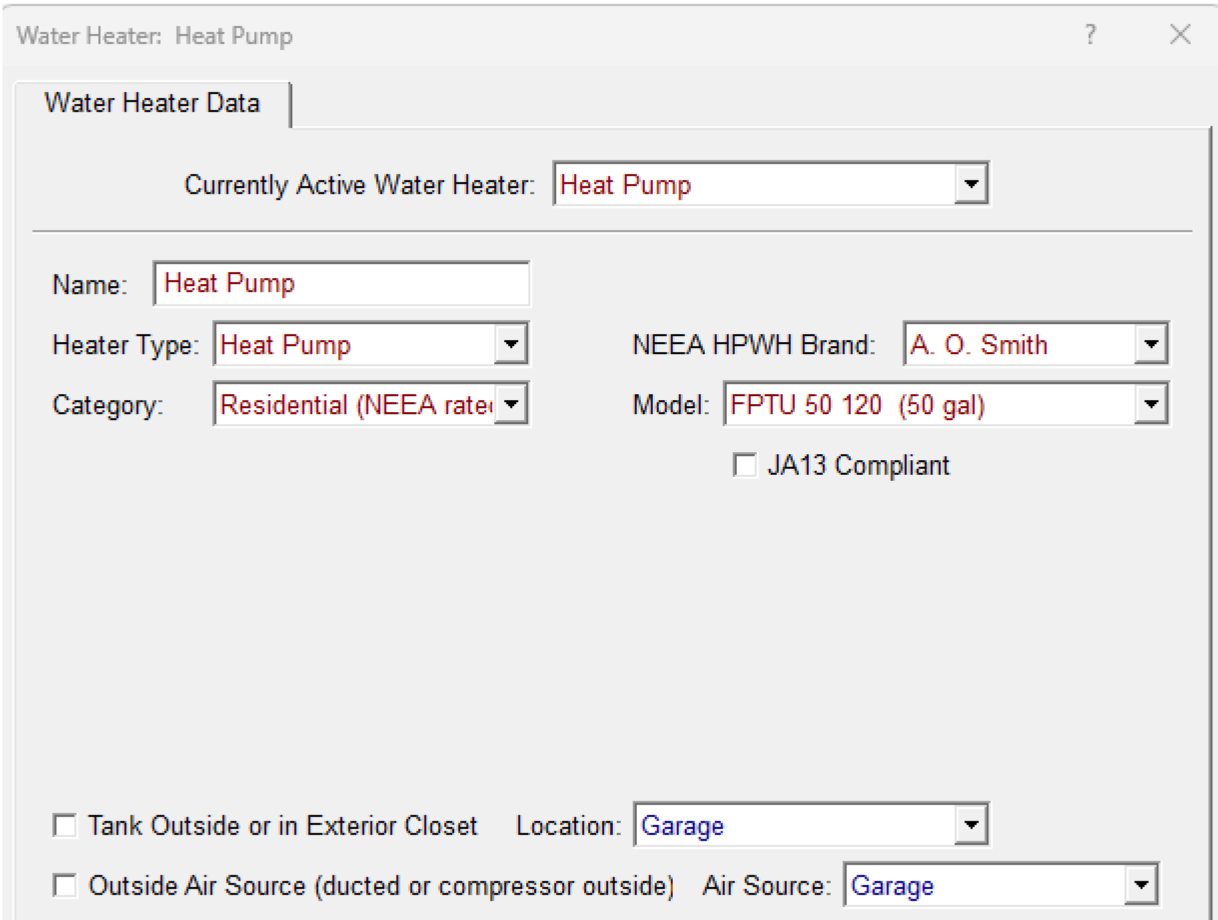


Figure 9-16: NEEA Rated Heat Pump Water Heater



9.7.1 Name

User-defined name for the water heater.

9.7.2 Heater Type

Choose heat pump. For electric resistance or gas see Section 9.7.

9.7.3 Category

Select whether the heat pump water heater is rated by the Northwest Energy Efficiency Alliance (NEEA) (Residential (NEEA rated)), UEF rated, Non-UEF rated, or a commercial HPWH product.

9.7.4 NEEA HPWH Brand and Model

Select from the list of water heaters brands and model numbers.

9.7.5 Energy Factor (EF) or Uniform Energy Factor (UEF)

Unless NEEA rated, enter the certified EF or UEF, such as 2.33, from one of the sources listed in Section 9-1.

9.7.6 Tank Volume

The volume (in gallons) from one of the sources listed in Section 9-1.

9.7.7 First Hour Rating

The first hour rating (in gallons) for the specified water heater.

9.7.8 Tank Outside or in Exterior Closet / Location

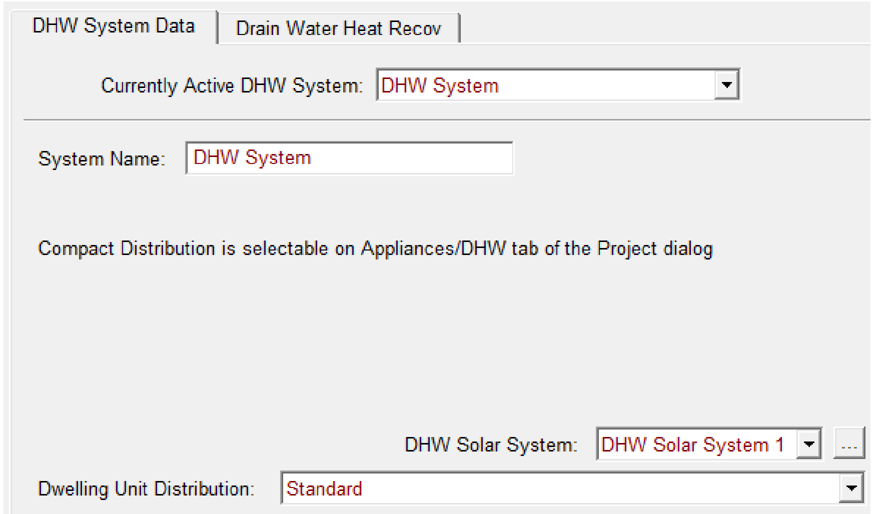
For heat pump and electric resistance water heaters only, indicate if the tank is located outside, or specify the location in the building.

9.7.9 JA13 Compliant

9.8 Solar Water Heating Data

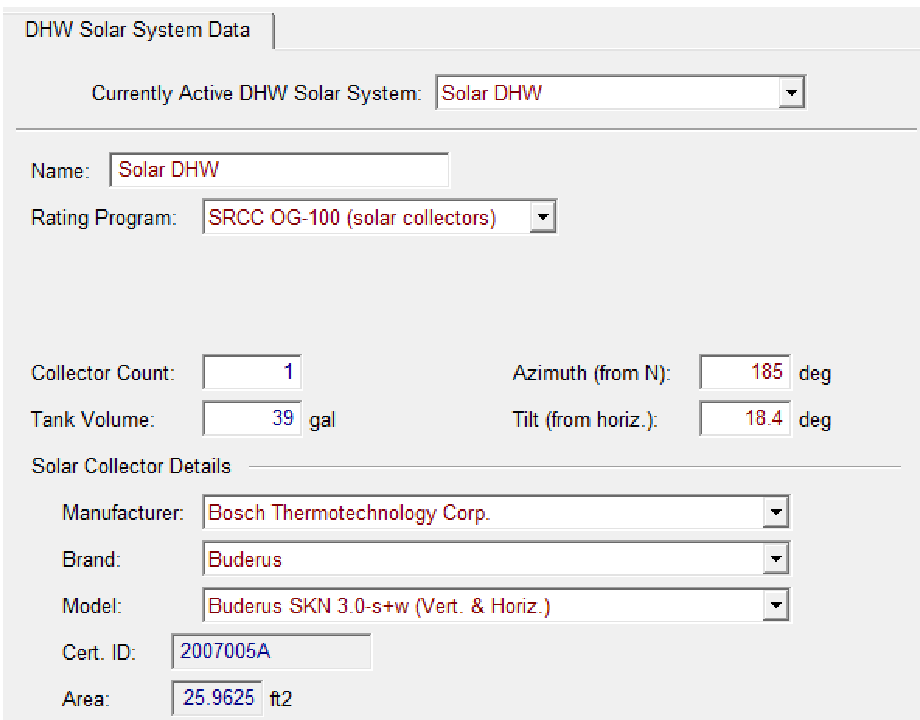
When credit for a solar water heating system is specified, the specifics about the system are modeled on the DHW Solar System Data tab. CBECC-Res can model either OG-100 or OG-300 systems (rated by the Solar Rating and Certification Corporation (SRCC)). Click on the ". . ." to define the system.

Figure 9-22: Solar Data



9.8.1 Solar Water Heating Data (OG-100)

Figure 9-23: Solar Collector Details (SRCC OG-100)



9.8.1.1 Rating Program

SRCC OG-100 (solar collectors).

9.8.1.2 Collector Count

Enter a value of 1 or greater.

9.8.1.3 Tank Volume

Rated systems include this value as part of the solar collector details. Once the solar collector is identified, this value will be completed. If there is no value, right-click and pick restore default.

9.8.1.4 Azimuth (from N)

Enter the azimuth (in degrees from North) of the solar collector panel(s).

9.8.1.5 Tilt (from horizontal)

Enter the roof or solar collector panel tilt. Typical values of various roof pitches are:

1:12 = 4.8	5:12 = 22.6
2:12 = 9.5	6:12 = 26.6
3:12 = 14	7:12 = 30.3
4:12 = 18.4	8:12 = 33.7

9.8.1.6 Manufacturer

Select from the list of approved manufacturers.

9.8.1.7 Brand

Select from the list of approved brands for the specific manufacturer.

9.8.1.8 Model

Select the model number of the Solar Rating and Certification Corporation (SRCC) certified collector. The SRCC certification number and collector area are automatically entered.

9.8.1.9 Cert. ID

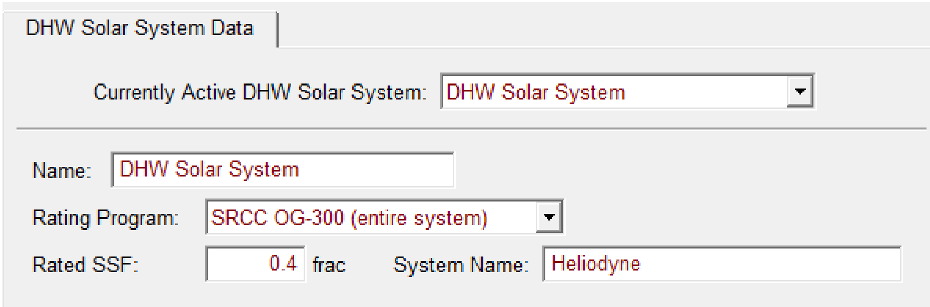
Certification ID is automatically completed for certified systems.

9.8.1.10 Area

Area is automatically completed for certified systems

9.8.2 Solar Water Heating Data (SRCC OG-300)

Figure 9-24: Solar System (OG-300)



9.8.2.1 Rating Program

SRCC OG-300 (entire system).

9.8.2.2 Rated SSF

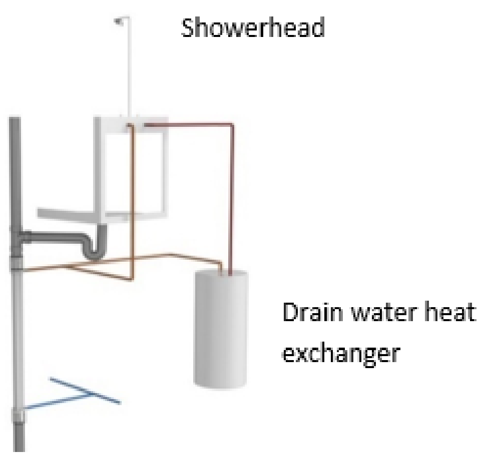
Rated solar savings fraction (SSF) for the proposed or installed system.

9.8.2.3 System Name

This user-defined field is reported on the CF1R. Include any specific identifying information.

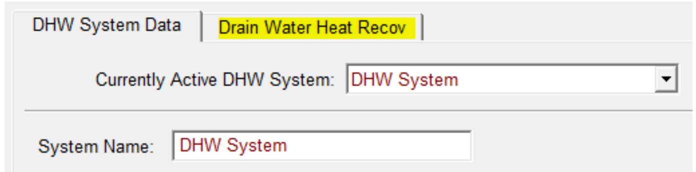
9.9 Drain Water Heat Recovery

Figure 9-25: Drain Water Heat Recovery (Equal)



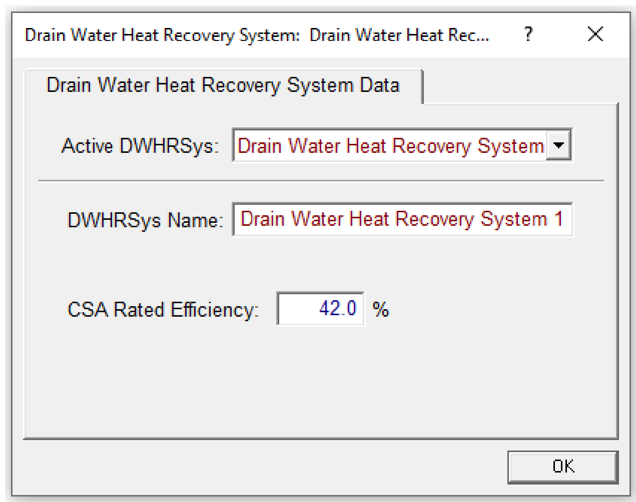
A drain water heat recovery (DWHR) device takes waste heat from shower drains and uses that water to preheat the cold inlet water. The preheated water is routed to the shower, water heater, or both.

Figure 9-26: Drain Water Heat Recovery Details



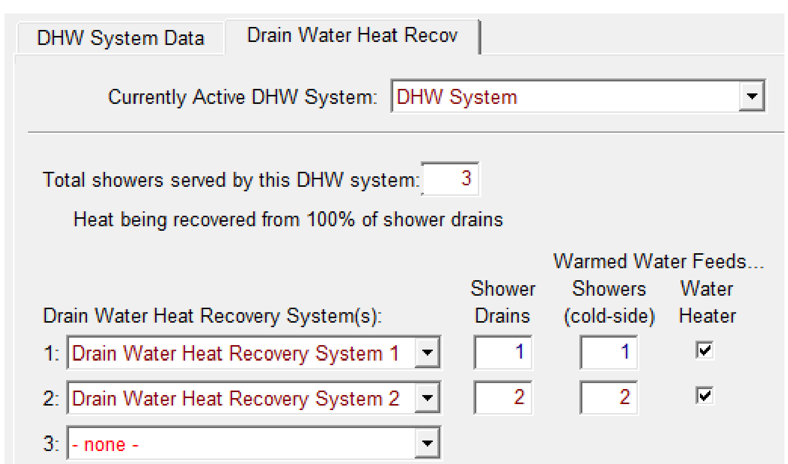
Access the tab for drain water heat recovery. Specify the Canadian Standards Association (CSA) rated effectiveness, obtained from manufacturer’s literature. The required value is 42 percent or higher.

Figure 9-27: Drain Water Heat Recovery System Data



As shown in Figure 9-28, the user indicates the number of showers and baths served by a drain water heat recovery device. Multiple DWHR devices can be used for a water heater system if there is more than one shower served. Enter the total number of showers that are served by a drain water heat recovery system and enter the details for the system configuration.

Figure 9-28: Drain Water Heat Recovery Configurations



The configuration choices include:

- **Equal Flow:** Showers (cold-side feed) value is greater than 0, and water heater checked. This configuration indicates the potable-side output of the heat exchanger feeds the shower cold water inlet(s) and the water heater inlet. Equal flow indicates the potable and drain flow rates are equal assuming no other simultaneous hot water draws. This scheme recovers more heat than the other configurations.

- **Unequal flow to shower:** Showers (cold-side feed) value is greater than 0 and water heater is not checked. This configuration indicates the potable-side output of the heat exchanger feeds only the shower cold water inlet(s). All pipe runs are local to the shower(s).

- **Unequal flow to water heater:** Showers (cold-side feed) is 0 and water heater is checked. This configuration indicates the potable-side output of the heat exchanger feeds the water heater inlet.

Specify the DHWR device for the water heating system and showers. ECC verification is required to meet the criteria, which comes from *Reference Appendices,* Residential Appendix RA3.6.9.

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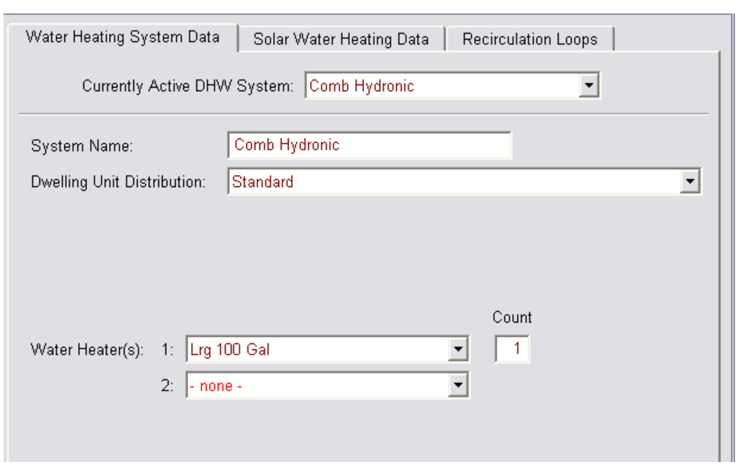
9.10 Combined Hydronic

A combined hydronic system uses a device such as a boiler, large storage, or instantaneous water heater to provide both space heating and water heating. Heat pumps are currently not allowed as the heating source for a combined hydronic system. For the space heating system inputs, see Section 8.3.5. See Figure 8-7 for the proper way to model the water heating portion of a combined hydronic system.

Figure 9-29: Combined Hydronic



To receive the full credit for a combined hydronic system, rather than leaving the water heating field as "none," list the same device providing the space heating as the water heating system (for example, large storage 100 gallon water heater).

9.11 Ground Source and Air-to-Water Heat Pumps

The water heating portion of a ground source heat pump or air-to-water heat pump is modeled by first defining the HVAC system, as described in Section 8.2.3 and checking the box "System Heats DHW" or domestic hot water.

The inputs for the water heating equipment data are:

9.11.1 Storage Tank Volume

Enter the tank volume (in gallons).

9.11.2 Insulation R-value

R-value of interior and/or exterior tank insulation.

9.11.3 Ambient Conditions

Specify whether installed in unconditioned or conditioned space.

NOTE: The final step is to connect the HVAC system to the DHW system. In this example, an HVAC system named Ground Source HP was specified and can be selected to serve as the water heating system for the zone. Once this connection is made, the **Mechanical** tab will look like Figure 9-.

Figure 9-30: Water Heater from an HVAC System

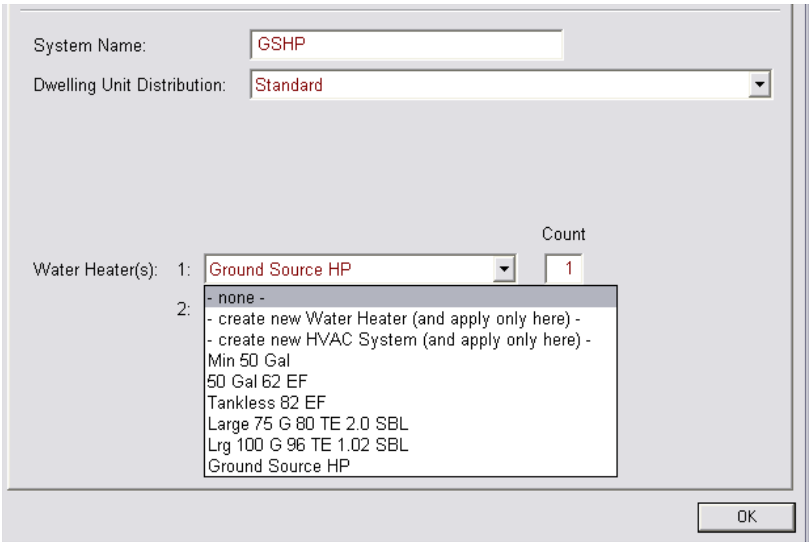
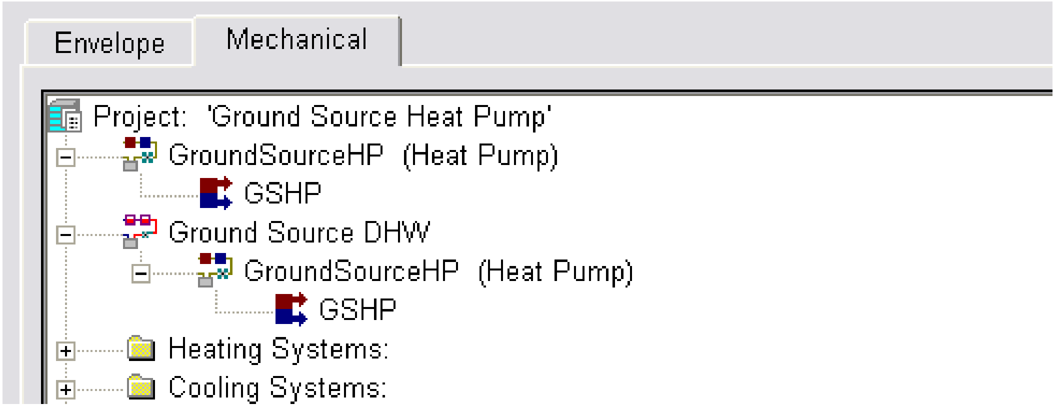


Figure 9-31: Water Heating Correctly Connected to HVAC



10 Additions and Alterations

10.1 Overview

Additions are very complex. It can take years to know which approach is most suitable for the specific project for which you are preparing compliance documentation. If you are the homeowner, picking the wrong compliance approach could cost you more in construction costs than hiring a good consultant. If you are a consultant, you need to know the differences between prescriptive, performance addition alone, and performance existing plus addition plus alteration. Every job is unique and usually one approach is better suited to a job. Before modeling a project, become familiar with the limits of a given approach. It is highly recommended that before beginning a project, you read §150.2(a)1 of the Energy Code, and possibly this chapter, and determine if performance compliance (modeling the building) is the best option. Appropriate questions are: What is the climate zone? How big is the addition? Are there plans for alterations to the existing house? What prescriptive requirements could be a problem?

NOTE: Converting unconditioned space into living space is treated as an addition.

10.1.1 Prescriptive

Prescriptive compliance allows more glazing area and has exceptions based on the size of a project that can often make it a better fit if you are considering modeling the addition alone. Compliance documents for the prescriptive approach (if no ECC requirements apply) can be found at the CEC's website for alterations and additions non-ECC verified forms. If ECC requirements apply, complete the compliance documents at the ECC provider's website .

10.1.2 Performance, Addition Alone

While addition alone may be easier to model, it is the most difficult to get to comply. Unlike existing plus addition plus alteration performance compliance, most of the exceptions for prescriptive compliance do not apply to addition alone. Compliance requirements are nearly identical to new construction.

As required by §150.2(a)2A of the Energy Code, an addition alone generally meets the same requirements as new construction (hint: the run scope is "newly constructed", and you check "addition alone"). The only exceptions are (from §150.2(a) of the Energy Code):

(1) Continuous insulation for wall extensions (see Section 10.7.2) and existing walls where siding is not removed (see Section 10.7.1) [**NOTE:** A previous *Blueprint* allowed these exceptions for any addition, regardless of compliance approach].

(2) Cool roof requirements (if any) when the addition is 300 ft^2 or less.
(3) QII requirements if addition is 700 ft^2 or less.
(4) Whole house fan requirements (if any) for an addition that is 1,000 ft^2 or less.
(5) Indoor air quality requirements for an addition that is not a new dwelling unit or for an addition that is 1,000 ft^2 or less. (If an addition increases the number of dwelling units, such as an accessory dwelling unit (ADU), IAQ compliance applies to the addition, regardless of size.
(6) PV requirements.

10.1.3 Performance, Existing Plus Addition Plus Alteration (E+A+A)

This compliance approach requires modeling the existing building. There is no penalty for the existing building that might have no insulation, or old windows. The status of existing ensures you are not penalized for existing building features. However, if you are converting an unconditioned space into conditioned space, this space is considered an addition and all surfaces in the addition are treated as new. Without violating any mandatory minimum requirements, you can keep the old characteristics if you can still comply. For example, if you have one unique single pane window you do not wish to change, if you can still manage comply you can keep that single pane window.

Compliance tips:

- Removed/deleted surfaces are not modeled.
- When altering a feature, the existing characteristics are not specified unless using verified existing conditions (see Section 10.8.1) which requires verification by a ECC rater before obtaining a permit.
- Pay careful attention to the status. “New” means it did not previously exist, and “altered” means it is being replaced. This is extremely important for windows and water heating, and less important for HVAC equipment (the same requirements apply in either case for HVAC equipment).
- Use one of the example files – addition alone is AAExample . . . or existing plus addition plus alteration is EAAExample . . .
- Change the name of the file, modify it to fit your project.

Prescriptive exceptions that apply (see §150.2(a)2B of the Energy Code) when using existing plus addition are listed in §150.2(a)1:

- Attic roof deck insulation (a requirement in Climate Zones 4, 8-16) is not required for additions ≤ 700 ft^2,
- Higher glazing allowances (up to 30 percent depending on size),
- Exception to QII for additions ≤ 700 ft^2.

They only apply when using the existing plus addition compliance approach.

10.2 Accessory Dwelling Units (ADU)

Sample files include for several options for modeling an ADU:

- ADU as an addition alone (ADUExample4AdditionAlone)
- ADU as an existing plus addition (EAAExample4ADU)
- An ADU as well as an addition (EAAExample4LrgAddADU)

10.2.1 Scope

ADUs are secondary dwelling units built on residential lots. The exceptions to continuous insulation for additions (discussed in detail in Section 10.7) often apply to ADUs, so the CEC provided guidance for determining the scope of an ADU construction project.

- Addition:
  - Converting an existing structure that is attached to the existing dwelling unit
  - Converting an existing structure that is detached from the existing dwelling
  - Constructing an addition or ADU that is attached to the existing dwelling
- Newly constructed (not an addition)
  - Constructing an ADU that is detached from the existing dwelling unit

The exceptions to continuous insulation apply to wood-framed walls in an addition. See Section 10.7.

10.2.2 IAQ

If complying as an addition, see Chapter 4 for where relevant details are entered. All ADUs must comply with the indoor air quality requirements of §150.0(o) of the Energy Code. Projects complying as an addition alone provide information that is used to determine the minimum CFM requirements, if any.

NOTE: The existing square footage and bedrooms required for addition alone projects are not relevant to an ADU which is always required to meet IAQ requirements. The information is needed to determine the minimum CFM requirements when an addition exceeds 1,000 ft^2. Even so, the entries should reflect the square footage and bedrooms of the existing dwelling unit which can be found by a simple web search of the property description.

Figure 10-1: ADU Compliance

Converting an existing space	 **Addition** –Attached to existing home (walls may qualify as “existing walls with siding” – Section 10.7.1)	 **Addition** - Detached from existing home (walls may qualify as “existing walls with siding” – Section 10.7.1)
Newly constructed	 **Addition** – Attached to existing home (some walls may meet criteria for an “extension” – Section 10.7.2)	 **New Construction** – Detached from existing home (none of the provisions for additions apply and it is not identified as an ADU for compliance)

10.3 Addition Alone

10.3.1 Overview

Addition alone is the most stringent compliance approach. Compliance requirements are virtually the same as new construction. The only exceptions that apply to all additions are found in §150.2(a) of the Energy Code:

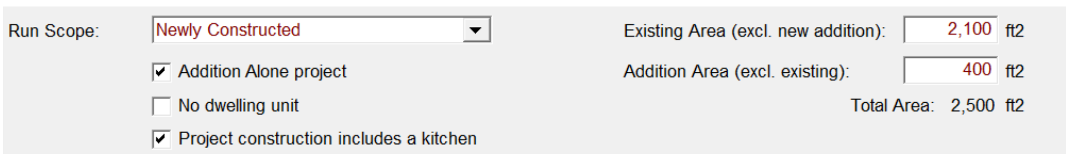
- IAQ (other than for ADUs) only applies when the addition is greater than 1,000 ft^2.
- Whole house fan (where applicable) is only included in the standard design when the addition is greater than 1,000 ft^2.
- Cool roof (where applicable) is included in the standard design for additions greater than 300 ft^2.
- PV requirements.
- Wall exceptions: 2x4 walls need only R-15, and 2x6 walls need R-21 (2025 Energy Code requirement) allowed for existing walls with siding not removed, and wall extensions are allowed in any addition by *Blueprint* No. 122.

The exceptions that do not apply to existing plus addition plus alteration, and not addition alone, are roof deck insulation, more generous glazing percentages, and no QII until > 700 ft^2. See §150.2(a)2A of the Energy Code.

10.3.2 Specifying Addition Alone

To model an addition alone, (1) set the run scope to Newly Constructed, (2) check the box for Addition Alone, (3) check the box to indicate if the addition includes a kitchen, (4) enter the floor area of the existing house, and (5) enter the floor area of the addition (see Figure 10-2).

Figure 10-2: Addition Alone



The total area includes the existing so that it represents the conditioned floor area after the addition is constructed (if you have already created the zone, you can use the program's default function to capture the existing floor area). The reason for the existing square footage is so the internal gains (from mass, cooking, people) are accounted for properly (80 ft^2 within 3,000 ft^2 is quite different than 400 ft^2 within 1,400 ft^2).

If existing HVAC equipment will serve an addition, follow the guidelines in Section 10.6 for setting the status flag of both the equipment and ducts.

All interior surfaces have an option that allows checking "is a party surface" meaning the conditioned zone on the other side of the surface is not being modeled.

10.4 Existing Plus Addition Plus Alteration

For existing plus addition plus alteration compliance, the standard design is based on sometimes modified prescriptive requirements as follows:

10.4.1 Attics/roofs

For additions of 700 ft^2 or less, the attic standard design assumes R-30 or R-38 ceiling insulation depending on the climate zone. Radiant barrier requirements for this size addition are based on prescriptive requirements for high performance attic option C. For additions greater than 700 ft^2, the standard design is based on prescriptive requirements, high performance attic option B (see Section 1.14.8 for more details).

10.4.2 Walls

The 2025 standard design wall in all additions is the same as the new construction prescriptive requirement. See Section 10.7 for the exceptions.

10.5 Existing Building

If the existing building will be modeled as part of an existing plus addition plus alteration analysis, model the entire existing building. The user has the option of specifying the status of a component as existing, altered, or new. Deleted or removed surfaces are not modeled. Section 10.6 below contains guidance for determining if a feature is altered or new.

The zone status is always existing, even if features of the zone are altered.

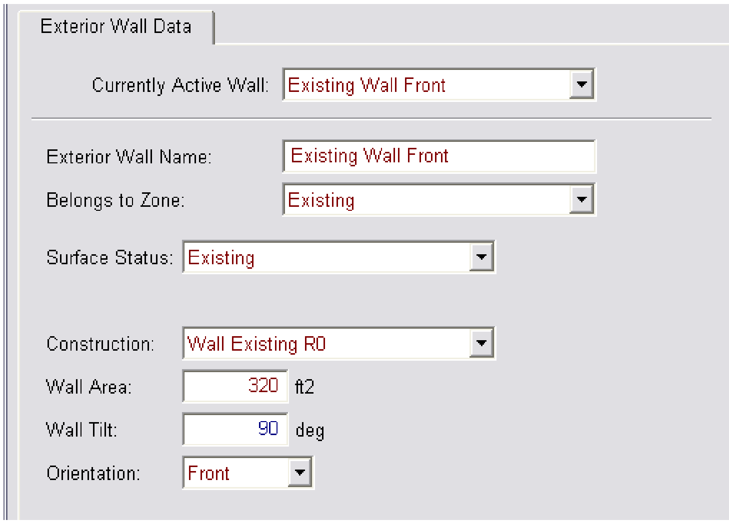
Model an interior wall connecting the existing building to the addition. If an addition (not an entire dwelling unit) is detached, model a hypothetical interior wall connecting the two buildings.

Specify the characteristics of all existing, altered, or new components (for example, a new window in an existing wall) associated with the existing part of the building.

If an existing garage is being converted to conditioned space, do not model the unconditioned garage. The garage is the addition because it is becoming conditioned space.

If existing features are unknown, a table of default assumptions (vintage table values) is included in Table 8-1 of the *2025 Single-Family Residential Compliance Manual*. Features that are being altered will follow the guidelines found in Section 10.6. Although credit is reduced without ECC verification of existing conditions, a pre-construction inspection is not required (see Section 10.8.1). For details on how to model altered components, see Section 10.10.

Figure 10-3: Existing Surface



10.6 Status Fields

The status field identifies a feature as ***Existing***, ***New***, or ***Altered*** (and the attic includes an **altered roof surface**) and affects the standard design. For the HVAC and DHW equipment, the status needs to be set at the zone level.

NOTE: If you find that the status of an HVAC or water heating system is incorrect on the CF1R, it is best to access the building zone, set the status, and redefine the system from the zone screen.

10.6.1 Zone Status

Status for the zone is either ***existing*** or ***new***. Only characteristics of the zone are altered, not the zone itself.

NOTE: An existing unconditioned space that is being converted to a living space is an addition. The zone status and all surfaces in the zone are new. Although the building/structure currently exists, conditioning an unconditioned space is an addition (see definitions, Section 100.1 of the Energy Code, ADDITION). All envelope components of a new zone are set as new.

10.6.2 Surface Status

Surfaces (windows, walls, floors, ceilings) in an existing zone are either (a) ***existing*** (if not being altered), (b) ***altered*** (with or without verified existing conditions), or (c) ***new*** if the surface did not previously exist.

Surfaces in the new zone are always **new** (if the surface previously existed, it is still considered new if it is in the new zone).

NOTE: If creating a new project rather than using an existing or example file, pay close attention to the status as the default status is always new. This can negatively impact your compliance results. Check the CF1R for accuracy with regard to the status.

10.6.3 Space Conditioning Status

In an existing zone, the space conditioning status should not be new. It is either existing or altered.

Existing is the correct status for space conditioning equipment in the existing or new zone if it will not be changed.

Altered is the correct status for space conditioning equipment that is replaced or changed. If the same equipment will condition the existing and new zones, the HVAC system status is set to altered in the existing and new zones.

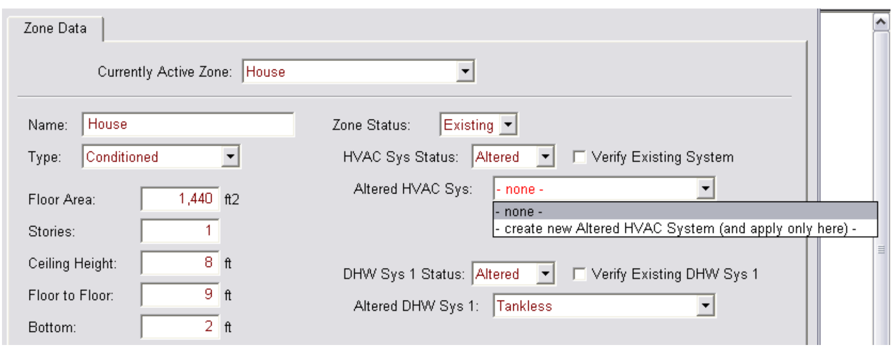
New is different than altered and applies only to new zones with equipment that serves only the new zone. New means space conditioning equipment did not previously exist for the floor area.

NOTES:

(1) Because the status of an HVAC system cannot be changed once it is created, begin at the **Zone Data** tab, select the appropriate status, and if necessary, define the system.

(2) Check the status of the ducts to be sure it is set correctly.

Figure 10-4: E+A+A HVAC System Status



10.6.4 Duct Status

The status of the distribution system can be defined as a distinct entry from the rest of the HVAC system. Be sure to check the status after defining the HVAC system because the default status is new, which triggers ECC verified duct leakage testing.

The duct status is set to:

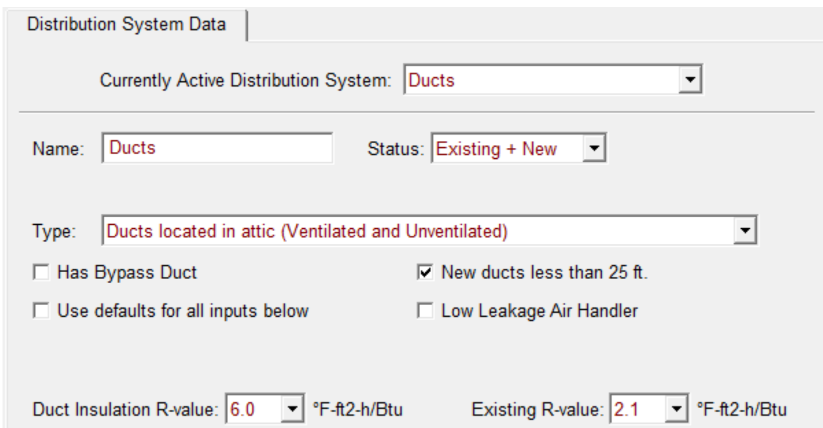
Existing when the existing ducts are remaining in the existing zone only (such as a separately defined HVAC system for an addition).

Existing + new when the same space conditioning equipment is conditioning both the existing and new zones, the existing ducts will remain, and new ducts are added for the addition. An exception to duct leakage testing (Exception 2 to Standards §150.2(b)1E) applies if less than 25 feet of duct in unconditioned space is added. Check the box if that condition applies (see Figure 10-5).

Altered when all the existing ductwork is replaced, and new ducts are being added for the addition.

New (or ***altered***) when an existing non-ducted system is being replaced with a ducted system.

Figure 10-5: Less than 25 feet of new duct



10.6.5 Water Heating Status

Water heating is assigned to the dwelling unit, not to specific floor area. In the existing zone, the water heating status is either ***existing*** or ***altered,*** and is never ***new***.

Existing status is used if no water heating changes are being made (it is also acceptable to model none for the Existing DHW System name).

Altered status is modeled if the water heater is being replaced.

New status is only used in the new zone if an additional water heating system is being added to supplement the existing water heater.

NOTE: Because the status of a DHW system cannot be changed once it is created, begin at the **Zone Data** tab (see Figure 10-4), select the appropriate status, and define the system.

10.7 Exceptions to Continuous Wall Insulation

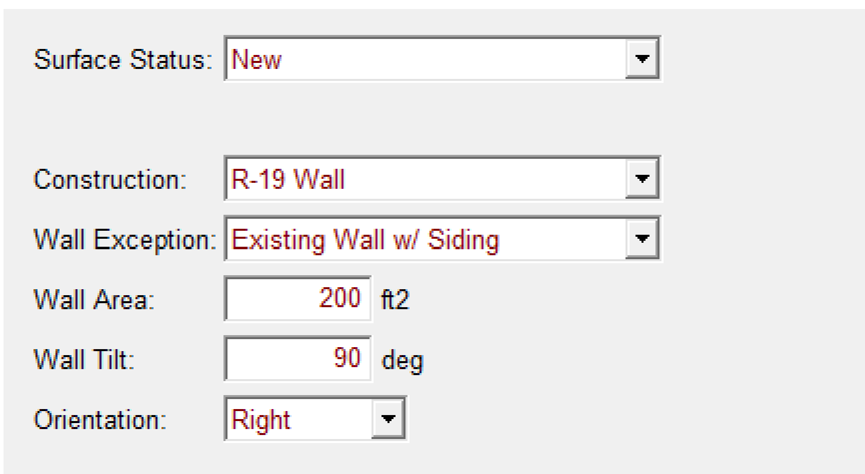
These exceptions to continuous wall insulation apply whether using addition alone or existing plus addition plus alteration compliance.

10.7.1 Existing Walls with Siding

As shown in Figure 10-1 when converting an attached or detached unconditioned space into conditioned space and siding is not removed there is no compliance penalty for not meeting the wall construction prescriptive requirements of §150.1(c) of the Energy Code. The minimum requirement for this provision is existing wood framed walls with cavity insulation of R-15 in 2x4 walls, or R-21 in 2x6 walls.

In defining the wall for a project that is an addition alone or existing plus addition plus alteration, if the proposed wall construction meets these requirements the wall exception field will appear, and you can select “existing wall w/ siding.” If the proposed wall does not meet these criteria, the exception field will not appear.

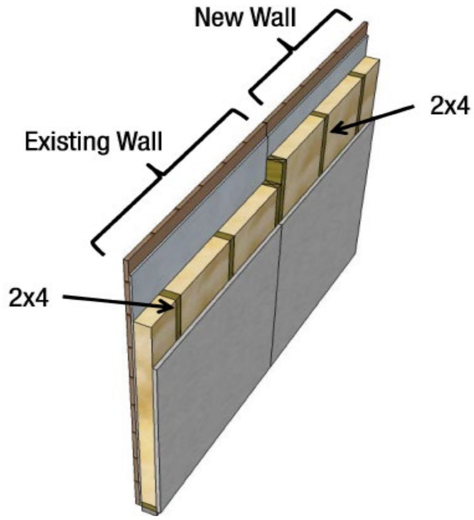
Figure 10-6: Wall with Existing Siding Inputs



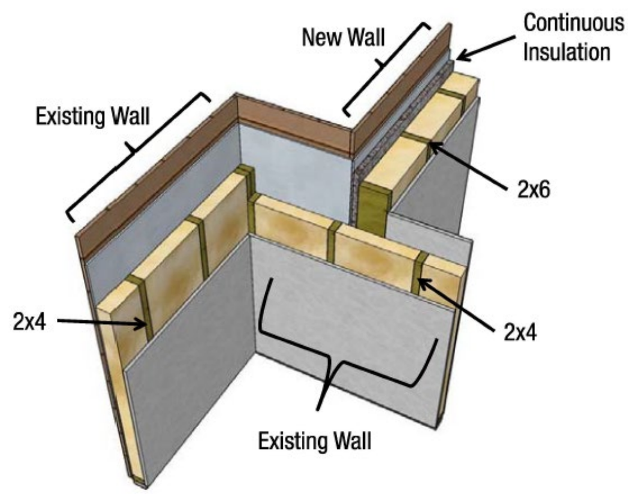
10.7.2 Wall Extensions

When an addition is built with a connection to an existing wood-framed wall, the new wall (which would otherwise need continuous insulation to avoid an energy penalty) is allowed to be built with the same frame size as the existing wall and without continuous insulation.

Figure 10-7: Identifying a Wall Extension

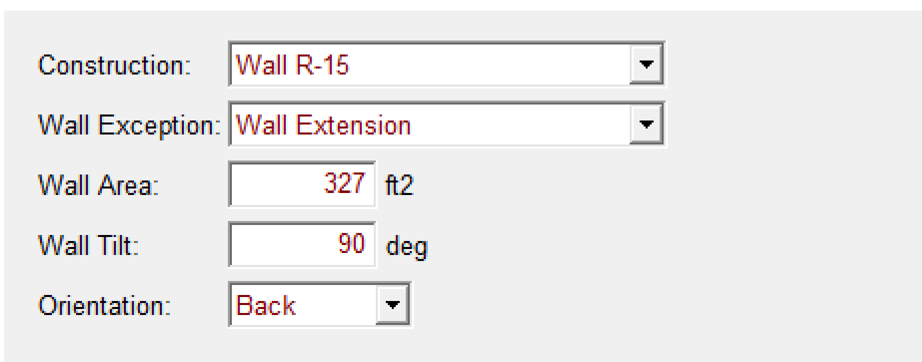


New wall is an extension.



New wall is not an extension.

Figure 10-8: Wall Extension Inputs



10.8 Standard Design (Energy Budget)

The standard design (energy budget) can vary significantly depending on the compliance type selected. The budget will depend on if: (1) the project is an addition alone, (2) the project includes the existing building and the size of the addition, (3) any existing conditions that will be verified by a ECC rater, and (4) whether individual altered components meet or exceed a minimum efficiency threshold (see Section 10.8.2 or Table 150.2-C of the Energy Code).

NOTE: Verifying existing conditions is optional (see Section 10.8.1). You will not be able to obtain a registered CF1R until the inspection by the ECC rater is complete.

10.8.1 Third Party Verification

While not required, the amount of credit for proposed alterations depends on whether the existing conditions are verified by a ECC rater. It is feasible to comply without this added step.

As an example, if windows that are single-pane, metal frame, with clear glass are altered with dual-pane, wood frame, Low-E windows, the standard design without ECC rater verification is windows having a 0.30 U-factor and 0.23 SHGC. The amount of credit for this alteration depends on how much lower than 0.30 is the U-factor of the proposed windows, or how much lower than 0.23 is the SHGC. If verified by an ECC rater, the standard design is set using the actual efficiency of the existing windows.

10.8.2 Efficiency Threshold

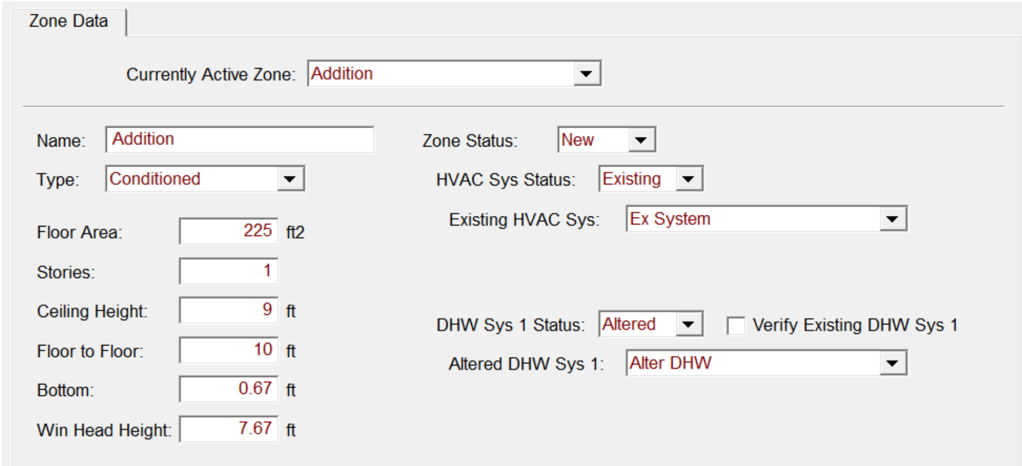
Another factor in determining the amount of credit or even a penalty that is achieved by an alteration is the proposed efficiency of the alteration. If an altered component does not meet the mandatory or prescriptive requirement in §150.2 of the Energy Code, the standard design will be based on the higher level. For example, if a ceiling has a verified insulation level of R-11, but the proposed alteration is to achieve R-19, the standard design is based on the standards' requirement of R-30, and the proposed ceiling alteration will receive an energy penalty.

10.9 Addition

The addition is modeled as a separate zone, identified by a zone status of new. Set the surface status to "new" for all envelope components in the addition including existing components in a previously unconditioned space. The exception is an existing HVAC system being extended to serve the addition. Pay special attention to the status fields for the HVAC (see Section 10.6.3), and particularly the ducts (see Section 10.6.4). Water heating is limited to existing or new (meaning an additional water heater).

Define the connection to the existing dwelling with an interior surface model as a child of the existing zone and define the zone on the other side as the addition. For addition alone compliance, define the connection to the existing dwelling with an interior surface and check the option "☑ is a party surface."

Figure 10-9: Addition HVAC and DHW



10.9.1 Quality Insulation Installation (QII) in an Addition

Modeling quality insulation installation (QII) (on the **Analysis** tab) will apply the credit to surfaces in new zones only. All surfaces in the new zone(s) must comply with the requirements of *Reference Appendices*, Residential Appendix RA3.5 for the ceiling/attic, knee walls, exterior walls, and exterior floors. QII credit will not be applied to any surfaces in the existing zone(s).

NOTE: Because a construction that does not meet QII is degraded to account for the lower quality construction, any assemblies used in the new zone must be unique from those in the existing zone. For example, if walls in both the existing and addition zone are R-19 with wood siding, you will need to create a second copy of the R-19 wall (use the Copy Data From option) giving it a unique name (R-19 Wall Exist).

10.10 Alterations

Altered components are modeled with the new characteristics. You will only specify the existing characteristics if the existing conditions are verified by a ECC rater (see Figure 10-10 and Figure 10-11). The “verify existing” check box opens additional fields to define the existing conditions.

Because only one surface status can be selected, model components that are being altered separately from those that will not be altered.

If a surface did not previously exist, it is modeled with a status of “new.”

Deleted or removed surfaces are not modeled.

Figure 10-10: Altered with Verified Existing Conditions

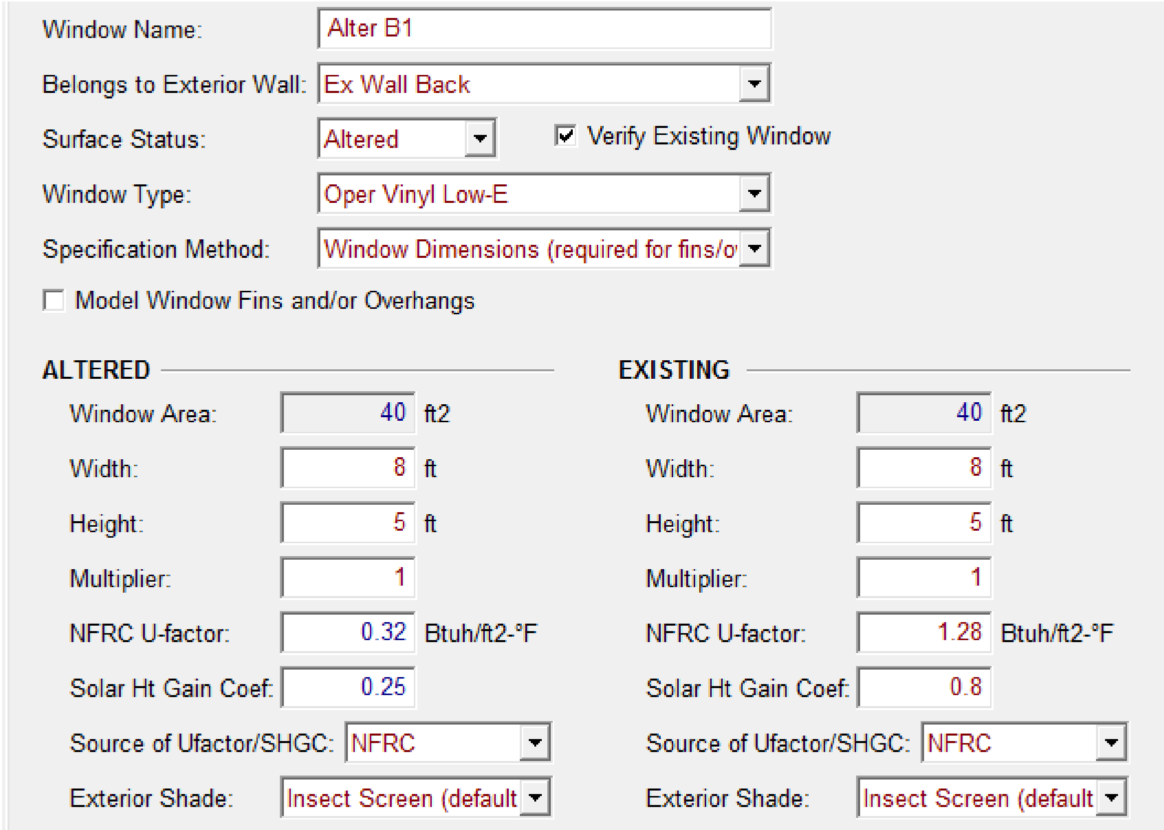
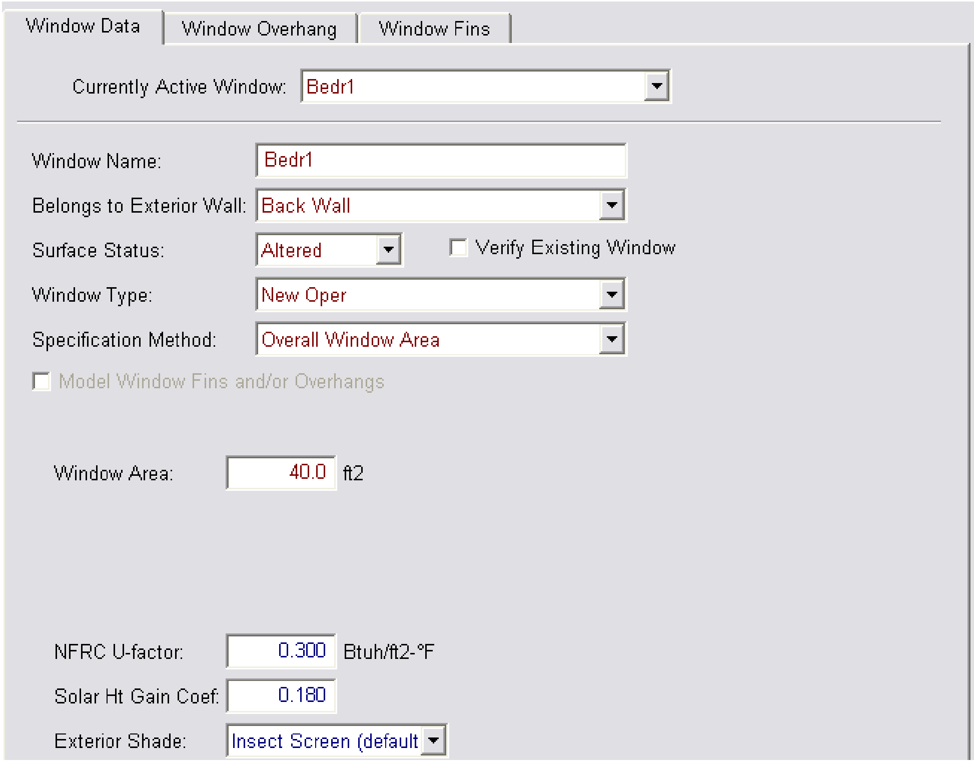


Figure 10-11: Altered Without Verified Existing Conditions

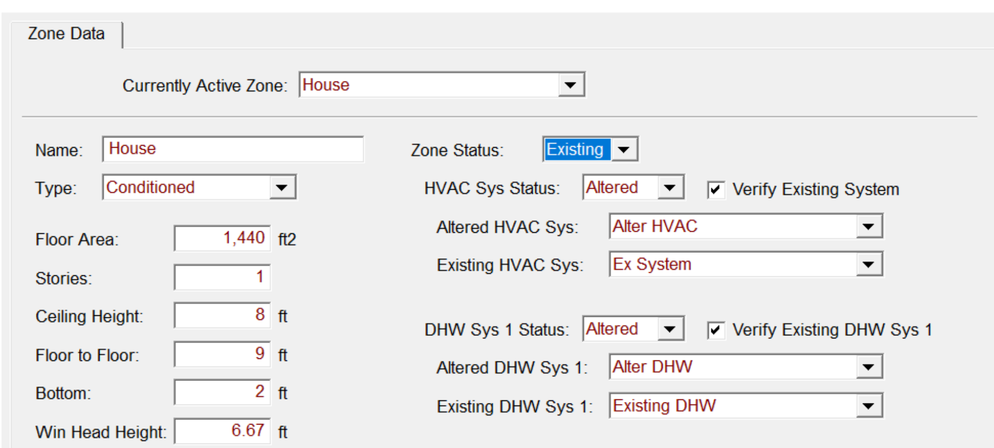


10.10.1 Radiant Barrier

Create a new attic over an addition. When creating the ceiling below attic for the addition, create a second attic zone with the appropriate features (radiant barrier, cool roof).

10.10.2 HVAC

Figure 10-12: Altered HVAC and DHW



First determine (1) if an existing system will be extended to serve an addition, (2) if a replacement (altered) system (including ducts) will be installed for the whole house, or (3) if a supplemental system will be added to serve the addition only. Existing equipment does not need to meet current standards (Exception 4 to §150.2(a) of the Energy Code).

10.10.2.1 Existing equipment to serve addition.

For the existing and new zones, set the system status to “existing” and model the actual values for the existing system (Figure 10-13). The distribution system data will have both existing and new sections of the system defined (Figure 10-14).

10.10.2.2 Replacement system for whole house.

For the existing and new zones, set the system status to “altered” and model the proposed conditions for the equipment (if selecting ***Verify Existing System***, also specify the existing conditions that were verified by the ECC rater). Model the appropriate conditions for the ducts, which may be altered if the existing ducts are being altered (this includes new ducts in the addition, as altered ducts will require duct leakage testing), new (if ducts did not previously exist) or existing + new if only the ducts in the addition are new.

Figure 10-13: Existing System

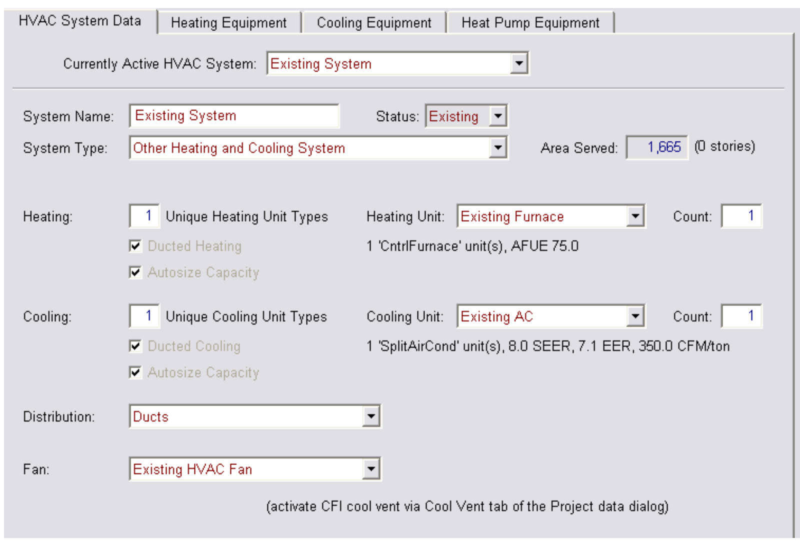
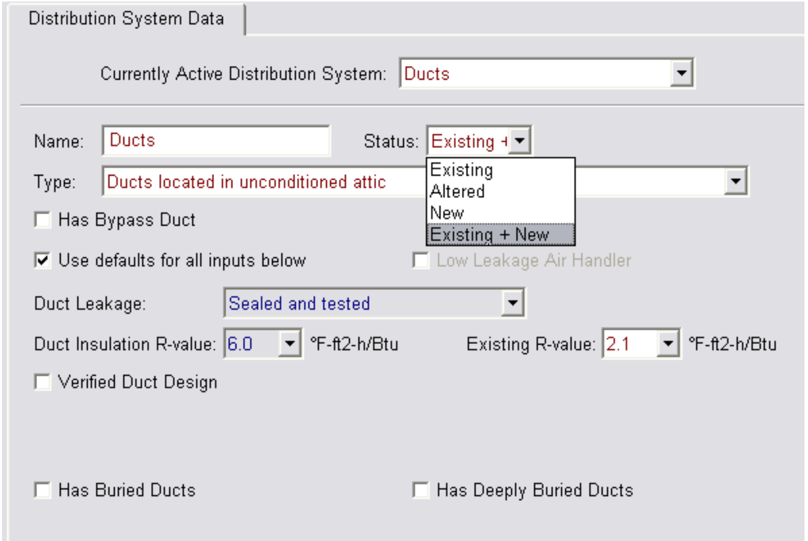


Figure 10-14: Duct System



10.10.2.3 Adding a system for the addition.

For the addition zone, define a separate system with the system status “new” with the proposed conditions of the new/supplemental system and duct conditions.

10.10.3 Water Heating

If altering a water heater, define the altered specifications. If existing conditions were verified, check the box, and include the specifications of the existing equipment. If the distribution system is being altered and the existing conditions are verified set the dwelling unit distribution type to an appropriate value (see Section 9.4).

If adding a water heater, define both the existing water heater in the existing zone and the added water heater in the addition zone.

10.10.4 Mechanical Ventilation

Alterations and additions of 1,000 square feet or less are not required to meet the mechanical ventilation requirements of §150.0(o) of the Energy Code.

10.10.5 Cooling Ventilation/Whole House Fan

It is not feasible to model ventilation cooling that serves only the addition.

Additions of 1,000 square feet or less are not required to meet the requirements of §150.1(c)12 of the Energy Code, which is part of the standard design in climate zones 8-14.

11 Appendix: 2024 Updates to CUAC Module in CBECC-Res

11.1 Step-by-Step: The Single Family CUAC Module

Step 1. Open an Existing Project in CBECC-Res

1.1. Launch CBECC-Res and open the existing project model file.

1.2. Ensure that the file is a complete CBECC-Res model file (not an addition-alone project), free of any errors. This does not need to be the same model that the project used for permits, but it does need to be just as accurate, even if it does not comply.

Step 2. Enable CUAC Reporting

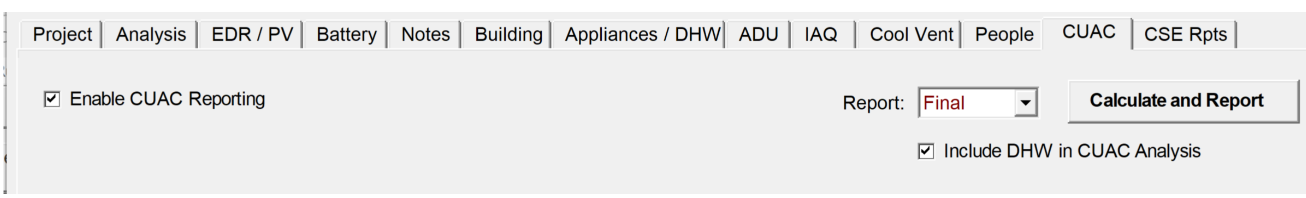
2.1. Click on "Project" to open the Project dialog.

2.2. Select the "CUAC" tab.

2.3. Check the box labeled "Enable CUAC Reporting."

2.4. Check the box to include "DHW in CUAC Analysis" if applicable to the project

Figure 11-1: Enabling a CUAC Report



Step 3. Configure User Inputs

3.1. **Choose Utility Providers:**

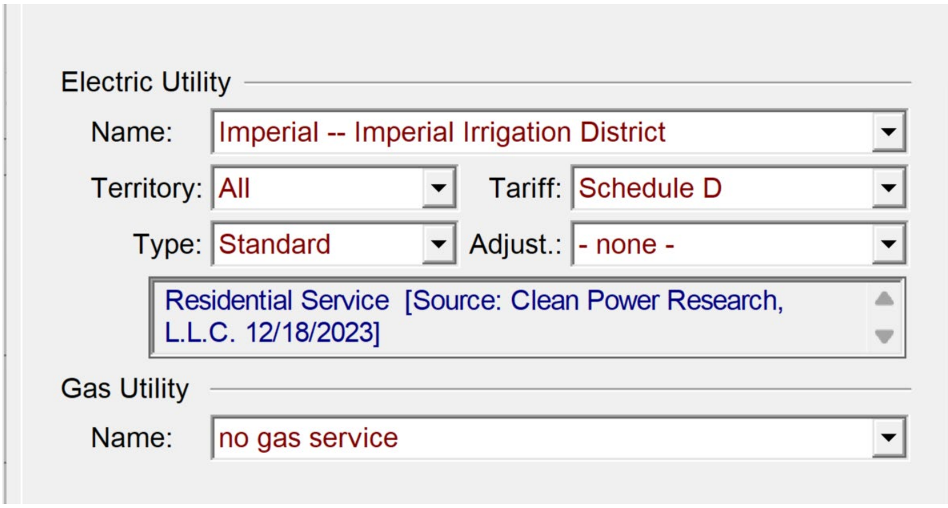
3.1.1. Select the utility provider for electricity and gas (e.g., PG&E).

3.1.2. Choose the appropriate territory, tariff rate, and type.

3.1.3. For gas, choose between options such as "Propane," "No Gas," or specific gas types depending on the project requirements.

3.1.4. For tariffs, select between "Standard" and "CARE" rates, and use the adjuster options if needed.

Figure 11-2: Tariff Selection Menu



3.2. **Water Bill Inputs:**

3.2.1. Choose from "Not Paid by Tenant," "Flat Monthly Rate," or "Usage Rate."

3.2.2. Enter the monthly cost or $/gallon rate based on the selected option.

3.3. **Trash Bill Inputs:**

3.3.1. Select between "Not Paid by Tenant" or "Flat Monthly Rate."

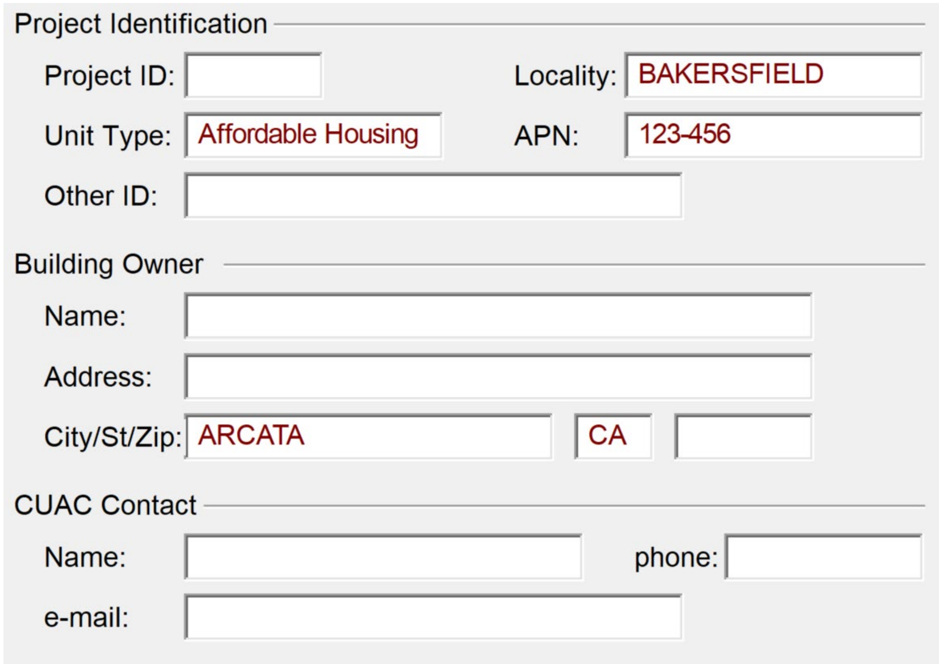
3.3.2. Enter the $/month rate if "Flat Monthly Rate" is selected.

Figure 11-3: Water and Trash Bill Inputs

3.4. **Site Location:**

3.4.1. Enter the project location information in this section.

Figure 11-4: Project Information Inputs



3.5. **PV Allocation / Community Solar:**

3.5.1. Click on "PV Allocation" or "Choose Community Solar" to open the allocation dialog.

3.5.2. Select "Use Community Solar" if applicable. Specify the amount of community solar and ensure that it adds up to 100% for each affordable unit type.

3.5.3. Choose from the billing options: "PV Offsets Monthly Use" or "PV Offsets Monthly Use w/ Carryover."

Step 4. Set Reporting Options

4.1. In the "CUAC" tab, select the type of reporting you need: "draft," "submittal," or "final." Questions regarding the report type can be directed to CTCAC, please reference the CTCAC website first.

Figure 11-5: Different Types of Reporting

Step 5. Run the CUAC Calculation

5.1. Click "CUAC Calculate and Report."

5.2. A pop-up window will appear; click "OK" to save the project and initiate the CUAC run, or click "Cancel" to stop.

Step 6. Review the Results

6.1. If the run is successful, you will have four options:

- **Continue** or **View Input/Result Details**: This will generate a CSV file containing the hourly utility usage details.
- **View Submittal Report**: This will open the Submittal report type, showing just the cost basis of the UA's for regulatory review.
- **View Details Report:** This will open the detailed report which shows the breakdown of energy consumption by listed end use and the % of the PV array allocated to each unit type.
- **View All Files**: Provides all the detailed files for the run.

11.2 Step-by-Step: The CUAC Combination Tool

Some affordable housing projects are complex, including both single family and multifamily units in the same property. Some single-family developments will contain multiple unit types and multiple floor plans within those unit types, each with their own energy model. To handle this situation, CBECC has gained the functionality to create a CUAC Details Report and Submittal based on multiple unit types. The software uses a weighted averages calculation method.

Step 1. Access the CUAC Combination Tool

1.1. Navigate to the CUAC Tab**:** Open the project in CBECC or CBECC-Res, and navigate to the CUAC tab, which is accessible from the Project dialog.

1.2. Locate the Combine Button: In the top right corner of the CUAC tab, you'll see a new button labeled **"Combine CUAC Reports."** This button initiates the combination process.

Step 2. Specify Location of CSV Input and Output Files

2.1. Input Files: In the **"Directory"** field, you can enter the path to a folder on your computer that contains all the CSV files you wish to combine. Specifying a directory will cause the tool to load all CSV files in that folder for processing.

Alternatively, if you leave the Directory field blank, you can manually select individual CSV files to combine.

2.2. Output File: In the **"Path and file name of the combined..."** field, enter the location where the combined report's CSV and PDF files will be saved. This forms the naming basis for the output file that contains the combined CUAC report.

Step 3. Run the Combination Process

3.1. Press the Combine Button: **Click the "Combine CUAC Reports" button to start** the report combination process.

3.2. Monitor Processing Status: Details regarding the success or failure of the combination process will be echoed in a pop-up dialog as well as displayed on the screen below the combination options.

Step 4. Testing the Combination

4.1. User Interface Functionality: Ensure that the dialog user interface is functioning correctly. Verify that it allows for correct entry of directories or individual files.

4.2. Check Data Consistency: Ensure that the primary dwelling data—including utility allowance and energy use—is being properly combined and reported in the final output.

11.2.1 Important Considerations for Using the CUAC Combination Tool

1. **CUAC Files Compatibility:** Only use CSV files generated from the latest version of CBECC and CBECC-Res. Files from earlier versions may cause errors during the combination process or may use incorrect older rates.
2. **Consistent Utility Rates and Weather Files:**
    - All CSV files being combined must use the same **Gas and Electric utility rates** to ensure consistency in the final report.
    - Ensure that all CSV files are based on the **same weather file** in CBECC. The Single Family CBECC-RES software provides only 1 weather file per climate zone in 2024, but the multifamily and nonresidential model software CBECC provides more options. Use the most accurate weather file available for your project.
3. CSV Files used to create the Combined CUAC must be made available in the CUAC Submittal folder sent to CTCAC for review, as well as all energy models used to create CSV files.

11.2.2 Guidance for Combining CUACs for Complex Projects

Some affordable housing developments include both **single-family** and **multifamily** units, with multiple unit types and energy models. The CUAC Combination Tool can handle this complexity, using a weighted average calculation method to combine different models effectively.

To combine CUACs from **single-family** and **multifamily** models:

1. **Prepare the CSV Files:** Ensure all CSV files meet the requirements mentioned above: same utility rates, consistent weather file, and generated using the latest CBECC/CBECC-Res version. CSV files created using previous versions of CBECC may generate errors and should not be used.
2. **Assign Proper Unit Types:** Make sure each unit type (Studio, 1-bedroom, 2-bedroom, etc.) is clearly defined, and that energy models are correctly designated in the CSV files. For mixed-market projects, ensure that the affordable units are properly marked to facilitate the weighted averaging.
3. **Run the Combination:** Use the CUAC Combination Tool as described in the previous steps. The tool will calculate weighted averages on the backend, ensuring accurate representation of utility allowances and energy use across different unit types.

11.2.3 Guidance for Projects with Weather File Mismatch

CBECC-Res utilizes 16 different weather files, one for each climate zone, but CBECC utilizes 96 weather files, with multiple for various climate zones, to improve its precision. CUAC Projects utilizing the CUAC Combiner Tool will need to use the same weather file if possible or use the most accurate weather file available in the software for the relevant models. Projects should not utilize multiple models that are placed in different Climate Zones.

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